1917 2026 109

RHODE ISLAND MEDICAL JOURNAL

iSTOCK

When ICE Comes to Work: Defending Access to Healthcare

See Commentary, page 75

FEBRUARY 2026 VOLUME 109 • NUMBER 2 ISSN 2327-2228

Are insurance costs affecting your bottom line?

As record setting malpractice verdicts occur with increasing frequency, insurance premiums for medical practices will continue to rise. It's critical to partner with an experienced insurance broker who can advocate on your behalf to secure the best coverage at the best price.

HUB can help. Our insurance and risk management specialists work with you to develop a strategy to manage your insurance costs — so you can continue to focus on patient care.

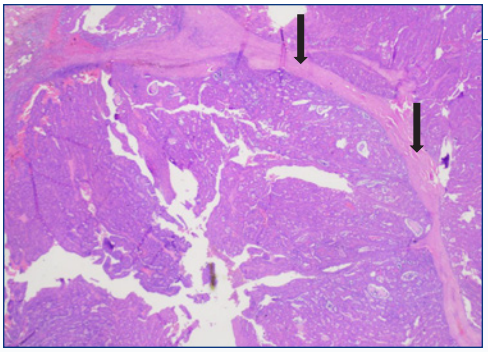
hubinternational.com/rimed

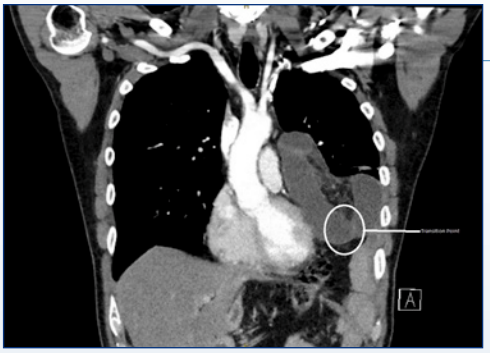
Put our resources to work for you.
Patrick Marra ○ 978-661-6203 ○ patrick.marra@hubinternational.com

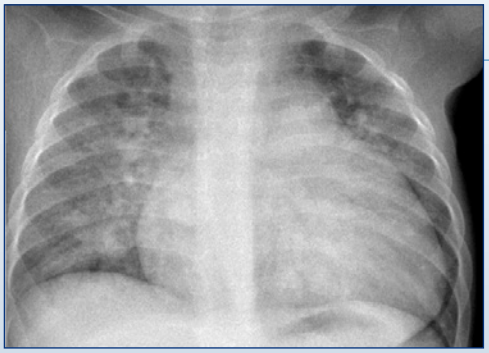
HUB

Risk & Insurance | Employee Benefits | Retirement & Private Wealth

RHODE ISLAND
MEDICAL JOURNAL







FEBRUARY 2026
VOLUME 109 • NUMBER 2

RHODE ISLAND MEDICAL JOURNAL

RHODE ISLAND MEDICAL JOURNAL (USPS 464-820), a monthly publication, is owned and published by the Rhode Island Medical Society, 225 Dyer Street, 2nd Floor, Providence RI 02903, 401-331-3207. ISSN 2327-2228.

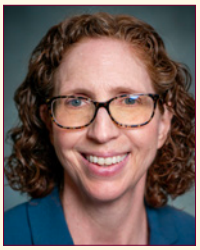
RESEARCH STUDIES

PUBLIC HEALTH

RHODE ISLAND MEDICAL JOURNAL

The United States Immigration and Customs Enforcement (ICE) is part of the United States Department of Homeland Security, a federal law enforcement agency. [ISTOCK]

George Washington on his deathbed.



C. Jackson, MBA

E. Akelman, MD

Favorite
Healthcare Staffing

Rhode Island's Medical Staffing Experts

Favorite Healthcare Staffing provides a comprehensive range of staffing services at preferred pricing to RIMS members. Call today to see why we are the favorite choice of healthcare professionals and physician practices across the US!

401.354.7115

MedicalStaffing@FavoriteStaffing.com

Favorite Healthcare Staffing is a Valued Sponsor of the Rhode Island Medical Society

AA / EOE / M / F / V / D

Encapsulated Papillary Carcinoma of the Breast: Two Cases with Literature Review and Molecular Insights

KOMEIL MIRZAEI BABOLI, MD; SARA SALEHIAZAR, MD; TRUC TRAN, MD

ABSTRACT

INTRODUCTION: Encapsulated papillary carcinoma (EPC) of the breast is a rare subtype of breast cancer, accounting for 0.5–2% of cases, and typically affects postmenopausal women. Characterized by well-circumscribed lesions lacking peripheral and central myoepithelial cells, EPC is associated with favorable prognosis due to its indolent behavior and high hormone receptor positivity. However, its potential association with ductal carcinoma in situ (DCIS) or invasive carcinoma necessitates thorough diagnostic evaluation.

CASE PRESENTATION: This study presents two cases of EPC—one in a 57-year-old and the other in a 39-year-old female—each with focal DCIS and strong estrogen and progesterone receptor expression. Both patients underwent breast-conserving surgery and were managed with hormone therapy.

CONCLUSION: Histopathological and immunohistochemical analyses confirmed the EPC diagnosis, and molecular insights revealed common mutations, particularly in the PIK3CA gene. This report underscores the importance of integrating clinical, histological, and molecular findings to guide diagnosis and management of EPC, which, despite its low invasive potential, shares genetic features with invasive ductal carcinoma.

KEYWORDS: papillary carcinoma; breast cancer

INTRODUCTION

Encapsulated papillary carcinoma (EPC) of the breast is a rare neoplasm and account for 0.5–2% of all breast cancer. EPC was first described in 1969,[1] and is typically characterized by a well-defined, slow-growing mass within the breast parenchyma. It predominantly affects postmenopausal women and often presents with favorable prognostic features, including low-grade histology and a high likelihood of hormonal receptor positivity, which can be treated with hormonal targeted therapy.[2] While EPC generally lacks invasive potential, its association with adjacent ductal carcinoma in situ (DCIS) or invasive carcinoma necessitates a comprehensive diagnostic and therapeutic approach.[1-3] A study suggested that the EPC capsule represents a reactive process characterized by increased collagen fiber width and density. This information supports the conclusion that EPC is an indolent invasive carcinoma based on the properties of its capsule.[3] Molecular analysis revealed that all invasive carcinomas associated with EPC exhibit recurrent hotspot mutations in the PIK3CA gene.[4]

This paper presents two cases of EPC, detailing its clinical course, diagnostic challenges. Additionally, we review the existing literature to provide insights into the histopathological and immunohistochemical (IHC) characteristics of EPC, with an emphasis on its molecular profile. By examining these two cases in conjunction with the current body of knowledge, we aim to enhance understanding of this uncommon entity and its implications for diagnosis, management, and prognosis.

CASE REPORT

Case 1

A 57-year-old woman with a medical history of morbid obesity and a prior hysterectomy for endometriosis presented with a slow-growing mass in the left breast, first noted four years ago. The mass was asymptomatic, with no associated pain or nipple discharge. She admitted to being noncompliant with routine mammography screenings during her 50s. Her family history was negative for breast carcinoma in first-degree relatives.

On physical examination, a 2.5 cm mass was palpated in the lower outer quadrant of the left breast. There were no signs of ulceration, edema, or axillary lymphadenopathy. Mammography revealed a high-density, oval-shaped mass with circumscribed margins, and ultrasonography (US) identified a hypoechoic lesion at the 5 o'clock position, 6 cm from the nipple, measuring 2.7 × 1.7 × 1.6 cm. An US-guided biopsy demonstrated carcinoma with papillary features. IHC staining was negative for p63, CD10, and calponin in the papillary fronds.

The clinical stage of the lesion was determined to be cT2N0Mx. Breast-conserving surgery was planned, and the patient underwent a left breast lumpectomy. Final pathological examination revealed a papillary lesion with a well-circumscribed border and a loss of both central and peripheral myoepithelial cells [**Figure 1**]. IHC staining showed negative expression for CD10 and p63 [**Figure 2**] and positivity for

Figure 1. Encapsulated Papillary carcinoma, H&E, 40x. Solid arrow shows thick fibrous capsule.

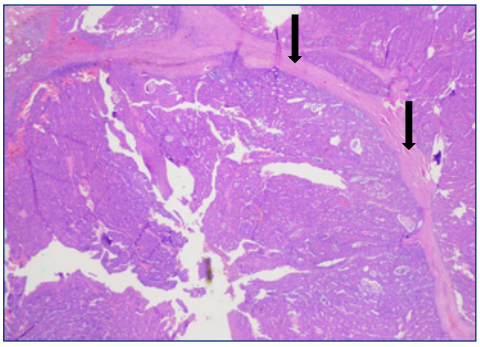


Figure 2. Encapsulated Papillary carcinoma, IHC stain, P63 negative on the papillae and periphery.

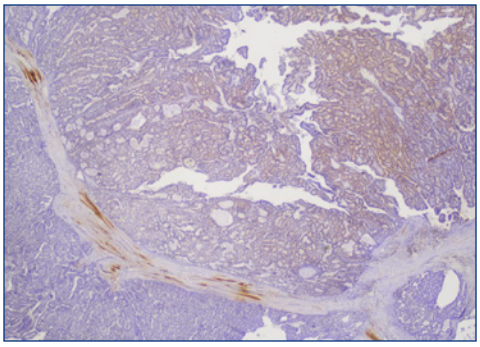
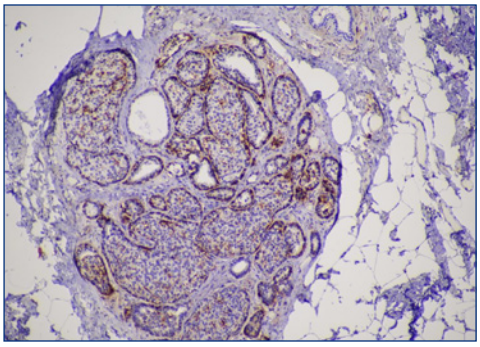


Figure 3. Ductal carcinoma in situ, IHC stain, CD10 highlights the myoepithelial cells.



CAM5.2, consistent with encapsulated papillary carcinoma (EPC). Additionally, focal areas of adjacent conventional-type ductal carcinoma in situ (DCIS) with low nuclear grade and no necrosis were identified and CD10 highlighted the myoepithelial layer [**Figure 3**].

The final staging was revised to pTisN(na)M(na). Due to the tumor's high estrogen receptor (ER) and progesterone receptor (PR) positivity (>90%) and HER2 negativity, the patient was initiated on adjuvant therapy with Anastrozole for a planned duration of five years.

Case 2

A 39-year-old woman with a medical history of obesity, hypertension, and uterine fibroids presented with a palpable, painless mass in the right breast. She reported no nipple discharge or skin changes. Her family history was negative for cancer among first-degree relatives.

On physical examination, a 2 cm mass was detected in the lower outer quadrant of the right breast. There were no signs of ulceration, edema, or axillary lymphadenopathy. Mammography revealed a mass with irregular borders, categorized as BIRADS 4b, and ultrasonography (US) identified a hypoechoic, irregular lesion at the 7 o'clock position, 4 cm from the nipple, measuring 2.2 × 2 × 1.5 cm. An US-guided biopsy confirmed papillary carcinoma, with IHCstaining negative for p63 and CK5/6.

The clinical stage was determined as cT2N0Mx. Breast-conserving surgery was planned, and the patient underwent a wide local excision of the right breast with sentinel lymph node biopsy. Final pathology revealed a papillary lesion with poorly circumscribed borders and a loss of central and peripheral myoepithelial cells [**Figure 4**]. IHC staining showed negative expression for CD10, calponin [**Figure 5**] and P63, consistent with EPC of intermediate nuclear grade. Additionally, focal areas of adjacent DCIS with intermediate nuclear grade and focal necrosis were identified; CD10 and calponin [**Figure 6**] highlighted the myoepithelial layer. All lymph nodes were negative for metastatic carcinoma.

The final pathological stage was revised to pTisN0M(na). Hormone receptor testing showed the tumor was positive for estrogen receptor (ER, 85%) and progesterone receptor (PR, 50%). Given the patient's young age, genetic counseling was recommended.

DISCUSSION

Encapsulated papillary carcinoma (EPC) is a rare subtype of breast cancer classified as a distinct entity by the World Health Organization (WHO). It is characterized by unique clinicopathological and molecular features and is often associated with a favorable prognosis. Representing 0.5–2% of breast cancers, EPC predominantly affects postmenopausal

Figure 4. Encapsulated Papillary carcinoma, H&E, 40x. Solid arrow shows thick fibrous capsule.

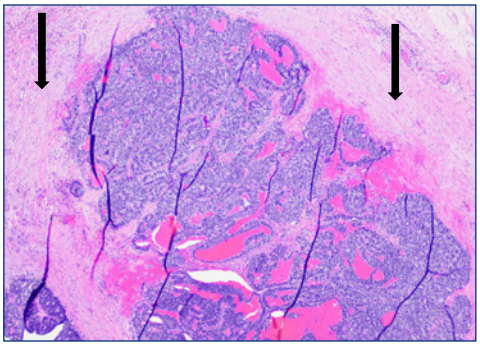


Figure 5. Encapsulated Papillary carcinoma, IHC stain, Calponin negative on the papillae and periphery.

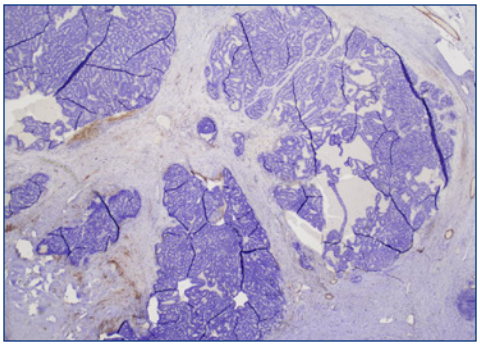
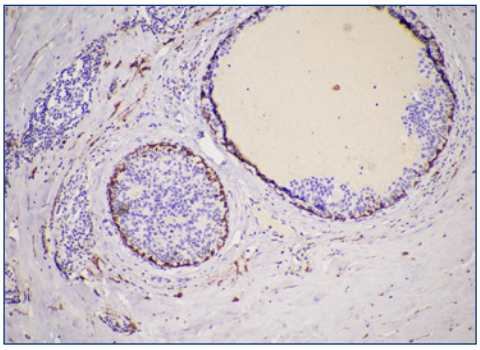


Figure 6. Ductal carcinoma in situ, IHC stain, Calponin highlights the myoepithelial cells.



women, with a median age at diagnosis of 65 years. Typically located beneath the nipple or areola, it presents as a retroareolar, painless lump or a solid-cystic mass, with diameters ranging from 0.3 to 6 cm and occasionally up to 15 cm, as reported in some studies. Symptoms may include nipple discharge or hemorrhage. Ill-defined margins are commonly linked to an invasive component.[1,2,4,6]

Histologically, EPC is characterized by a thick fibrous capsule, a solid-cystic structure, and papillary formations. A distinct histopathological feature is the absence of myoepithelial cells at the periphery and within the papillae.[1,2,3,6]

Imaging modalities like ultrasound, mammography, and MRI play a crucial role in diagnosing EPC. MRI offers superior visualization of lesion architecture and is particularly effective in identifying invasive components or associated DCIS. Ultrasound outperforms mammography in distinguishing between benign and malignant papillary lesions, with a sensitivity of 56% and specificity of 90%, compared to mammography's sensitivity of 69% and specificity of 25%.[1]

EPC is characterized by papillary structures enclosed within a fibrous capsule and an absence of myoepithelial cells. The tumor cells typically display low- to intermediate-grade nuclei, with occasional apocrine differentiation. Diagnosis relies on myoepithelial markers such as p63, CK5/6, and calponin, which help differentiate EPC from other papillary lesions, as these markers are negative at the papillae and periphery. The absence of myoepithelial cells suggests an invasive potential, despite the tumor's generally indolent behavior.[1,5]

Tumor cells in EPC demonstrate strong positivity for the estrogen receptor (ER) and variable expression of the progesterone receptor (PR). The Ki67 index indicates low proliferative activity in EPC. Human epidermal growth factor receptor 2 (HER-2) is almost always negative, though some studies have reported positive cases.[1,2,4,5] Approximately one-third of EPCs are found alongside conventional ductal carcinoma in situ (DCIS), while another third is associated with invasive ductal carcinoma (IDC). Despite some overlapping features, EPCs are typically staged as in situ lesions due to their encapsulated morphology and low metastatic potential.[4]

EPC is enclosed by a thick fibrous capsule, characterized by a higher content of collagen I and reduced collagen III compared to normal breast tissue and ductal carcinoma in situ (DCIS). Unlike the thin, organized basement membrane (BM) observed in normal tissue or DCIS, the EPC capsule displays a heterogeneous structure with straighter, shorter, and more disorganized fibers. The capsule consists of distinct inner and outer regions: the outer layer is denser and richer in collagen I, while the inner layer has a higher proportion of collagen III. These findings suggest that the capsule formation in EPC is a reactive process.[3]

Matrix metalloproteinases (MMPs) are molecular markers associated with invasiveness and tumorigenesis. The expression profile of MMPs in EPC falls between that of DCIS and IDC, suggesting that the invasive potential of EPC is intermediate between these two conditions.[1,4]

EPC exhibits genetic similarities with estrogen receptor-positive IDC, including PIK3CA mutations and chromosomal gains on 16p and 1q. Additionally, mutations in chromatin-remodeling genes, such as CREBBP and KMT2A, have been reported. Other mutations, like TP53 and GATA3, show more variability and occur in only a subset of cases.[1,4]

The standard treatment for EPC includes local excision or mastectomy. Sentinel lymph node biopsy (SLNB) is recommended for invasive EPC due to the possibility of lymph node involvement. Adjuvant therapies, including radiotherapy, are recommended for patients with associated DCIS or after breast-conserving surgery. Hormonal therapy is used for hormone receptor-positive EPC, while HER2-targeted therapies are applied in HER2-positive cases.[1,5,6]

EPC generally has an excellent prognosis, with low recurrence and metastasis rates. High-grade EPC, characterized by hormone receptor negativity and elevated Ki-67, shows more aggressive behavior and warrants systemic therapy. Long-term survival exceeds 90%, with similar outcomes for pure EPC, EPC with DCIS, and EPC with invasive carcinoma.[1,6]

When there is frank invasion arising from the papillary neoplasms, such as encapsulated papillary carcinoma, ductal carcinoma in-situ with papillary type, or solid papillary carcinoma, it is treated the same as other invasive carcinomas of the breast and the treatment approaches are similar to those. This is the same when there is metastasis. CDK4/6 inhibitors are FDA-approved to treat ER/PR positive/Her2 negative tumor.[7]

CONCLUSION

The findings from the literature, including data on genetic alterations, MMP levels, capsule characteristics, and the Ki67 index, suggest that this tumor possesses a low invasive potential. However, its shared genetic pathway with IDC grants it the capability to progress into invasive carcinoma and metastasize to lymph nodes.

Our case presents a classical ER- and PR-positive EPC with concurrent DCIS, managed through local excision with negative margins and hormone therapy. Follow-up demonstrated excellent outcomes, with no recurrence or metastasis, consistent with the prognosis for low-grade EPC.

References

1. Changrong W, Zhibo Z, Jufeng, Hongju Y, et al. Encapsulated Papillary Carcinoma of the Breast: A Review of Clinicopathologic Characteristics, Molecular Mechanisms, and Patient Management. Cancer Control. 2024 Jan-Dec:31. doi: 107327 48241299071
2. Tan HJ, Tan PH, Leong LCH, Tan VKM, et al. Encapsulated papillary carcinoma of the breast: An institutional case series and literature review. Cancer Med. 2023 May;12(10):11408-11416. doi: 10.1002/cam4.5855
3. Ghannam SF, Rutland CS, Allegrucci C, Mongan NP, Rakha E. Encapsulated papillary carcinoma of the breast: does it have a native basement membrane? Histopathology. 2023;83, 376–393. https://doi.org/10.1111/his.14939
4. Schwartz CJ, Boroujeni AM, Khodadadi-Jamayran A, Heguy A, et al. Molecular analysis of encapsulated papillary carcinoma of the breast with and without invasion. Hum Pathol. 2021 May:111:67-74. doi: 10.1016/j.humpath.2021.02.005
5. Kulka J, Madaras L, Floris G, Lax SF. Papillary lesions of the breast. Virchows Archiv 2022;480:65–84. doi: 10.1007/s00428-021-03182-7
6. Xu L, Mao Q, Gao Y, Luo L, et al. Encapsulated papillary carcinoma of the breast: A single institution experience. Oncol Lett. 2023 Sep 7;26(4):459. doi: 10.3892/ol.2023.14046
7. Wang X, Zhao S, Xin Q, et al. Recent progress of CDK4/6 inhibitors' current practice in breast cancer. Cancer Gene Ther. 2024;31:1283–1291(https://doi.org/10.1038/s41417-024-00747-x

Authors

Komeil Mirzaei Baboli, MD, Department of Pathology, Harbor-UCLA Medical Center, Torrance, CA.

Sara Salehiazar, MD, Department of Pathology, Yale School of Medicine, New Haven, CT.

Truc Tran, MD, Department of Pathology, Harbor-UCLA Medical Center, Torrance, CA.

Disclosures

Funding: Not applicable

Conflicts of interest/Competing interests: The authors declare that they have no conflicts of interest relevant to this study

Ethics approval: Not applicable

Consent to participate: Consented

Written Consent for publication: Consented

Correspondence

Komeil Mirzaei Baboli, MD
Department of Pathology, Harbor-UCLA Medical Center
1000 W Carson St, Torrance, CA 90502
424-306-66410
Fax 424-306-66400
KMirzaeiBaboli@dhs.lacounty.gov

Closed-Loop Obstruction in a Paraconduit Diaphragmatic Hernia

DAVID DORFMAN, MD, MS; LELAND PERICE, MD; LACHLAN DRIVER, MD

KEYWORDS: Diaphragmatic Hernia; Ivor-Lewis Esophagectomy

CASE PRESENTATION

A 53-year-old man with a past medical history significant for esophageal squamous cell carcinoma treated with neo-adjuvant chemoradiation followed by remote open Ivor-Lewis esophagectomy, hypertension, gastroesophageal reflux disease, chronic alcohol-related pancreatitis with pancreatic insufficiency, chronic pain on oxycodone, and ongoing tobacco use presented to a community emergency department (ED) with one day of severe, left upper-quadrant abdominal pain and nausea. He described a similar, brief, self-resolving episode one week prior. He denied emesis, fever, chills, or weight loss.

In the ED, laboratory studies showed leukocytosis to 15 x10^9 cells/L and lactate elevation to 2.2 mEq/L. Computed tomography (CT) of the chest and abdomen with contrast demonstrated a large, left hemidiaphragmatic hernia with two components, intrathoracic small bowel obstruction, mesenteric edema, and interloop ascites concerning for a strangulated hernia with developing ischemia. No free air or pneumatosis was present.

Figure 1. Axial CT image showing dilated small bowel loops herniated into the left hemithorax adjacent to the gastric conduit.

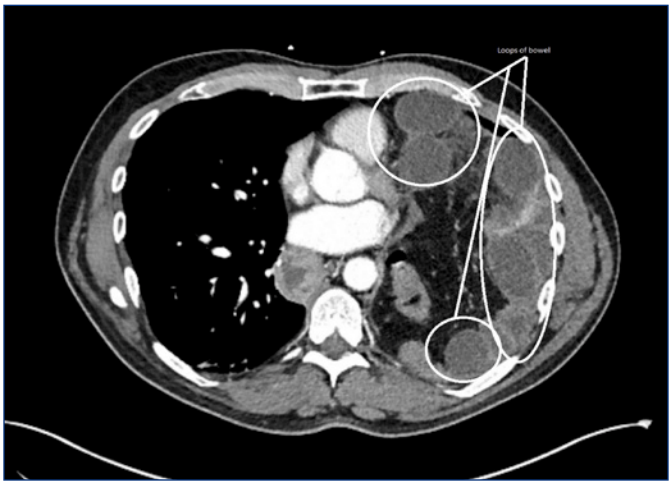


Figure 2. Coronal CT reconstruction demonstrating transition point with mesenteric edema and interloop ascites concerning for developing ischemia.

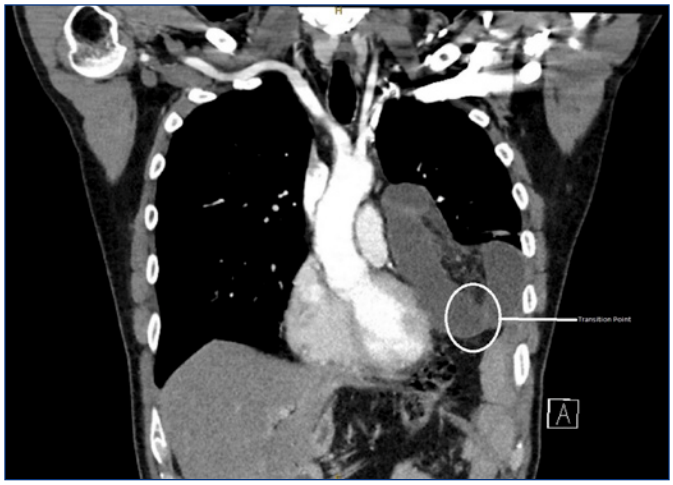
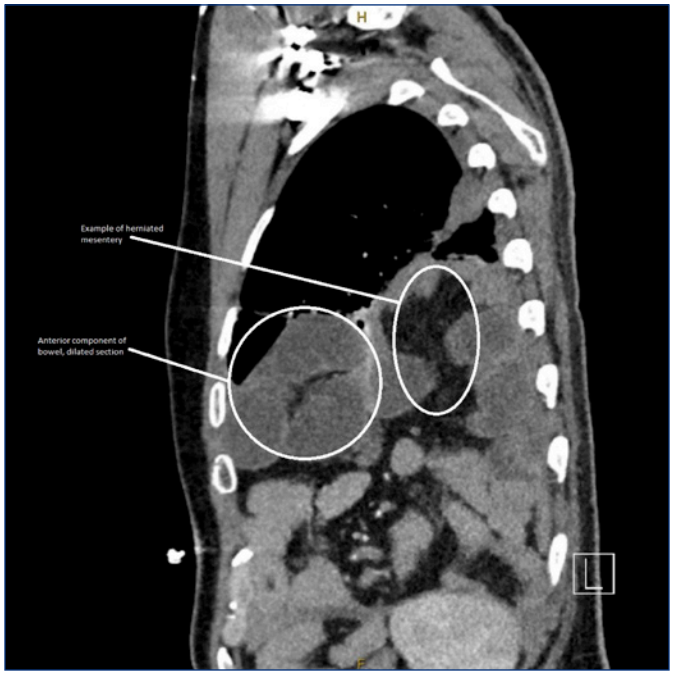


Figure 3. Sagittal CT view outlining the diaphragmatic defect and displacement of small bowel into the thoracic cavity.



Surgical oncology and thoracic surgery were consulted, and the patient underwent robotic-assisted laparoscopy with extensive lysis of adhesions, reduction of herniated small bowel, repair of an intraoperative enterotomy, and mesh repair of the diaphragmatic defect. Intraoperatively, nearly the entire small bowel was found to be herniated into the left hemithorax adjacent to the gastric conduit. A dense fibrotic band was identified at the transition point and divided, relieving the obstruction. The bowel appeared viable after reduction. A 13 × 8 cm PTFE mesh was used to bridge the large defect. He tolerated the procedure well and was admitted to the surgical intensive care unit postoperatively; he was ultimately discharged in stable condition three days post-procedure.

DISCUSSION

Diaphragmatic hernia is an uncommon complication of esophagectomy with gastric conduit reconstruction. Symptomatic hernias requiring surgical intervention occur in 3.1% to 8% of patients.[1-4] While herniation is most likely to occur within two years of surgery, it has infrequently been observed occurring five or more years after esophagectomy.[5-6] Presenting symptoms can be nonspecific, with respiratory distress being a common chief complaint when presenting within 30 days of surgery[7]; bowel obstruction and abdominal pain, accompanied by nausea and/or vomiting, are common in more delayed cases.[1] Other symptoms include chest pain and pressure, dysphagia, diarrhea, and constipation.[8]

Prior esophagectomy should trigger consideration of conduit-related complications when evaluating abdominal or chest pain. CT scan of the chest and abdomen represents the gold standard diagnostic modality; addition of intravenous contrast is not required for diagnosis but allows for earlier and more reliable detection of bowel ischemia.[9-10] Images should be scrutinized for ischemic features, including decreased bowel wall enhancement, mesenteric edema, interloop fluid, pneumatosis, or free air.[10-11]

CONCLUSION

In patients who have had a previous esophagectomy who present with chest or abdominal pain, consideration of an intra-thoracic bowel obstruction is important as rapid recognition and expedited surgical intervention are essential to prevent bowel infarction and improve outcomes. This case highlights how a post-esophagectomy patient presenting with acute abdominal pain can harbor a complex diaphragmatic hernia with closed-loop obstruction, diagnosed in the ED through CT and managed successfully with surgical repair.

References

1. Lee AHH, Oo J, Cabalag CS, Link E, Duong CP. Increased risk of diaphragmatic herniation following esophagectomy with a minimally invasive abdominal approach. *Dis Esophagus*. 2022 Jun 15;35(6):doab066. doi: 10.1093/dote/doab066. PMID: 34549284.
2. Benjamin G, Ashfaq A, Chang YH, Harold K, Jaroszewski D. Diaphragmatic hernia post-minimally invasive esophagectomy: a discussion and review of literature. *Hernia*. 2015 Aug;19(4):635-43. doi: 10.1007/s10029-015-1363-8. Epub 2015 Mar 5. PMID: 25739716.
3. Fumagalli Romario U, Rosati R. Diaphragmatic hernia after Ivor Lewis esophagectomy for cancer: a retrospective analysis of risk factors and post-repair outcomes. *J Thorac Dis*. 2021 Jan;13(1):160-168. doi: 10.21037/jtd-20-1974. PMID: 33569196; PMCID: PMC7867823.
4. Kuvendjiska J, Jasinski R, Hipp J, Fink M, Fichtner-Feigl S, Diener MK, Hoeppner J. Postoperative Hiatal Hernia after Ivor Lewis Esophagectomy-A Growing Problem in the Age of Minimally Invasive Surgery. *J Clin Med*. 2023 Sep 1;12(17):5724. doi: 10.3390/jcm12175724. PMID: 37685791; PMCID: PMC10488699.
5. Matthews J, Bhanderi S, Mitchell H, Whiting J, Vohra R, Hodson J, Griffiths E. Diaphragmatic herniation following esophagogastric resectional surgery: an increasing problem with minimally invasive techniques? : Post-operative diaphragmatic hernias. Surg Endosc. 2016 Dec;30(12):5419-5427. doi: 10.1007/s00464-016-4899-5. Epub 2016 Apr 22. PMID: 27105617.
6. Puccetti F, Cossu A, Parise P, Barbieri L, Elmore U, Carresi A, De Pascale S, Fumagalli Romario U, Rosati R. Diaphragmatic hernia after Ivor Lewis esophagectomy for cancer: a retrospective analysis of risk factors and post-repair outcomes. J Thorac Dis. 2021 Jan;13(1):160-168. doi: 10.21037/jtd-20-1974. PMID: 33569196; PMCID: PMC7867823.
7. Gooszen JAH, Slaman AE, van Dieren S, Gisbertz SS, van Berge Henegouwen MI. Incidence and Treatment of Symptomatic Diaphragmatic Hernia After Esophagectomy for Cancer. Ann Thorac Surg. 2018 Jul;106(1):199-206. doi: 10.1016/j.athoracsur.2018.02.034. Epub 2018 Mar 16. PMID: 29555244.
8. Oor JE, Wiezer MJ, Hazebroek EJ. Hiatal Hernia After Open versus Minimally Invasive Esophagectomy: A Systematic Review and Meta-analysis. Ann Surg Oncol. 2016 Aug;23(8):2690-8. doi: 10.1245/s10434-016-5155-x. Epub 2016 Feb 29. PMID: 26926480.
9. Expert Panel on Gastrointestinal Imaging; Garcia EM, Pietryga JA, Kim DH, Fowler KJ, Chang KJ, Kambadakone AR, Korngold EK, Liu PS, Marin D, Moreno CC, Panait L, Santillan CS, Weinstein S, Wright CL, Zreloff J, Carucci LR. ACR Appropriateness Criteria® Hernia. *J Am Coll Radiol*. 2022 Nov;19(11S):S329-S340. doi: 10.1016/j.jacr.2022.09.016. PMID: 36436960.
10. Giuffrida M, Perrone G, Abu-Zidan F, Agnoletti V, Ansaloni L, Baiocchi GL, Bendinelli C, Biffl WL, Bonavina L, Bravi F, Carcoforo P, Ceresoli M, Chichom-Mefire A, Coccolini F, Coimbra R, de'Angelis N, de Moya M, De Simone B, Di Saverio S, Fraga GP, Galante J, Ivatury R, Kashuk J, Kelly MD, Kirkpatrick AW, Kluger Y, Koike K, Leppaniemi A, Maier RV, Moore EE, Peitzmann A, Sakakushev B, Sartelli M, Sugrue M, Tian BWCA, Broek RT, Vallicelli C, Wani I, Weber DG, Docimo G, Catena F. Management of complicated diaphragmatic hernia in the acute setting: a WSES position paper. *World J Emerg Surg*. 2023 Jul 26;18(1):43. doi: 10.1186/s13017-023-00510-x. PMID: 37496073.
11. Saba L, Mallarini G. Computed tomographic imaging findings of bowel ischemia. J Comput Assist Tomogr. 2008 May-Jun;32(3):329-40. doi: 10.1097/RCT.0b013e3180dc8cb1. PMID: 18520533.

Authors

David Dorfman, MD, MS, Brown Emergency Medicine, Warren Alpert Medical School of Brown University, Providence, RI.

Leland Perice, MD, Brown Emergency Medicine, Warren Alpert Medical School of Brown University, Providence, RI.

Lachlan Driver, MD, Brown Emergency Medicine, Warren Alpert Medical School of Brown University, Providence, RI.

Disclosures

Funding: None

Conflicts of Interest: None of the authors have any conflict of interests to disclose.

Ethical Approval: Not applicable

Data Sharing Statement: Not applicable

Correspondence

David Dorfman, MD
593 Eddy St
Providence, RI 02903
david_dorfman@brown.edu

Acquired Hemophilia A After Neoadjuvant Immunotherapy for Renal Cell Carcinoma

GRACE SUN, MD; ELIAS O.U. ETESHOLA, MD, PhD; MATTHEW J. HADFIELD, DO; ANDREW HSU, MD

ABSTRACT

While many eligible cancer patients now receive immune checkpoint inhibitor (ICI) therapy, a significant number will develop immune-related adverse events (irAEs). Hematologic irAEs are rarely reported, in part due to their infrequent occurrence, but possibly also due to their under recognition. We report a case of acquired hemophilia A (AHA) associated with the use of combined therapy ipilimumab and nivolumab for a patient with renal cell carcinoma and discuss the clinical course and events leading to the diagnosis. AHA is an exceedingly rare yet potentially fatal hematologic irAE and presents most commonly with subcutaneous and mucosal bleeding. The mainstay of treatment for irAE-related AHA includes the use of immunosuppressive therapy to decrease the inhibitor level and risk of recurrent bleeding. This case highlights the importance of early and thorough diagnostic work-up for bleeding disorders in cancer patients with bleeding symptoms and a history of ICI treatment. IrAEs can be difficult to diagnose, and when they are not considered by the clinician, can result in prolonged work-ups without a diagnosis. Ultimately, our patient had a therapeutic response to emicizumab despite a delayed diagnosis. This case underscores the critical need for early recognition and tailored management of rare irAEs to improve patient outcomes.

INTRODUCTION

Immune checkpoint inhibitors (ICIs) have changed the cancer treatment landscape, and function therapeutically by recruiting the body's immune system to increase antitumor activity. Many eligible patients receive ICIs as a part of their cancer therapy; among those who do, a significant number develop a novel class of toxicities called immune-related adverse events (irAEs). IrAEs can occur at any time during treatment, including after discontinuation of therapy, and symptoms may oscillate thereafter.[1] There are currently no screening tests available to help risk stratify or predict severity. Furthermore, it is now understood that irAEs can impact any organ system of the body, most commonly being GI, dermatologic, hepatic, endocrine, and pulmonary toxicities.[2] Hematologic irAEs are rarely reported, in part due to their infrequent occurrence, but possibly also due to their poor recognition.[3] As such, acquired hemophilia A (AHA) resulting from ICI-related toxicity is exceedingly rare and presents differently from inherited hemophilia A. Notably, AHA can arise as a rare complication of malignancies such as lymphoproliferative disorders and gastrointestinal cancer, as well as an iatrogenic side effect of medications such as sulfonamide antibiotics. To date, six cases on AHA irAE have been described, five of which involved either nivolumab or ipilimumab.

CASE DESCRIPTION

A 70-year-old adult patient with multiple medical comorbidities presented with right-sided abdominal pain and macroscopic hematuria and subsequently diagnosed with unresectable stage III renal cell carcinoma (RCC). As first line therapy, the patient pursued palliative vascular embolization of the lower pole of the right kidney followed by neoadjuvant combination immunotherapy consisting of ipilimumab (1mg/kg) and nivolumab (3mg/kg) (ipi/nivo) every three weeks per Checkmate-214 protocol for advanced/unresectable locally-advanced RCC. After two cycles of ipi/nivo, the patient developed grade 3 nephritis, grade 1 pancreatitis, and grade 1 hypothyroidism, which have been previously reported side effects of the combination therapy.[4] This was treated with a prednisone taper over two months, leading to resolution of nephritis. At this time ipi/nivo was discontinued. They also underwent one cycle of cabozantinib but this was discontinued due to hematuria. Ultimately, the patient completed curative radical nephrectomy of the right kidney at roughly nine months after the last dose of ipi/nivo with no additional therapy following surgery.

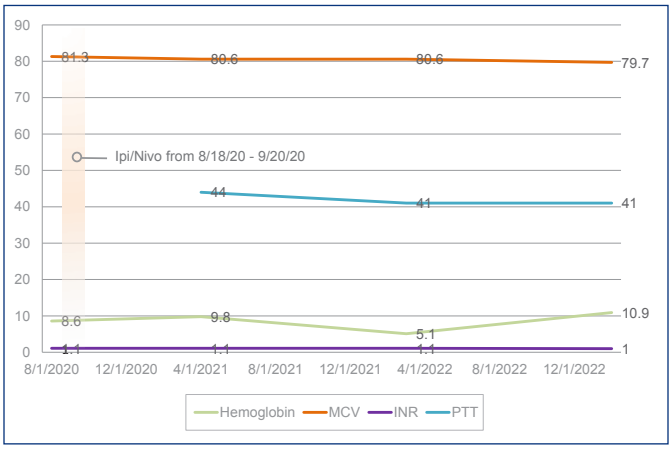
About seven months after cessation of ipi/nivo, the patient's labs were notable for an isolated prolonged activated partial thromboplastin time (aPTT) test at 44 seconds. The prolonged aPTT value was longer than one drawn a month prior to initiation of ipi/nivo (aPTT = 33 seconds). Institutional reference range for normal aPTT is 24.0 to 37.0 seconds. The prolonged aPTT persisted for over two years. As shown in **Table 1** and **Figure 1**, the patient's prior coagulation studies (prothrombin time, PT and aPTT) were both normal. Diagnostic evaluation to determine the etiology of the prolonged aPTT test occurred approximately 10 months

Table 1. Summary of laboratory results for bleeding disorder evaluation

	Reference Range	Day 0*	Day 91	Day 98	Day 111	Day 119†	Day 333
Hgb	13.5–16.0g/dl	10.9	9.1	–	8.9	9.2	7.6
Hct	37.0–47.0%	33.1	27.2	–	27.0	27.9	24.4
MCV	80.0–98.0fL	79.7	81.3	–	83.1	83.2	86.5
PT	10.0–13.0s	11.3	–	11.4	10.9	11.0	–
INR	0.8–1.2s	1.0	–	–	1.0	1.0	–
aPTT	24.0–37.0s	41.0	–	64.0	47.0	45.0	–
Factor VIII Activity	50–150%	–	37	4	–	7	–
Chromogenic Factor VIII	50–135%	–	–	–	–	–	39
Factor VIII inhibitor		–	–	negative	negative	negative	–
Factor IX Activity	60–170%	–	107	–	–	–	–
Factor XI Activity	60–160%	–	100	–	–	–	–
Factor XII Activity	50–150%	–	44	48	49	–	–
von Willebrand Antigen	50–180%	143	–	–	–	–	–
Ristocetin Factor	40–180%	162	–	–	–	–	–

* Initial hematology clinic visit for evaluation of bleeding disorder
† When a diagnosis of acquired hemophilia A was made
Hgb, hemoglobin; Hct, hematocrit; MCV, mean corpuscle volume; PT, prothrombin time; INR, international normalized ratio; aPTT, activated partial thromboplastin time

Figure 1. Trend for lab values prior to diagnosis of acquired hemophilia A.



later, after the patient's medical course was complicated by multiple episodes of bleeding from small intestinal arteriovenous malformations (AVMs). The first episode occurred approximately 17 months after the first infusion of ipi/nivo, when the patient was admitted to the hospital for an elective procedure. At the time, the patient's baseline hemoglobin (Hgb) ranged from 7.5–8.5 g/dL. During the hospitalization, the patient reported new melenic stool with an acute drop in Hgb. The patient was not on systemic anticoagulation therapy. The patient promptly underwent an esophagogastroduodenoscopy (EGD) procedure which revealed multiple actively bleeding AVMs in the duodenum that were stabilized with argon plasma coagulation (APC). The patient underwent EGD three more times for the stabilization of bleeding AVMs in the small bowel.

The patient eventually presented to the hematology clinic over a year after the first diagnosis of small bowel AVMs. This was approximately three years after the last dose of ipi/nivo. The patient was initially referred to a hematologist for workup of iron deficiency anemia. At the initial visit, the patient reported easy bruisability. The patient denied no personal or familial bleeding history or excessive bleeding with procedures. Physical examination revealed prominent ecchymosis on the flexor surface of the right forearm.

The patient underwent screening for disorders of the intrinsic pathway of the coagulation cascade. They had decreased factor VIII (FVIII) at 4–37%, that dropped to 4% and 7% within a month [**Table 1**]. Strangely, the inhibitor to FVIII remained negative. Otherwise, they had normal serum protein electrophoresis, negative lupus anticoagulant, and negative studies for von Willebrand's disease. The patient was subsequently diagnosed with mild to moderate AHA, that was determined to be immune mediated from ipi/nivo. Despite the patient being negative for an inhibitor on lab work, there are proposed mechanisms (discussed below) for those who clinically present as having an inhibitor but the titer is negative.

For the patient's newly diagnosed mild-moderate AHA, they were offered treatment options which would include immunosuppressive therapy with glucocorticoids alone or in combination with the agents cyclophosphamide, rituximab, or IVIG in the front-line setting. In this case, the hematologist was in favor of using prednisone 1mg/kg daily (100mg) along with plans for initiating low-dose rituximab (100mg weekly for four weeks) given that previous studies showed this regimen to be efficacious.[5] Ultimately after

shared-decision making, this patient elected to hold on starting prednisone with rituximab given that their FVIII level was greater than 1%. The patient was concerned that the use of immunosuppressive therapy could potentially lead to loss of antitumor response, risking the development of recurrent or metastatic RCC.

Eventually, after review of risks and benefits, the patient elected to start on replacement therapy with emicizumab (Hemlibra) 3mg/kg every two weeks. The patient has since achieved FVIII activity levels of 65% on this medication, indicating response.

DISCUSSION

Here, we present a case of ipi/nivo-associated AHA in a patient with RCC. The formal diagnosis was made approximately two-and-a-half years after the first dose of ICI [**Figure 1**]. The first elevated aPTT was documented about eight months after the last dose of ipi/nivo. Leading up to the diagnosis of AHA, the patient experienced multiple bleeding AVMs in the small bowel requiring hospitalizations. This case urges clinicians to maintain a high suspicion of hematologic irAEs including AHA for a timely diagnosis and subsequent appropriate management.

Ipilimumab is a monoclonal antibody targeting the CTLA-4 pathway and received FDA approval in 2011 for solid tumors. Nivolumab was approved in 2014 and targets the PD-1 pathway in T-lymphocytes. Several mechanisms have been proposed to explain irAEs, including autoreactive T-cells, B-cells/autoantibodie and cytokines/chemokines.[6] Ipilimumab toxicity has been shown to be dose dependent, often arising after the third to fourth dose.[7] When ipilimumab is combined with nivolumab, the incidence of high-grade toxicities is roughly double that observed with single-agent PD-1 pathway therapy.[8] In solid tumor patients, the incidence of any-grade irAEs was found to be 66% with PD-1/PD-L1 inhibitors and 72% with CTLA-4 inhibitor monotherapy.[9] One meta-analysis that included 5923 patients from studies using single-agent ICI therapy found a hematologic irAE rate of 3.6%.[10] Hematologic irAEs also tended to be characterized as serious adverse reactions with a mortality rate of 14%. Most frequently, hematologic toxicities present as hemolytic anemia, thrombocytopenia, neutropenia, bone marrow failure, and hemophagocytic lymphohistiocytosis.[11]

AHA is a bleeding disorder where autoantibodies are formed against FVIII. Extremely rare, with an incidence of one to two cases per million per year,[12] the most common presentation are bleeding in subcutaneous tissue (80%), then muscular (45%), gastrointestinal (21%), genitourinary (9%) and retroperitoneal (9%) spaces.[13] AHA has been associated with pregnancy, autoimmune disorders such as rheumatoid arthritis, malignancy such as lymphoproliferative disorders and gastrointestinal cancer, and certain medications sulfonamide antibiotics.[14]

The first case of irAE AHA was reported in 2011 arising from ipilimumab treatment for metastatic non-small cell lung cancer (NSCLC) [**Table 2**]. Since then, ipilimumab or nivolumab monotherapy linked to AHA has been reported in the treatment of two cases of NSCLC[15,16] and two cases of melanoma[17,18] [**Table 2**]. Macroscopic hematuria and anemia resulted from ipilimumab monotherapy, while bruising, macroscopic hematuria, and anemia resulted from nivolumab monotherapy. One case linked to nivolumab presented with a bleeding gastric ulcer. Additionally, two cases of AHA were reported with pembrolizumab[18] and atezolizumab[19] monotherapy that presented as bruising and hemarthrosis. The timing from initial dose of immunotherapy to onset of bleeding disorder symptoms varied, spanning from two months to more than a year.

There are currently no published diagnostic guidelines highlighting the work-up of AHA irAE. Furthermore, there are currently no screening tests available to help risk stratify or predict severity. Therefore we rely on the diagnostic guidelines for general AHA. AHA should be suspected in patients, especially the elderly, who experience recent onset of abnormal bleeding and on lab work are found to have an isolated prolongation in aPTT with normal PT.[20] Recommended work-up includes obtaining a mixing study, FVIII level, von Willebrand factor-antigen (VWF:Ag), Willebrand factor-Ristocetin co-factor (VWF:RCo), and anti-human factor VIII inhibitor (anti-h-FVIII) level. A FVIII inhibitor is confirmed and quantified by the Bethesda assay (BA) or Nijmegen Bethesda assay (NBA).

The diagnosis of mild to moderate irAE-related AHA in our patient resulted from their history of exposure to ipi/nivo, clinical presentation of bleeding AVMs, easy bruisability, and distinct lab values. Our patient was found to have a low FVIII activity level at 4%. Of note, when the patient was evaluated by hematology, a mixing test was not performed. Kruse-Jarres et al recommend that a mixing test may not be needed if an AHA diagnosis can be confirmed by a low FVIII activity.[20] Interestingly, the anti-h-FVIII level was negative in our patient. While this is uncommon, cases can be negative in the setting of low titer inhibitor, non-specific inhibitors (such as antiphospholipids antibodies) which can interfere with the assay, or improper handling of the specimen. Furthermore, the BA and NBA may underestimate the inhibitor titer through mechanisms of a nonlinear inactivation of FVIII and residual FVIII activity.[21,22] The BA used to measure inhibitor potency assumes a log-linear relationship between inhibitor concentration and effect on residual FVIII activity to allow exact quantification. However, this mechanism is not present for the type 2 inhibitors typically seen in AHA.[22]

For our patient, a test using a different method to assess for FVIII activity level, known as the chromogenic FVIII activity assay, was utilized and returned positive with an abnormal level at 39% (institutional reference range is 50–135%).

Table 2. Summary of preceding case reports of AHA irAE

Authors	Cancer, stage	ICI	Time to irAE (months)	Case Summary
Delyon et al.	Melanoma, metastatic	Ipilimumab	2	Patient had hematuria and anemia. AHA suspected from prolonged aPTT. First treated with prednisolone therapy, then hemostatic agents: rFVIIa, NovoSeven; and tranexamic acid. Bleeding resolved within 2 weeks.
Kato et al.	NSCLC, metastatic	Nivolumab	17	Patient developed melena and anemia. Endoscopy found a bleeding gastric ulcer. A prolonged aPTT led to diagnosis of AHA. They were treated was treated with prednisone, cyclophosphamide, and rFVIIa.
Gokozan et al.	NSCLC, metastatic	Nivolumab	1	Patient hospitalized for bruising and hematuria, labs with prolonged aPTT. First given FVIII, then activated prothrombin concentrate. Lab evidence of AHA resolved after steroids and weekly rituximab.
Gidaro et al.	Melanoma, metastatic	Nivolumab	Not reported	Patient developed hematuria and anemia with a prolonged aPTT and they were diagnosis with AHA. They received multiple doses of prednisone and rFVIIa, but bleeding persisted, leading to the use of rituximab plus prednisone with eventual resolution.
Gidaro et al.	Melanoma, metastatic	Pembro-lizumab	3.5	Patient reported easy bruising and asthenia at which time he was referred to a hemophilia center and AHA was diagnosed. They were successfully treated with rFVIIa, prednisone, and later with rituximab.
Fletcher et al.	Small cell lung cancer, extensive stage	Atezo-lizumab	16	Presented with asymptomatic anemia. First managed with blood transfusion, correction of factor deficiency, and suppression of factor inhibition, but rehospitalized with spontaneous hematomas. Bleeding resolved following the use of rituximab, prednisone, and rFVIIa.

AHA, acquired hemophilia A; irAE, immune related adverse event; ICI, immune checkpoint inhibitor; NSCLC, non-small cell lung cancer; rFVIIa, recombinant activated Factor VII; aPTT, activated partial thromboplastin time

Chromogenic FVIII differs from the assay for standard FVIII activity in that chromogenic FVIII is less likely to be affected by interference from heparin or direct thrombin inhibitors.[23]

Current guidelines recommend acute bleeding control and immunosuppressive therapy to decrease the inhibitor and reduce the risk of recurrent bleeding. A retrospective study showed that an upfront combination of cyclophosphamide, dexamethasone, and rituximab (CyDRi) for AHA resulted in overall higher rates of complete remission in addition to more tolerable side effects compared to prolonged steroid therapy.

IrAEs can be difficult to diagnose—and when they are not considered by the clinician—can result in prolonged work-ups without a diagnosis. This has the potential for unintended but detrimental consequences for the patient, such as multiple hospitalizations or emotional distress for patients. As demonstrated by our case, the diagnosis of AHA irAE, is possible through multidisciplinary collaboration. In a cancer patient who presents with recurrent bleeding episodes and persistently abnormal APTT who has a history of undergoing ICI treatment, our key takeaway is to maintain a high suspicion of AHA irAE.

References

1. Postow MA, Sidlow R, Hellmann MD. Immune-Related Adverse Events Associated with Immune Checkpoint Blockade. N Engl J Med 2018;378(2):158-68 doi: 10.1056/NEJMra1703481.
2. Schneider BJ, Naidoo J, Santomasso BD, et al. Management of Immune-Related Adverse Events in Patients Treated With Immune Checkpoint Inhibitor Therapy: ASCO Guideline Update. J Clin Oncol 2021;39(36):4073-126 doi: 10.1200/JCO.21.01440 [published Online First: 20211101].
3. Davis EJ, Salem JE, Young A, et al. Hematologic Complications of Immune Checkpoint Inhibitors. Oncologist 2019;24(5):584-88 doi: 10.1634/theoncologist.2018-0574 [published Online First: 20190228].
4. Somekawa K, Horita N, Kaneko A, et al. Adverse events induced by nivolumab and ipilimumab combination regimens. Ther Adv Med Oncol 2022;14:17588359211058393 doi: 10.1177/17588359211058393 [published Online First: 20220211].
5. Simon B, Cegledi A, Dolgos J, et al. Combined immunosuppression for acquired hemophilia A: CyDRi is a highly effective low-toxicity regimen. Blood 2022;140(18):1983-92 doi: 10.1182/blood.2022016873.
6. Perdigoto AL, Kluger H, Herold KC. Adverse events induced by immune checkpoint inhibitors. Curr Opin Immunol 2021;69:29-38 doi: 10.1016/j.coi.2021.02.002 [published Online First: 20210225].
7. Wolchok JD, Neyns B, Linette G, et al. Ipilimumab monotherapy in patients with pretreated advanced melanoma: a randomised, double-blind, multicentre, phase 2, dose-ranging study. Lancet Oncol 2010;11(2):155-64 doi: 10.1016/S1470-2045(09)70334-1 [published Online First: 20091208].
8. Zhou S, Khanal S, Zhang H. Risk of immune-related adverse events associated with ipilimumab-plus-nivolumab and nivolumab therapy in cancer patients. Ther Clin Risk Manag 2019;15:211-21 doi: 10.2147/TCRM.S193338 [published Online First: 20190131].

9. Yang F, Shay C, Abousaud M, et al. Patterns of toxicity burden for FDA-approved immune checkpoint inhibitors in the United States. J Exp Clin Cancer Res 2023;42(1):4 doi: 10.1186/s13046-022-02568-y [published Online First: 20230105].
10. Michot JM, Lazarovici J, Tieu A, et al. Haematological immune-related adverse events with immune checkpoint inhibitors, how to manage? Eur J Cancer 2019;122:72-90 doi: 10.1016/j.ejca.2019.07.014 [published Online First: 20191018].
11. Kroll MH, Rojas-Hernandez C, Yee C. Hematologic complications of immune checkpoint inhibitors. Blood 2022;139(25):3594-604 doi: 10.1182/blood.2020009016.
12. Richter T, Nestler-Parr S, Babela R, et al. Rare Disease Terminology and Definitions-A Systematic Global Review: Report of the ISPOR Rare Disease Special Interest Group. Value Health 2015;18(6):906-14 doi: 10.1016/j.jval.2015.05.008 [published Online First: 20150818].
13. Collins PW, Hirsch S, Baglin TP, et al. Acquired hemophilia A in the United Kingdom: a 2-year national surveillance study by the United Kingdom Haemophilia Centre Doctors' Organisation. Blood 2007;109(5):1870-7 doi: 10.1182/blood-2006-06-029850 [published Online First: 20061017].
14. DW S, GM R. Acquired hemophilia a: a current review of autoantibody disease. Clin Adv Hematol Oncol 2012;10(1):19-27.
15. Kato R, Hayashi H, Sano K, et al. Nivolumab-Induced Hemophilia A Presenting as Gastric Ulcer Bleeding in a Patient With NSCLC. J Thorac Oncol 2018;13(12):e239-e41 doi: 10.1016/j.jtho.2018.06.024 [published Online First: 20180712].
16. Gokozan HN, Friedman JD, Schmaier AH, Downes KA, Farah LA, Reeves HM. Acquired Hemophilia A After Nivolumab Therapy in a Patient With Metastatic Squamous Cell Carcinoma of the Lung Successfully Managed With Rituximab. Clin Lung Cancer 2019;20(5):e560-e63 doi: 10.1016/j.cllc.2019.06.022 [published Online First: 20190626].
17. Delyon J MC, Lambert T. Hemophilia A Induced by Ipilimumab. N Engl J Med 2011;365 doi: 10.1056/NEJMc1110923.
18. Gidaro A, Palmieri G, Donadoni M, et al. A Diagnostic of Acquired Hemophilia Following PD1/PDL1 Inhibitors in Advanced Melanoma: The Experience of Two Patients and a Literature Review. Diagnostics (Basel) 2022;12(10) doi: 10.3390/diagnostics12102559 [published Online First: 20221021].
19. Fletcher J, Bird R, McLean AJW, O'Byrne K, Xu W. Acquired Hemophilia A Secondary to an Immune Checkpoint Inhibitor: A Case Report. JTO Clin Res Rep 2022;3(11):100409 doi: 10.1016/j.jtocrr.2022.100409 [published Online First: 20220919].
20. Kruse-Jarres R, Kempton CL, Baudo F, et al. Acquired hemophilia A: Updated review of evidence and treatment guidance. Am J Hematol 2017;92(7):695-705 doi: 10.1002/ajh.24777 [published Online First: 20170605].
21. Batty P, Moore GW, Platton S, et al. Diagnostic accuracy study of a factor VIII ELISA for detection of factor VIII antibodies in congenital and acquired haemophilia A. Thromb Haemost 2015;114(4):804-11 doi: 10.1160/TH14-12-1062 [published Online First: 20150611].
22. Tiede A, Werwitzke S, Scharf RE. Laboratory diagnosis of acquired hemophilia A: limitations, consequences, and challenges. Semin Thromb Hemost 2014;40(7):803-11 doi: 10.1055/s-0034-1390004 [published Online First: 20141009].
23. Moser KA, Adcock Funk DM. Chromogenic factor VIII activity assay. Am J Hematol 2014;89(7):781-4 doi: 10.1002/ajh.23723 [published Online First: 20140415].

Authors

Grace Sun, MD, Department of Medicine, Warren Alpert Medical School of Brown University, Providence, RI.

Elias O.U. Eteshola, MD, PhD, The Warren Alpert Medical School of Brown University, Providence, RI.

Matthew J. Hadfield, DO, Assistant Professor of Medicine, Department of Medicine, Division of Hematology/Oncology, Warren Alpert Medical School of Brown University, Providence, RI.

Andrew Hsu, MD, Assistant Professor of Medicine, Department of Medicine, Division of Hematology/Oncology, Assistant Professor of Medicine, Clinician Educator, Legorreta Cancer Center, Warren Alpert Medical School of Brown University, Providence, RI.

Disclosures

Ethical Approvals: Our institution does not require ethical approval for reporting individual cases.

Disclaimer: The views expressed herein are those of the authors and do not necessarily reflect the views of Brown University Health.

Correspondence

Grace Sun, MD
Grace_sun@brown.edu

Mixed Total Anomalous Pulmonary Venous Connection to Superior Cavoatrial Junction

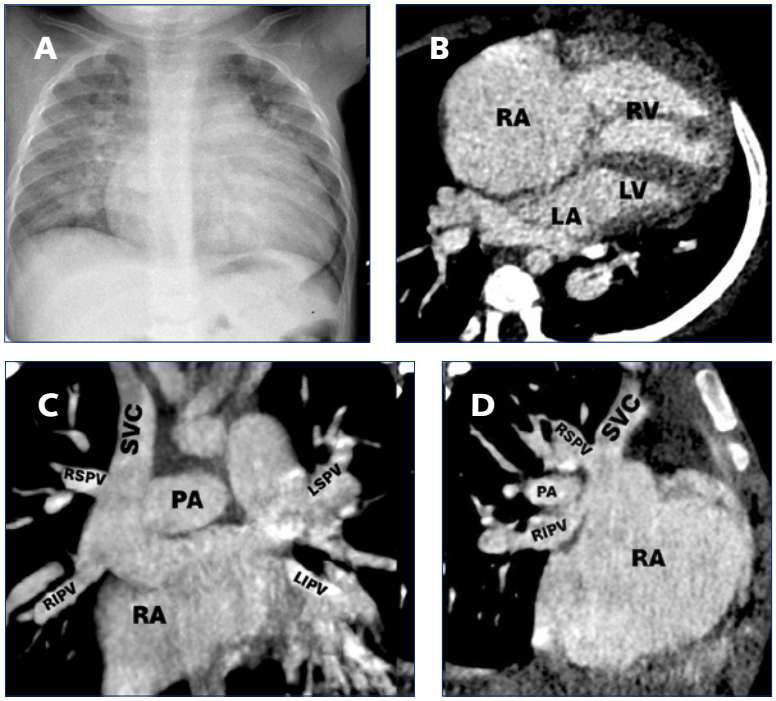
JOSÉ MARTÍN ALANÍS-NARANJO, MD, FACC; ANA MARÍA ROSAS-VÁZQUEZ, MD

CASE PRESENTATION

An 11-month-old male with a seven-month history of diaphoresis and malaise during breastfeeding was referred for evaluation after a pulmonary systolic murmur was noted on physical examination. Chest radiography revealed cardiomegaly mainly affecting the right heart chambers [**Figure 1A**]. Transthoracic echocardiography (TTE) demonstrated right heart chamber dilation and a secundum atrial septal defect. Cardiac computed tomography angiogra- (CCTA) demonstrated a mixed-type total anomalous pulmonary venous connection (TAPVC), with the left pulmonary veins (PVs) and the right inferior PV draining via a common confluence into an enlarged right atrium; additionally, the right superior PV drained directly into the origin of the superior vena cava [**Figures 1B-D, Figure 2**]. The cardiovascular surgery department was consulted to perform surgical correction and establish pulmonary venous return to the left atrium.

Figure 1. Mixed Total Anomalous Pulmonary Venous Connection to the Superior Cavoatrial Junction

[A] Chest X-Ray showed right chamber cardiomegaly along with bilateral enlarged pulmonary hilum. CCTA showing an enlarged right atrium and hypertrophied right ventricle, along with right inferior pulmonary vein and left pulmonary veins draining to a common collector which flows to the right atrium as well as the right superior pulmonary vein draining independently to the origin of the superior vena cava; **[B]** Axial MPR view, **[C]** Coronal MIP view, **[D]** Sagittal MIP view.



CCTA: Cardiac Computed Tomography Angiography, LA: Left Atrium, LIPV: Left Inferior Pulmonary Vein, LSPV: Left Superior Pulmonary Vein, LV: Left Ventricle, MPR: Multiplanar Reconstruction, MIP: Maximum Intensity Projection, PA: Pulmonary Artery, RA: Right Atrium, RIPV: Right Inferior Pulmonary Vein, RSPV: Right Superior Pulmonary Vein, RV: Right Ventricle, SVC: Superior Vena Cava.

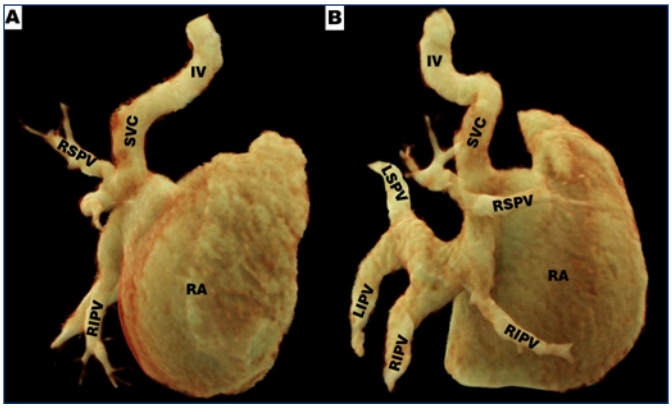
DISCUSSION

Mixed-type TAPVC, characterized by more than one level of pulmonary venous drainage, is the least frequent subtype, representing approximately 5% to 10% of all TAPVC cases.[1] Among these, variants in which all PVs drain into the superior cavoatrial junction are considered rare.[2] Although transthoracic echocardiography (TTE) is typically the first-line imaging modality and is sufficient in many cases to detect anomalous PV connections and obstruction, its diagnostic yield may be limited. Frequently, only two or three PVs are visualized, which can complicate accurate anatomical assessment. Consequently, up to 44.4% of mixed-type TAPVC cases are diagnosed only after surgery.[1] Given these challenges, a multimodality imaging approach is indicated in all patients with unrepaired TAPVC, especially before surgical intervention or in the presence of clinical deterioration or new symptoms.[3] CCTA provides comprehensive evaluation, allowing for precise identification of all four PVs, definition of their drainage pathways, and detailed delineation of PV anatomy through high-resolution, three-dimensional reconstructions.[1] Accurate characterization of PV anatomy is critical in mixed-type TAPVC, as surgical correction is technically complex due to the heterogeneous and variable arrangement of pulmonary venous confluences. The primary goal of surgical repair is to establish a non-obstructive connection between the pulmonary venous confluence and the left atrium, minimizing the risk of postoperative complications and ensuring anatomical compatibility with patient growth.[2] Among patients with TAPVC who have undergone

Figure 2. Mixed Total Anomalous Pulmonary Venous Connection to the Superior Cavoatrial Junction.

CCTA 3D cinematic volumetric rendering reconstruction:

[**A**] Anterior view, [**B**] Lateral view.



CCTA: Cardiac Computed Tomography Angiography, IV: Innominate vein, LIPV: Left Inferior Pulmonary Vein, LSPV: Left Superior Pulmonary Vein, RA: Right Atrium, RIPV: Right Inferior Pulmonary Vein, RSPV: Right Superior Pulmonary Vein, SVC: Superior Vena Cava

surgery, the overall survival rate is 87.2%, with higher survival observed in children (94.1%) and in those with mixed-type TAPVC (96%).[4] Postoperative follow-up is essential and should include TTE within the first 30 days after surgical repair, followed by surveillance imaging at three to six months in asymptomatic patients with no or mild sequelae, and at one to two-year intervals thereafter in patients who remain clinically stable.[3]

References

1. Xiang M, Wu C, Pan Z, Wang Q, Xi L. Mixed type of total anomalous pulmonary venous connection: diagnosis, surgical approach and outcomes. J Cardiothorac Surg. 2020 Oct 2;15(1):293.
2. Shamsuddin AM, Wong AR, Anderson RH, Corno AF. An Unusual Type of Totally Anomalous Pulmonary Venous Connection to the Superior Cavoatrial Junction. World J Pediatr Congenit Heart Surg. 2016 Jul;7(4):490-3.
3. Sachdeva R, Valente AM, Armstrong AK, Cook SC, Han BK, Lopez L, et al. ACC/AHA/ASE/HRS/ISACHD/SCAI/SCCT/SCMR/SOPE 2020 Appropriate Use Criteria for Multimodality Imaging During the Follow-Up Care of Patients With Congenital Heart Disease: A Report of the American College of Cardiology Solution Set Oversight Committee and Appropriate Use Criteria Task Force, American Heart Association, American Society of Echocardiography, Heart Rhythm Society, International Society for Adult Congenital Heart Disease, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Pediatric Echocardiography. J Am Coll Cardiol. 2020 Feb 18;75(6):657-703.
4. Cervantes-Salazar JL, Calderón-Colmenero J, Martínez-Guzmán A, García-Montes JA, Rivera-Buendía F, Ortega-Zhindón DB. Total anomalous pulmonary venous connection: 16 years of surgical results in a single center. J Card Surg. 2022 Oct;37(10):2980-2987.

Authors

José Martín Alanís-Naranjo, MD, FACC, Cardiovascular Imaging Department, Instituto Nacional de Cardiología Ignacio Chávez, Mexico City, Mexico.

Ana María Rosas-Vázquez, MD, Cardiovascular Imaging Department, Instituto Nacional de Cardiología Ignacio Chávez; CT Scanner, Lomas Altas, Mexico City, Mexico.

Disclosure

We confirm that there are no conflicts of interest or disclosures to report for all authors of this study. No financial support was received for this publication.

Correspondence

José Martín Alanís-Naranjo, MD, FACC
Juan Badiano 1, 14080, Mexico City, Mexico
+524432062240
martin.alanis.n@gmail.com

Evaluation of Occupational Crush Fractures of the Hand and Time Off Work

MARGARET R. WANG, BS; TIMOTHY JENG, BA; ISHAN SHAH, BS; NIKHIL SOBTI, MD; ERNEST DIMBO, MPhil; MATTHEW LEE, BA; REENA A. BHATT, MD

ABSTRACT

BACKGROUND: Occupational injuries of the hand are a major cause of disability. This study analyzes crush injury fractures of the hand and resultant time off work at a Level I Trauma Center in Providence, Rhode Island.

METHODS: Adult patients presenting to the emergency department with acute fractures to the metacarpals or phalanges following occupational hand crush injuries between July 2011 and June 2023 were retrospectively identified. Patients were evaluated for demographic variables, injury patterns, treatment, and time to return to work (RTW). Bivariate and multivariate regression analyses assessed RTW in relation to covariates with a significance level set at <0.05.

RESULTS: One hundred and thirty-five (135) patients met study criteria, of which the mean age of presentation was 42.4. Almost all patients were engaged in manual labor (n = 123, 91.1%); 78.5% of injuries were open fractures (n = 106), 20.0% were intra-articular (n = 27) and 54.8% were comminuted (n = 74). Amputation injury occurred in 30.4% (n = 41) of cases. One-third, (n = 45, 33.3%) required surgery. The median RTW was 67.5 days post-injury. Regression analysis demonstrated that Hispanic/Latino ethnicity, increased age, intra-articular fractures and middle phalanx and metacarpal fractures were significantly associated with longer RTW.

CONCLUSION: Occupational hand crush fractures are associated with considerable time off work, with a median of 67.5 days demonstrated in our cohort. Several factors may be associated with prolonged RTW, including older age and more complex injury patterns. These findings underscore the importance of providing equitable care to facilitate timely RTW._

KEYWORDS: Occupational hand injury; hand crush injury; return to work; retrospective study

INTRODUCTION

Hand injuries are common injuries that are a major cause of disability worldwide, with many occurring in occupational settings.[1-4] Crush injuries, often due to industrial machinery with high energy mechanisms, can result in complex and severe injuries to the hand.[5,6] Such injuries can impair a worker's daily and occupational function and lead to significant time out of work, in some cases leading to permanent disability.[7-9] In the United States, Worker's Compensation Insurance covers both medical care as well as compensation for lost time and is associated with high costs.[10-12]

A multitude of factors affect Return to Work (RTW) after hand injury, including pain, physical hand function and socioeconomic pressure. Demographic factors and occupational factors have also been found to be associated with RTW after occupational injury in previous studies.[13,14] Despite hand injuries being a common occupational injury presenting to the Emergency Department, the epidemiology and individual burden have not been well characterized.[7,15,16] This study analyzes the mechanisms and sequelae influencing RTW following hand fractures due to occupational crush injury at a tertiary academic hospital located in a mid-sized city in the northeastern United States. We hypothesize that while injury severity likely correlates with lengthened recovery, there are also socioeconomic drivers that affect return to work outcomes following occupational hand injury.

METHODS

Data Collection

A retrospective medical record review was conducted of patients who presented to the Emergency Department (ED) with hand crush injuries seen by the Plastic Surgery Hand Service between July 2011 and June 2023 at Rhode Island Hospital in Providence, Rhode Island. Study inclusion criteria consisted of adult patients with acute fracture injuries limited to the hand, where injuries occurred in an occupational setting. Injuries that did not result in acute fractures as seen on radiographical imaging or injuries that extended beyond the hand (i.e., proximal to the metacarpals) were excluded. Polytrauma injuries were also excluded. Patients' records were evaluated for demographics including occupation, language spoken, injury mechanism and pattern, treatment required including ED procedures and surgeries, and follow-up duration. Manual labor was defined as any occupation that primarily involves physical and repetitive tasks, including those in the manufacturing, construction, transport, warehouse and food service industries. Estimated time to return to work (RTW) data was gathered from medical documentation, including physician completed Worker's Compensation reports. For those who remained out of work

at last follow-up appointment due to functional impairment, RTW date was estimated using medical documentation of work clearance when available. For those that had yet to achieve work clearance, the last follow-up date was used as the return-to-work date. All aspects of this study were approved by the authors' Institutional Review Board (#1683478).

Data Analysis

Bivariate and multivariate regression analyses were conducted to assess return to work duration in relation to injury patterns and surgical intervention. Shapiro-Wilk tests were used to evaluate normality, and non-parametric tests were used to compare RTW times between groups. Linear regression models were used to assess predictors of lengthened time to RTW. All statistical analysis was completed at a significance level of 0.05 using IBM SPSS Version 29 (Armonk, NY).

RESULTS

Patient Demographics

Three-hundred-fifty-seven (357) patients were reviewed, of which 135 occupational crush injuries were identified per study criteria. The median age of presentation was 42 years old, with a range from 19 to 71. The average age of presentation was 42.4 (SD 13.3). 85.9% of patients were male (n = 116) and 14.1% were female (n = 19); 51.5% of patients identified as White (n = 69), 9.6% identified as Black (n = 13), 3.0% as Asian (n = 4) and 36.3% (n = 49) as other. In terms of ethnicity, 32.6% (n = 44) identified as Hispanic or Latino; 37.0% of patients (n = 50) did not have documented health insurance, while 34.1% (n = 46) possessed commercial insurance and 28.9% had public insurance (n = 39) including Medicaid and Medicare. Worker's compensation claims were documented in 74.8% of cases (n = 101). In terms of English language proficiency, 21.5% (n = 29) were documented as requiring an interpreter. The majority of patients with limited English proficiency were of Hispanic/Latino ethnicity (n = 23. 79.3%).

A past medical history of diabetes was documented in 7.4% (n = 10), and 43.0% (n = 58) of patients were either current or former smokers. Right-hand dominance was noted in 85.2% (n = 115), and 7.4% (n = 10) were left-hand dominant. Two patients (1.4%) were noted as ambidextrous and eight patients (5.9%) did not have documentation of hand dominance. Descriptive statistics for patient demographics are detailed in **Table 1**.

In terms of patient employment, 91.1% (n = 123) of patients were engaged an occupation associated with manual labor. The largest occupational sectors represented were manufacturing (n = 43, 31.8%), maintenance and repair, including automotive repair (n = 22, 16.3%), transportation and warehouse work (n = 21, 15.6%), and construction (n = 18, 13.3%). Distribution of patient occupation is detailed in **Table 1**.

Table 1. Demographics and Occupational Variables of Entire Cohort (N = 135)

Age at presentation	
Mean (±SD)	42.4±13.3
Median (Range)	42 (19–71)
Sex (n, %)	
Male	116 (85.9%)
Female	19 (14.1%)
Race (n, %)	
White	69 (51.1%)
Black	13 (9.6%)
Asian	4 (3.0%)
Other	49 (36.3%)
Ethnicity (n, %)	
Hispanic or Latinx	91(67.4%)
Non-Hispanic or Latinx	44 (32.6%)
Limited English Proficiency	29 (21.5%)
Insurance (n, %)	
Private	46 (34.1%)
Public (Medicaid, Medicare)	39 (28.9%)
No Insurance	50 (37.0%)
Past Medical History (n, %)	
Diabetes	10 (7.4%)
Hypertension	32 (23.7%)
Positive Smoking History	58 (43.0%)
Hand Dominance (n, %)	
Right	115 (85.2%)
Left	10 (7.4%)
Ambidextrous	2 (1.4%)
Unknown	8 (5.9%)
Worker's Compensation Claim (n, %)	101 (74.8%)
Manual Laborer (n, %)	123 (91.1%)
Occupational Sector (n, %)	
Construction	18 (13.3%)
Manufacturing	43 (31.8%)
Transportation/Warehouse	21 (15.6%)
Maintenance/Repair	22 (16.3%)
Food Service/Production	8 (5.9%)
Fisheries	3 (2.2%)
Forestry	1 (0.7%)
Healthcare	2 (1.5%)
Hospitality	1 (0.7%)
Administration	2 (1.4%)
Education	2 (1.4%)
Not recorded	2 (1.5%)

Table 2. Injury Characteristics and Management of Entire Cohort (N = 135)

Variable	Number of Patients (n, %)
Injury Laterality	
Right	74 (54.1%)
Left	60 (44.4%)
Bilateral	2 (1.5%)
Dominant Hand Injury	70 (51.9%)
Open fracture	106 (78.5%)
Comminuted fracture	74 (54.8%)
Intra-articular Fracture	27 (20.0%)
Amputation Injury	41 (30.4%)
Complete Amputation	18 (13.3%)
Partial Amputation	24 (17.8%)
Distal Phalanx Fracture	104 (77.0%)
Tuft Fracture	85 (63.0%)
Middle Phalanx Fracture	13 (9.6%)
Proximal Phalanx Fracture	20 (14.8%)
Metacarpal Fracture	13 (9.6%)
Extensor or Flexor Tendon Injury	11 (8.1%)
Flexor Tendon Injury	2 (1.5%)
Extensor Tendon Injury	9 (6.7%)
Number of Fingers Fractured	
One	117 (86.7%)
Two	14 (10.4%)
Three	3 (2.2%)
Four	1 (0.7%)
Finger Fractured	
Thumb	16 (11.9%)
Second	28 (20.7%)
Third	30 (22.2%)
Fourth	28 (20.7%)
Fifth	15 (11.1%)
Multiple Fingers	18 (13.3%)
Machine Injury	63 (46.7%)
Door Injury	13 (9.6%)
Management Technique	
Any ED Procedure	111 (82.2%)
ED Amputation Revision	27 (20.0%)
Any OR Procedure	45 (33.3%)
OR Reduction and Fixation	29 (21.5%)
OR Amputation Revision	10 (7.4%)
ED to OR Amputation Revision	8 (5.9%)
Flexor or Extensor Tendon Repair	8 (5.9%)
Occupational Therapy Participation	74 (54.8%)

Injury Patterns

The right hand was injured in 54.1% (n = 74) of cases, while 44.4% (n = 60) involved the left. Two cases (1.5%) involved both hands. Over half of patients injured their dominant hand (51.9%, n = 70). Most patients presented within a day of injury (90.4%, n = 123), with all remaining patients presenting after one day (9.6%, n = 13). The most commonly fractured structure was the distal phalanx, involved in 77.0% (n = 104) of cases. Of these, 81.7% (n = 85) were tuft fractures. Injuries proximal to the distal phalanx, involving the middle, distal phalanx, metacarpals, were seen in 26.7% of cases (n = 36). Specifically, there were 13 (9.6%) middle phalanx fractures, 20 (14.8%) proximal phalanx fractures and 13 (n = 9.6%) metacarpal fractures. Amputation injury occurred in 30.4% (n = 41) of cases, with 24 partial amputations and 18 complete amputation injuries. There were 11 (8.1%) patients that had a concurrent flexor or extensor tendon injury, with two (1.5%) flexor tendon injuries and nine (6.7%) extensor tendon injuries. The majority of fractures were described as open (78.5%, n = 106), while 54.8% were described as comminuted fractures (n = 74). Intra-articular involvement was described in 20.0% of cases (n = 27).

Most patients injured one finger (77.2%, n = 105), while 19.1% injured two fingers (n= 26). Four patients injured three fingers (2.9%). One patient injured four fingers (n = 1, 0.7%). Of patients that injured one finger, the most frequently fractured finger was the middle finger (n = 30, 22.2%) followed by the second (n = 28, 20.7%) and fourth fingers (n = 28, 20.7%). In terms of injury mechanism, industrial machinery was involved in 46.7% (n = 63) of cases. Descriptive statistics for injury characteristics are detailed in **Table 2.**

Management, Procedures and Surgeries

One-third of patients (33.3%, n = 46) required surgical repair while 82.2% (n = 111) required an ED procedure including reduction, washout and closure or revision amputation. Twenty-seven (27) amputation revisions were performed in the ED. In the operating room (OR)there were 10 amputation revisions, 29 OR reduction and fixations and eight extensor or flexor tendon repairs. Eight patients that underwent ED amputation revision required subsequent OR revision. There were a total of 72 surgeries completed across the 45 patients that required surgery, an average of 1.6 surgeries per patient (range 1–5). For surgical reduction and fixation, 96.5% of patients (n = 28) underwent Kirschner wire (K-wire) fixation. In patients with metacarpal fractures (n = 13), six (46.2%) patients underwent K-wire fixation, one patient (7.7%) underwent fixation with an intramedullary screw, and the rest were managed non-operatively (n = 4, 30.8%). All patients were treated with standardized post-operative immobilization, finger vs. short arm splint with digits held in intrinsic plus as indicated. In terms of occupational/hand therapy (OT), 54.8% (n = 74) of patients had documented OT participation. Descriptive statistics for management technique are detailed in **Table 2.**

Table 3. Descriptive Statistics: Time to Return to Work and Follow-Up Duration

	Time to Return to Work (Days)	Follow-Up Duration (Days)
Number of Patients	100	135
Mean ± SD	118.9±160.2	144.8±242.6
Median (IQR)	67.5 (33.0–146.8)	62.0 (12.–161.0)
Range	0–934	0–1623

Return to Work

Overall, 74.0% (n = 100) of patients had a RTW date recorded, with a median of 67.5 (IQR 113.75) days post-injury, average of 118.9 days (SD 160.2) and range of 0 to 934 days. Patients had a median follow-up time of 62 (IQR 149) days, average of 144.8 days (SD 242.6) and range 0 to 1623 days. Six patients remained unable to work due to functional impairment at last follow-up appointment. Descriptive statistics for RTW and follow-up times are detailed in **Table 3.** Of note, increased RTW is defined as increased time to return to work in results reported below.

Statistical Analysis

RTW time was not found to be normally distributed ($p < 0.001$). Mann Whitney U tests demonstrated significantly increased RTW duration in patients who identified as Hispanic or Latino compared to those who did not identify as Hispanic or Latino ($U = 1423.5$, $Z = 2.194$, $p = 0.028$). Increased RTW duration was demonstrated in patients with intra-articular fractures ($U = 1103.0$, $Z = 2.315$, $p = 0.021$), comminuted fractures ($U = 1556.5$, $Z = 2.148$, $p = 0.032$) and metacarpal fractures ($U = 845.0$, $Z = 2.865$, $p = 0.004$). Increased RTW was also demonstrated in patients undergoing ED revision amputation ($U = 1138.5$, $Z = 2.073$, $p = 0.038$) and those requiring operative intervention ($U = 1870.5$, $Z = 4.718$, $p < 0.001$). Age at presentation was found to be positively correlated to RTW time (Pearson's Correlate: 0.233, $p = 0.020$). There was no significant difference in RTW found between race, insurance status, smokers vs. non-smokers and those with diabetes vs. no diabetes. There were no differences

Table 4. Comparing Return to Work (RTW) across different variables for patients with RTW to work date (N = 100). Mann-Whitney U tests conducted at a significance of $p < 0.05$.

	Groups	N	Median (IQR)	Mean Rank	U	Z	P
Ethnicity	Not Hispanic	66	58.0 (99)	45.93	1423.5	2.194	**0.028**
	Hispanic	34	88.5 (110)	59.37			
Limited English Proficiency	No	80	66.0 (129)	49.31	895.0	0.819	0.413
	Yes	20	78.0 (75)	55.25			
Smoking History	Negative	56	68.0 (108)	51.20	1193.0	–0.271	0.787
	Positive	44	66.5 (113)	49.61			
Hypertension	No	75	73.0 (116)	52.05	822.50	–0.916	0.360
	Yes	25	59.0 (74)	45.90			
Diabetes	No	93	68.0 (113)	50.74	303.0	–0.304	0.761
	Yes	7	63.0 (63)	47.29			
Dominant Hand Injury	No	46	70.5 (115)	50.73	1231.5	–0.073	0.942
	Yes	54	65.0 (115)	50.31			
Industrial Machine Injury	No	48	58.5 (148)	47.97	1369.5	0.838	0.402
	Yes	52	71.5 (90)	52.84			
Open fracture	No	20	64.0 (140)	49.25	825.0	0.215	0.829
	Yes	80	68.5 (105)	50.81			
Intra-articular Fracture	No	79	63.0 (111)	47.94	1103.0	2.315	**0.021**
	Yes	21	111.0 (194)	63.52			
Comminuted Fracture	No	47	55.0 (105)	43.88	1556.5	2.148	**0.032**
	Yes	53	83.0 (115)	56.37			
Tendon Injury	No	89	63.0 (126)	49.29	597.0	1.184	0.236
	Yes	11	98.0 (70)	60.27			
Amputation Injury	No	66	61.0 (78)	46.85	1363.0	1.754	0.079
	Yes	34	93.5 (141)	57.59			
Distal Phalanx Fracture	No	25	111.0 (81)	59.22	719.5	–1.736	0.083
	Yes	75	62.0 (81)	47.59			
Middle Phalanx Fracture	No	90	64.0 (111)	49.42	547.0	1.115	0.625
	Yes	10	83.0 (354)	60.20			
Proximal Phalanx Fracture	No	85	63.0 (98)	48.52	806.0	1.627	0.104
	Yes	15	125.0 (153)	61.73			
Metacarpal Fracture	No	87	61.0 (94)	47.29	845.0	2.865	**0.004**
	Yes	13	150.0 (410)	72.0			
Two or More Fingers Fractured	No	77	63.0 (128)	49.32	976.0	0.741	0.458
	Yes	23	83.0 (74)	54.43			
ED Revision Amputation	No	77	61.0 (90)	47.21	1138.5	2.073	**0.038**
	Yes	23	98.0 (162)	61.5			
Any OR Procedure	No	60	48.5 (77)	39.33	1870.5	4.718	**<0.001**
	Yes	40	111.5 (150)	67.26			

in RTW duration observed across different occupations, injuries involving industrial machinery, nor across dominant- vs. non-dominant-hand injuries. There was no significant difference demonstrated in rate of machine injury in Hispanic patients compared to non-Hispanic patients (54.5% vs 42.9%, p = 0.137). There was also no significant difference in RTW with amputation- vs. non-amputation injuries or open vs. closed fractures. Concurrent extensor or flexor tendon injuries were not associated with increased RTW in this cohort. Results of this bivariate analysis comparing RTW times across groups are detailed in **Table 4.**

Linear Regression Analysis

To avoid overfitting models, separate regression models were built to evaluate patient demographics, injury characteristics and management as predictors for increased RTW. The first model evaluated patient demographics and past medical history, including insurance coverage, age, race, ethnicity, limited English proficiency, diabetes and smoking history. This model (R^2 = 0.092) found that increased age (p = 0.08) and Hispanic and/or Latino ethnicity (p = 0.015) were significant predictors of increased RTW.

The second model (Adjusted R^2 = .275) evaluated fracture location, adjusting for patient age and ethnicity given previous significant findings. This model found that metacarpal (p = 0.001) and middle phalanx fractures (p = 0.016) were significant predictors of increased RTW, while age (p = 0.017) and ethnicity (p = 0.018) also remained significant. Proximal phalanx fractures did not reach significance as a predictor (p = 0.056), and distal phalanx fractures were not found to be significant.

The third model (Adjusted R^2 = 0.198) evaluated injury characteristics including open fractures, intra-articular fractures, comminuted fractures and amputation injuries, number of fingers injured, again adjusting for age and ethnicity. This model found that intra-articular fractures were a significant predictor of lengthened RTW (p <0.001). Number of fingers fractured was no longer found to be a significant predictor on this analysis.

The fourth model (Adjusted R^2 = 0.279) evaluated clinical management, including any ED procedure, ED revision amputations, any OR procedure, OR reduction and OR revision amputation. This model found that OR revision amputation was a significant predictor of lengthened RTW (p <0.001). Any OR procedure approached significance (p = 0.090) Age and ethnicity remained significant predictors in both these models. These models are detailed in **Tables 5.**

The last model (Adjusted R^2 = 0.329) was a combined model of all predictors previously found to be significant or near significant. This model included age, ethnicity, metacarpal, middle phalanx and proximal phalanx fractures, intra-articular fractures, comminuted fractures, any OR procedure and OR revision amputation. This model found that metacarpal fractures were the strongest predictor of increased RTW (p =

Table 5. Logistic Regression Analysis for Predictors of Lengthened RTW by Predictor Category. All tests conducted at a significance of p <0.05. Only significant or near significantly associated variables are listed in the table. *0 signifies negative presence of a variable.

Model 1: Patient Demographics. Included variables: Age, Ethnicity, Race, Insurance Coverage, Diabetes, Smoking (R^2 = 0.092).					
Predictor	**Odds Ratio**	**Std. Error**	**Sig. (p)**	**95% CI**	
				Lower	**Upper**
Intercept	36.1	54.6	0.5	–72.2	144.5
Age	2.2	1.2	**0.008**	0.8	5.6
Ethnicity (non-Hispanic)	–80.2	32.4	**0.015**	–144.5	–15.8
Model 2: Fracture Location. (Adjusted R^2 = 0.275).					
Predictor	**Odds Ratio**	**Std. Error**	**Sig. (p)**	**95% CI**	
				Lower	**Upper**
Intercept	428.2	111.5	.000	206.7	649.6
MC Fx = 0	–198.0	58.3	**0.001**	–313.9	–82.1
P2 Fx = 0	–118.9	48.4	**0.016**	–215.1	–22.8
P1 Fx = 0	–91.0	47.0	**0.056**	–184.3	2.4
P3 Fx = 0	–63.4	52.4	0.2	–167.5	40.6
Age	2.6	1.1	**0.017**	0.5	4.7
Ethnicity = 0	–72.0	29.9	**0.018**	–131.4	–12.6
Model 3: **Fracture Characteristics**. Included Open, Comminuted Fracture, Intra-articular Fracture, Number of Fingers Injured, Amputation injury. Age Ethnicity. (Adjusted R^2 = 0.198).					
Predictor	**Odds Ratio**	**Std. Error**	**Sig. (p)**	**95% CI**	
				Lower	**Upper**
Intercept	138.3	58.2	0.019	22.8	253.8
Intra-articular Fracture = 0	–131.1	35.2	**<0.001**	–201.0	–61.3
Age	3.2	1.1	**0.004**	1.0	5.5
Ethnicity (non-Hispanic)	–81.1	30.5	**0.009**	–141.6	–20.7
Model 4: Clinical Management. Included ED Procedure, ED Revision Amputation, Any OR Reductions, OR Revision Amputation, Age, Ethnicity (Adjusted R^2 = 0.279)					
Predictor	**Odds Ratio**	**Std. Error**	**Sig. (p)**	**95% CI**	
				Lower	**Upper**
Intercept	219.9	61.3	0.001	98.2	314.7
OR Revision Amputation = 0	–179.5	48.3	**<0.001**	–275.3	–83.7
Age	3.2	1.1	**0.003**	1.1	5.3
Ethnicity (non-Hispanic)	–66.7	29.0	**0.024**	–124.3	–9.1
OR Required = 0	–52.8	30.8	0.090	–113.9	8.3

Table 6. Model Including all Significant Predictors

(Adjusted R^2 = 0.329) *0 signifies negative presence of a variable.

Predictor	Odds Ratio	Std. Error	Sig. (p)	95% CI	
				Lower	Upper
Intercept	503.8	115.6	0.000	273.1	732.4
MC Fx = 0	–172.8	58.0	**0.004**	–287.9	–57.6
Age	2.9	1.0	**0.006**	0.8	4.9
Ethnicity (non-Hispanic)	–67.1	29.1	**0.023**	–124.8	–9.3
OR Revision Amputation = 0	–112.2	52.5	**0.035**	–216.4	–7.9
P2 Fx = 0	–100.2	47.9	**0.039**	–195.3	–5.0
Intra-articular Fx = 0	–72.4	35.7	**0.046**	–143.3	–1.4
P1 Fx = 0	–58.5	46.5	0.2	–150.9	33.9
P3 Fx = 0	–42.4	50.1	0.4	–141.9	57.2
OR Required = 0	–3.5	34.7	0.9	–72.3	65.4

0.004). This was followed by age (p = 0.006), ethnicity (p = 0.023), OR revision amputation (p = 0.035), middle phalanx fractures (p = 0.039) and intra-articular fractures (p = 0.046) were significant positive predictors of lengthened RTW. Comminuted fractures, proximal and distal phalanx fractures and any OR procedures were not significant predictors in this model. This model is detailed in **Table 6.**

DISCUSSION

The hand and fingers have been documented as the most frequent type of work injury presenting to the Emergency Department in the United States.[4] The present study evaluates factors associated with return to work (RTW) following occupational bony crush injuries of the hand. Through a retrospective analysis of 135 patients presenting to the Emergency Department with acute fractures, we found a median RTW of 67.5 days post-injury. On multivariate linear regression analyses, increased age at presentation and Hispanic and Latino ethnicity were consistently found to be significant predictors of lengthened RTW. As many of these patients are manual laborers and with lower socioeconomic backgrounds, these findings highlight not only the burden of such occupational injuries on individuals, but also the disparities among the populations affected.

Patient Demographics

Our patient cohort largely consisted of male patients, a finding consistent with males comprising nearly three quarters of manufacturing and construction sectors from 2021-2023.[17] Additionally, using insurance coverage as a proxy for socioeconomic status, we find that most of our patient cohort possessed public insurance or was uninsured, suggesting that these injuries disproportionally affect those of low income. Notably, Latino and Hispanic patients were found to have significantly higher RTW than non-Latino and Hispanic patients, highlighting potential disparities in injury severity and access to care. This is also consistent with national research demonstrating significant increases of work-related disabilities amongst foreign-born Hispanic workers.[18] This finding is particularly important given the high proportion of Hispanic/Latinx individuals in Rhode Island, comprising 16.6% of the state's population (2020 US Census).[17] This finding must also be put interpreted in the context that Hispanic workers may be more likely to work in dangerous conditions, leading to more severe injury and prolonged RTW.

Furthermore, the majority our patients suffered injuries in an industrial setting, while operating machinery or engaged in manual labor. Occupational hand injuries are more likely to occur in industries such as manufacturing, construction and food preparation.[4] Such blue-collar workers are disproportionally affected by these possibly debilitating injuries, with low-income individuals bearing greater economic consequences from prolonged time away from work.[13]

Interestingly, there was no differences in RTW observed between English speakers compared to those that required an interpreter. However, there was a significantly greater proportion of non-English speakers in the Hispanic patient cohort compared to those with of non-Hispanic ethnicity. Notably, language proficiency was collected from information in the medical chart and may not have accurately reflected the patients' English proficiency. This finding suggests that language barriers may influence patient outcomes, and future research is needed to evaluate its impact on occupational injury and return to work outcomes.

Return-to-Work Durations

A systematic review of prognostic factors related to RTW following occupational hand injuries found that impairment severity and lower pre-injury income were two of the most significant predictors of delayed RTW, underscoring the role of socioeconomic status in occupational injury.[16] This finding suggests that workers from lower-income backgrounds, who may be overrepresented in blue-collar jobs like construction and manufacturing, face unique challenges in post-injury RTW. This may be due to greater injury severity and difficulty navigating comprehensive post-injury care like workers compensation.

One retrospective review found that patients with traumatic soft tissue and nerve injuries to the hand may experience delayed workers compensation resolution before RTW.[19] Our findings reinforce these observations, as patients who received OR revision amputations, who likely faced greater soft tissue damage to the hand, were more likely to have increased RTW times. Prolonged RTW following

occupational hand injuries highlight the difficulties of achieving effective and timely recovery among patients facing severe hand trauma.

Reported RTW timelines vary globally, with one study reporting 38 days as the average RTW time for hand injuries in Australia.[11] In contrast, our US-based study population faced longer RTW times, with a median of 67.5 days, with older patients and those of Latino and Hispanic ethnicity facing even longer RTW durations. This disparity may reflect racial inequities that delay a patient's daily function and subsequent ability to return to full-time employment. It is worth noting, however, that this disparity may also be confounded by fundamentally different approaches to healthcare between the US and Australia.

Fracture Location, Injury Patterns, and Treatment

The distal phalanx (i.e., fingertip) was the most fractured hand structure in the present study. Despite this, our analysis found that metacarpal fractures—comprising 9.6% of the present study's patients—were associated with the greatest increase in RTW duration. The multitude of soft tissue structures, such as nerves, ligaments, and tendons, near the metacarpals may explain the increased RTW duration in metacarpal fractures. Middle phalanx fractures were also observed to associated with increased RTW in our study cohort. This may be similarly explained by its anatomy and the role of the middle phalanx in grip, an important hand function for many manual labor occupations. In contrast, proximal phalanx fractures were not observed to be associated with lengthened RTW, likely attributable to the limited sample size of our cohort. Similarly, comminuted fractures, often indicative of more severe injuries, were not significantly associated with RTW on our analysis. Larger cohort studies are required to clarify the role of comminuted and proximal phalanx fractures on RTW outcomes.

Interestingly, open fractures were not associated with increased RTW in the present study. This finding may be attributed to most of the present study's fractures being described as open, consistent with high impact crush injury mechanisms that result in both soft tissue and bony injury. These results suggesting that soft tissue injury may not be a core factor in recovery outcomes.

Our study also finds intra-articular fractures, suggestive of more severe and complex injuries, were associated with increased RTW. A study by Yamamoto et al out of rural Japan found that 76.6% of patients were able to return to work after 150 days following traumatic hand/forearm injury.[20] This study found that increased injury severity and female sex were associated with delay in RTW. While our study did not replicate the finding of lengthened RTW in female patients, the correlation of injury severity with longer RTW is supported.

When comparing the difference in RTW between injuries of the dominant versus non-dominant hand, the present study found no difference. This is consistent with studies from Shi et al and Bear-Lehman et al., both of which reported similar conclusions.[16,21] It suggests that hand dominance may not be as critical of a factor in determining RTW after occupational hand injuries. This result highlights that the extent of functional impairment and hand function—fine motor skills, sensation, and grip strength—may have stronger correlations with recovery times than the patient's dominant or non-dominant hand. Occupational tasks require precision and dexterity independent of the impacted hand. As a result, injury severity and its impact on the patient's ability to perform occupational tasks may outweigh the contribution of hand dominance in determining RTW. In terms of treatment, over one-third of patients required surgical intervention, with amputation revisions found to be significantly associated with lengthened RTW duration. This finding is consistent with increased injury severity as a predictor of prolonged recovery and subsequent return to work.

Limitations

This study is limited by the retrospective nature, with data collection and return to work (RTW) dates gathered through chart review limited by prior documentation. In turn, RTW dates used in the study were not confirmed by patients and may not precisely reflect real life circumstances. Study power and generalizability are decreased due to the single-center study design and limited patient cohort and follow-up. This small patient cohort was associated with a broad range in RTW times, which limits conclusions that may be drawn from this data. Furthermore, the study does not account for potential biases and social determinants, such as how Hispanic individuals may be more likely to work in more hazardous work environments. Future studies may address these limitations through a multi-center, prospective or cross-sectional study design with larger study cohorts.

CONCLUSION

Overall, we find that occupational crush injury-related fractures of the hand result in prolonged RTW periods, often spanning several months or longer. Several factors impact recovery time and subsequently result in delayed RTW. These include may include older fractures to the metacarpals, middle phalanx fractures, intra-articular fractures and injuries requiring operative intervention. With such crush injuries disproportionately affecting manual laborers in the manufacturing and construction sectors, these findings underscore the importance of ensuring equitable access to quality and timely care for these patients to improve recovery times, reduce time out of work and alleviate individual burden.

References

1. Dias JJ, Garcia-Elias M. Hand injury costs. Injury. 2006/11/01/2006; 37(11):1071-1077. doi:https://doi.org/10.1016/j.injury.2006.07.023
2. Izadi N, Jamshidi S, Mehrdad R, Nasibi E. Predictors of return to work in patients with occupational hand injury. Hand Surgery and Rehabilitation. 2020/05/01/ 2020;39(3):218-222. doi:https://doi.org/10.1016/j.hansur.2020.01.009
3. Chen Y-H, Lin H-T, Lin Y-T, et al. Self-perceived health and return to work following work-related hand injury. Occupational Medicine. 2012;62(4):295-297. doi:10.1093/occmed/kqr215
4. Sorock GS, Lombardi DA, Hauser RB, Eisen EA, Herrick RF, Mittleman MA. Acute traumatic occupational hand injuries: type, location, and severity. Journal of occupational and environmental medicine. 2002;44(4):345-351.
5. Goodman AD, Got CJ, Weiss A-PC. Crush injuries of the hand. The Journal of hand surgery. 2017;42(6):456-463.
6. Lahiri A. Guidelines for management of crush injuries of the hand. Journal of clinical orthopaedics and trauma. 2020;11(4):517-522. doi:10.1016/j.jcot.2020.03.028
7. Moellhoff N, Throner V, Frank K, et al. Epidemiology of hand injuries that presented to a tertiary care facility in Germany: a study including 435 patients. Arch Orthop Trauma Surg. Mar 2023;143(3):1715-1724. doi:10.1007/s00402-022-04617-9
8. Che Daud AZ, Yau MK, Barnett F, Judd J, Jones RE, Muhammad Nawawi RF. Integration of occupation based intervention in hand injury rehabilitation: A Randomized Controlled Trial. Journal of Hand Therapy. 2016/01/01/ 2016;29(1):30-40. doi:https://doi.org/10.1016/j.jht.2015.09.004
9. Robinson LSB, Sarkies MB, Brown T, O'Brien L. Direct, indirect and intangible costs of acute hand and wrist injuries: A systematic review. Injury. 2016;47(12):2614-2626. doi:10.1016/j.injury.2016.09.041
10. Baker LC, Krueger AB. Medical costs in workers' compensation insurance. Journal of Health Economics. 1995/12/01/ 1995; 14(5):531-549. doi:https://doi.org/10.1016/0167-6296(95)00020-8
11. Roesler ML, Glendon AI, O'Callaghan FV. Recovering from traumatic occupational hand injury following surgery: a biopsychosocial perspective. Journal of Occupational Rehabilitation. 2013;23:536-546.
12. Leigh JP, Markowitz SB, Fahs M, Shin C, Landrigan PJ. Occupational injury and illness in the United States: estimates of costs, morbidity, and mortality. Archives of internal medicine. 1997;157(14):1557-1568.
13. Lilley R, Davie G, Ameratunga S, Derrett S. Factors predicting work status 3 months after injury: results from the Prospective Outcomes of Injury Study. BMJ Open. 2012;2(2):e000400. doi:10.1136/bmjopen-2011-000400
14. Larsson TJ, Björnstig U. Persistent Medical Problems and Permanent Impairment Five Years after Occupational Injury. Scandinavian Journal of Social Medicine. 1995;23(2):121-128. doi:10.1177/140349489502300207
15. Wenzinger E, Rivera-Barrios A, Gonzalez G, Herrera F. Trends in Upper Extremity Injuries Presenting to US Emergency Departments. Hand (New York, NY). 2019;14(3):408-412. doi:10.1177/1558944717735943
16. Shi QMDM, Sinden KMCK, MacDermid JCPTP, Walton DPTP, Grewal RMDM. A systematic review of prognostic factors for return to work following work-related traumatic hand injury. Journal of Hand Therapy. 2014;27(1):55-62. doi:10.1016/j.jht.2013.10.001
17. Bureau USC. US Census Bureau's QWI Explorer. Accessed Nov 8, 2024, https://qwiexplorer.ces.census.gov/
18. Seabury SA, Terp S, Boden LI. Racial And Ethnic Differences In The Frequency Of Workplace Injuries And Prevalence Of Work-Related Disability. Health Aff (Millwood). Feb 1 2017;36(2):266-273. doi:10.1377/hlthaff.2016.1185
19. Gray A, Young C. Effects of Injury Pattern and Treatment on Case Length and Disposition for Hand Injuries Treated Under a Workers' Compensation Claim. Hand. 2022;17(6):1228-1235.
20. Yamamoto K, Motomiya M, Ono K, Matsui Y, Yasui K, Iwasaki N. Initial patient demographics affecting return to original work after traumatic hand injury in a rural area in Japan: A retrospective single-center study. Journal of Orthopaedic Science. 2024;29(5):1280-1286. doi:10.1016/j.jos.2023.09.002
21. Bear-Lehman J. Factors affecting return to work after hand injury. The American Journal of Occupational Therapy. 1983;37(3): 189-194.

Authors

Margaret R. Wang, BS, Medical Student, Department of Plastic Surgery, Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Timothy Jeng, BA, Medical Student, Department of Plastic Surgery, Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Ishan Shah, BS, Medical Student, Department of Plastic Surgery, Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Nikhil Sobti, MD, Plastic Surgery Resident, Department of Plastic Surgery, Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Ernest Dimbo, MPhil, Medical Student, Department of Plastic Surgery, Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Matthew Lee, BA, Medical Student, Department of Plastic Surgery, Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Reena A. Bhatt, MD, Division Chief of Hand Surgery, Department of Plastic Surgery, Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Disclosures

Conflict of Interest Statement: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statement of Funding: No funding was received for this study from any sources.

Ethics Statement: Ethical approval to report this submission was obtained from the Brown University Health Institutional Review Board (IRB # 1683478).

Disclaimer: The views expressed herein are those of the authors and do not necessarily reflect the views of Brown University or Brown University Health.

Correspondence

Margaret Wang, BS
222 Richmond St
Providence, RI, 02903
647-886-7095
margaret_wang1@brown.edu

Academic Productivity of American Shoulder and Elbow Surgeons Fellowship Programs and Affiliated Faculty

PETER BOUFADEL, MD; JAD LAWAND, BS; TARISHI PARMAR, BS; MOHAMMAD DAHER, BS; MOHAMAD Y. FARES, MD ; ADAM Z. KHAN, MD; JOHN G. HORNEFF 3RD, MD; JOSEPH A. ABBOUD, MD

ABSTRACT

BACKGROUND: Academic productivity is an important factor in determining career success and institutional ranking. The Hirsch-index (h-index) is a validated measure that assesses both quantity and quality of research output. The aim was to explore factors associated with increased academic productivity among American Shoulder and Elbow Surgeons(ASES)-recognized fellowship programs and faculty.

METHODS: Shoulder and elbow surgery fellowship programs and affiliated faculty were identified via the ASES website, searched on December 6, 2023. Program-specific and faculty-specific characteristics were recorded. The h-index and total publication number were used as metrics and determined for each faculty member using the Scopus database.

RESULTS: A total of 156 faculty members from 34 ASES fellowship programs were included, of which 96.2% were male, 77.6% academically affiliated, and 81.4% completed a shoulder and elbow surgery fellowship. The average years in practice was 18.3 years. The average h-index and total publications per fellowship program were 24.9(SD 12.5, IQR 16.6–33) and 520.3 (SD 458.8, IQR 181–649), respectively. Academic affiliation and faculty number were significant factors associated with increased h-index and total publications of a program. The average h-index and total publications per faculty member were 26.9 (SD 22.7, IQR 9.5–38.5) and 125.4(SD 145.4, IQR 26–169), respectively. Academic title of Professor, years in practice, and research staff were independent factors associated with faculty member productivity.

CONCLUSION: ASES-recognized fellowship programs and affiliated faculty demonstrated a high level of academic productivity. This information can help shoulder and elbow surgeons benchmark and further improve their research output and academic influence.

KEYWORDS: Academic productivity; shoulder and elbow surgery; research; h-index; fellowship

INTRODUCTION

Academic productivity continues to be strongly emphasized in the field of orthopedic surgery. In addition to clinical service and education, research productivity is a major factor in determining career success, institutional ranking, and eligibility for promotion for surgeon physicians.[1,2] As many orthopedic programs emphasize and strive for academic excellence, research productivity can also play an important role in faculty recruitment.[1,3,4] The cumulative productivity of faculty members within a program, which contributes to the overall reputation of a program, may also influence a candidate's choice of fellowship training.[5] Thus, an objective metric is necessary to quantify research productivity.

While several metrics exist to measure academic productivity, including total publications, total citations, publication type, journal impact factor, and grant funding, an accepted metric that assesses both quantity and quality of research output is the Hirsch index (h-index).[1,2,6] The h-index is defined as the number of publications (h) with at least h number of citations.[6] Hence, an author with an h-index of 4 has four publications that have been cited at least four times each. The h-index has been adopted and used as a benchmarking tool in academic medicine,[7-10] and in the field of orthopedics research, including sports medicine, spine, adult joint reconstruction, and hand surgery subspecialties.[2,11-13]

Within the field of shoulder and elbow surgery, Cope et al previously explored factors influencing academic productivity among fellowship programs and determined that the most important factors were the total number of years of experience of faculty in a fellowship program as well as medical school affiliation.[14] However, in their study, the authors only included publications between 2010 and 2014, assessed factors associated with productivity of fellowship programs and not that of the individual faculty members, and used total number of citations as the metric to measure academic productivity.[14] With the significance of academic productivity for both surgeon physicians and programs, the aim of our study is to characterize and explore factors associated with increased academic productivity among American Shoulder and Elbow Surgeons (ASES) recognized fellowship programs and affiliated faculty, using h-index and total number of publications as metrics.

METHODS

Study Design

Shoulder and elbow surgeons who are active participating full-time members within ASES-recognized shoulder and elbow fellowship programs were included in this study. A comprehensive list of current fellowship programs and faculty members was compiled via the ASES website (https://www.ases-assn.org/shoulder-and-elbow-fellowships/) searched on December 6, 2023. Each faculty member was searched individually to confirm their active association with the specific institution and fellowship program.

Independent Study Variables (Predictors)

Program-specific characteristics were collected from the respective website of each program, including academic affiliation, number of faculty members, number of fellows, clinical fellow research requirement, availability of a dedicated research staff, and region. Programs were categorized as academic-affiliated if their institution was associated with a medical school. Number of faculty members was categorized into three groups: 1–3, 4–5, and >5. Programs were assigned a region based on the US Census Bureau classification: West, Midwest, South, and Northeast.

Faculty-specific characteristics were collected using physician profiles on departmental websites or via publicly available websites, including gender, clinical fellowship training, academic title, departmental position, and years in practice. Academic title was comprised of four categories: Assistant Professor, Associate Professor, Professor, and Clinical Instructor. Faculty members were recorded as a Clinical Instructor if they were not affiliated with an academic program. Departmental positions included positions such as Fellowship Director/Co-director and Chairman of the Department of Orthopaedics. Years in practice was calculated from last year of fellowship or residency to the year 2023. Program-specific characteristics were also assigned to each faculty member based on their associated institution and program in order to account for factors related to the program in the analysis.

Dependent Study Variables (Outcomes)

The Scopus database (Elsevier B.V., Amsterdam, Netherlands) was queried to collect the h-index, total number of publications, and total number of citations of each faculty member, and calculate the mean h-index and collective total number of publications for each fellowship program. Publications with more than one faculty member as an author were counted only once to avoid repetition when determining the collective total number of unique publications of each program. All searches were performed and completed in December 2023. The primary outcomes were mean h-index and mean number of publications.

Statistical Analysis

The mean, standard deviation, median, and interquartile range (IQR) of both the h-index and the number of publications were calculated for programs and faculty members. Univariate analysis of each program- and faculty-specific characteristic was performed using a two-tailed Student t-test for two-group comparisons and analysis of variance (ANOVA) for between-group comparisons of three or more subgroups. Variables with a p-value <.05 were included in the multivariate model, and a multivariate regression analysis was performed to identify statistically significant independent predictors of h-index and total number of publications for a program and faculty member. A p-value of <.05 determined significance. Statistical analyses were performed using Stata statistical software, Release 14.1 (StataCorp LLC, College Station, TX).

RESULTS

Program and Faculty Characteristics

Thirty-four shoulder and elbow fellowship programs were identified [**Table 1**]. Twenty-three (68%) had an academic

Table 1. Program Characteristics

Characteristic	N (%)
Academic Affiliation	
Yes	23 (67.7)
No	11 (32.3)
Number of Faculty Members	
1–3	13 (38.2)
4–5	11 (32.2)
>5	10 (29.4)
Number of Fellows	
1	24 (70.6)
2	8 (23.5)
3	1 (2.9)
4	1 (2.9)
Fellow Research Requirement	
Yes	26 (76.5)
No	8 (23.5)
Dedicated Research Staff	
Yes	21 (61.8)
No	13 (38.2)
Region	
Northeast	12 (35.3)
Southeast	5 (14.7)
Midwest	7 (20.6)
West	8 (23.5)
Southwest	2 (5.9)

Table 2. Faculty Characteristics

Characteristic	N (%)
Academic Affiliation	
Yes	121 (77.6)
No	35 (22.4)
Gender	
Male	150 (96.2)
Female	6 (3.8)
Shoulder and Elbow Fellowship trained	
Yes	127 (81.4)
No	29 (18.6)
Second Fellowship	
Sports Medicine	23 (19.0)
Hands	10 (8.3)
Trauma	3 (2.5)
Academic Title	
Assistant Professor	25 (16.0)
Associate Professor	28 (17.9)
Professor	55 (35.3)
Clinical Instructor	48 (30.8)
Departmental Position	
Yes	46 (29.5)
No	110 (70.5)
Years in Practice	
Mean	18.3
Standard deviation	11.1
Range	1, 49

Table 3. Mean h-index and total publications per fellowship program on univariate analysis

Characteristic	H-Index				Total Publications			
	Mean	SD	IQR	p-value	Mean	SD	IQR	p-value
Total Overall	24.9	12.5	16.6–33		520.3	458.8	181–649	
Academic Affiliation*								
Yes	30.6	10.6	24.8–34.8	<0.001	674.3	473.1	298–897	**0.002**
No	13.1	6.2	6.7–18.6		198.2	182.9	60–391	
Number of Faculty*								
1–3	18.5	9.3	11–26	**0.044**	197.5	147.1	108–283	**0.001**
4–5	30.6	12.9	20.5–38		614	474.5	298–741	
>5	27.1	12.9	18.4–33		836.8	469.2	504–1253	
Number of Fellows								
1	23.0	13.8	13.1–30.2	0.312	441.5	468.6	109–637	0.306
2	30.9	7.2	26.4–33.9		698.8	355.1	437–975	
>2	24.4	8.2	18.6–30.2		751.5	709.2	250–1253	
Fellow Research Requirement								
Yes	27.5	12.4	18.6–34	**0.015**	599	489.3	203–867	**0.035**
No	16.6	9.2	9.1–21.6		264.4	198.2	89–447.5	
Research Staff								
Yes	27.9	12.9	18.6–34	**0.037**	625.8	525.4	203–897	**0.044**
No	20.1	10.6	9.7–28.7		349.8	260.4	94–630	
Region								
Northeast	28.4	12.3	20.7–36.4	0.198	634.3	500.8	243–1075	0.521
Southeast	20.3	8.4	18.4–19.7		331	197.1	184–391	
Midwest	31.0	16.0	16.7–44.2		636.1	656.2	110–1208	
West	17.7	9.9	7.6–27.6		340.5	319.0	72–560	
Southwest	23.3	6.7	18.5–28		622.5	167.6	504–741	

SD, Standard deviation; IQR, Interquartile range.
P-values in bold indicate significance in the univariate analysis.
* Factors that were significantly associated with increased mean h-index and total number of publications in the multivariate analysis.

affiliation with a medical school. The number of faculty members varied across programs: 13 (38%) had one to three faculty members, 11 (32%) had four to five, and 10 (30%) had more than five members. A total of 47 fellowship positions were available at the 34 programs, with 24 programs (71%) offering a position for one fellow, and 8 (24%) offering positions for two fellows. Twenty-six (77%) had a research requirement for fellows, and 21 (62%) had a dedicated research staff. The majority of fellowship programs were in the Northeast (35.3%), followed by the West (23.5%) and Midwest (20.6%).

Within the 34 fellowship programs, a total of 156 faculty members were identified [**Table 2**]. The majority of faculty members were at academic programs (n=121, 78%) and were male (n=150, 96%). One hundred and twenty-seven (81%) faculty members were shoulder and elbow fellowship trained, of which 35 completed an additional fellowship in sports medicine (n=23), hand (n=10), or trauma (n=5). Of note, one faculty member completed three fellowships in shoulder and elbow, sports medicine, and hand. With regards to academic title, 16% were Assistant Professors, 18% were Associate Professors, 35% were Professors, and 31% were Clinical Instructors. Forty-six (29.5%) held departmental positions. The mean years in practice was 18.3 ± 11.1 (median 17; range, 1–49 years).

Academic Productivity of Programs and Faculty

The average collective number of total publications of all faculty members in a program was 520.3 ± 458.8 (median 391; IQR, 181–649), and the average h-index per fellowship program was 24.9 ± 12.5 (median 25.4; IQR, 16.6–33) [**Table 3**]. The average number of publications per faculty member was 125.4 ± 145.4 (median 74; IQR, 26–169); the average h-index was 26.9 ± 22.7 (median 21; IQR, 9.5–38.5); and the average number of citations was 4291.9 ± 7092.7 (median 1567; IQR, 421.5–5061.5) [**Table 4**].

Table 4. Mean h-index and total publications per fellowship-associated faculty member on univariate analysis

Characteristic	H–Index				Total Publications			
	Mean	SD	IQR	p–value	Mean	SD	IQR	p–value
Total Overall	26.9	22.7	9.5–38.5		125.4	145.4	26–169	
Academic Affiliation								
Yes	30.4	23.3	14–42	**<0.001**	147.4	153.9	41–209	**<0.001**
No	14.6	15.3	4–16		49.2	71.3	7–50	
Gender								
Male	27.0	22.9	10–38	0.310	126.0	146.1	26–166	0.285
Female	22.3	19.1	9–42		108.7	137.8	25–179	
Shoulder and Elbow Fellowship Trained								
Yes	25.8	21.0	10–38	0.877	119.9	127.5	27–164	0.837
No	31.3	29.2	7–47		149.3	207.5	17–187	
Academic Title*								
Professor	42.3	23.7	23–59	**<0.001**	221.4	175.3	85–310	**<0.001**
Associate Professor	25.4	12.3	17–31.5		116.9	80.5	52–173	
Assistant Professor	17.1	24.0	5–20		70.2	126.6	17–74	
Clinical Instructor	15.0	14.0	5.5–19		48.9	63.6	7.5–60	
Departmental Position								
Yes	31.6	23.1	16–42	**0.045**	143.5	137.7	43–182	0.157
No	24.9	23.1	6–34		117.7	148.4	20–162	
Fellow Research Requirement								
Yes	30.3	23.6	12–42	**<0.001**	152.0	157.7	41–220	**<0.001**
No	17.5	17.0	7–21		52.9	63.5	10–62	
Research Staff*								
Yes	30.4	22.9	14–42	**0.005**	150.2	156.5	38–220	**0.002**
No	20.7	21.2	6–24		82.2	112.5	18–88	
Region								
Northeast	32.5	23.3	16–43	**0.008**	150.0	137.4	58–213	**0.044**
Southeast	19.1	15.2	6–25		87.6	87.6	25–135	
Midwest	33.2	22.8	17–44		170.4	192.4	49–209	
West	18.7	18.0	5–24		88.3	117.4	8–102	
Southwest	21.4	29.0	5–21.4		77.8	157.6	8–66.5	

SD, Standard deviation; IQR, Interquartile range.
P-values in bold indicate significance in the univariate analysis.
* Factors that were significantly associated with increased mean h-index and total number of publications in the multivariate analysis.

Factors Associated with Increased Productivity of Fellowship Programs

On univariate analysis, academic affiliation (p<0.001), number of faculty members (p=0.044), fellow research requirement (p=0.015), and research staff (p=0.037) were significantly associated with increased mean h-index for a program [**Table 3**]. However, on multivariate analysis, only academic affiliation (regression coefficient [RC] 14.1, 95% CI 6.8–21.6, p=0.001) and number of faculty members (>5 vs. 1–3: RC 8.2, 95% CI 0.8–15.5, p=0.030; 4–5 vs. 1–3: RC 11.5, 95% CI 4.3–18.7, p=0.003) remained significant and were independent predictors for increased mean h-index for fellowship programs (R2=0.62) [**Table 5**].

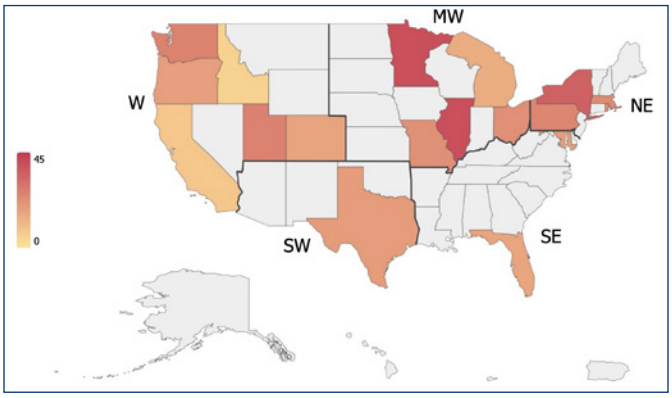
Similarly, when assessing factors associated with increased total number of publications for a program, academic affiliation (p=0.002), number of faculty members (p=0.001), fellow research requirement (p=0.035), and research staff (p=0.044) were significant [**Table 3**]. On multivariate analysis, academic affiliation (RC 295.3, 95% CI 25.5–565.0, p=0.033) and number of faculty members (>5 vs. 1–3: RC 658.2, 95% CI 390.6–925.7, p<0.001; 4–5 vs. 1–3: RC 433.9, 95% CI 172.2–695.5, p=0.002) were found to be independent predictors for increased total publications (R2=0.63) [**Table 5**]. Number of fellows and region had no significant effect on mean h-index and total publications.

Factors Associated with Increased Productivity of Faculty Members

On univariate analysis, academic affiliation (p<0.001), academic title (p<0.001), departmental position (p=0.045), fellow research requirement (p<0.001), research staff (p=0.004), region (p=0.008), and years in practice (p<0.001) were significantly associated with increased mean h-index per faculty member [**Table 4**]. The distribution of the average h-index of faculty members across U.S. states and region is displayed in **Figure 1**. However, on multivariate analysis, only academic title (Professor vs. Clinical Instructor: RC 18.9, 95% CI 5.3–32.4, p=0.007), years in practice (RC 0.7, 95% CI 0.4–1.0, p<0.001), and research staff (RC 7.6, 95% CI 0.3–14.9, p=0.041) remained significant and were independent predictors for increased mean h-index (R2=0.42) [**Table 5**].

Similar findings were shown for mean total publications per faculty on univariate and multivariate regression models. Academic affiliation (p<0.001), academic title (p<0.001), fellow research requirement (p<0.001), research staff (p=0.002), region (p=0.044), and years in practice (p<0.001) were significantly associated with increased mean total publications per faculty member on univariate analysis [**Table 4**]. Academic title (Professor vs. Clinical Instructor: RC 127.8, 95% CI 37–218.5, p=0.006),

Figure 1. Distribution of the average h-index of faculty members across U.S. states and regions



years in practice (RC 2.9, 95% CI 0.9–4.9, p=0.005), and research staff (RC 55.6, 95% CI 6.2–105.1, p=0.028) were significant on multivariate analysis and were independent predictors for increased mean total publications (R2=0.34) [**Table 5**]. Gender, Shoulder and Elbow fellowship training, and second fellowship training had no significant effect on mean h-index and total publications for faculty members.

Table 5. Significant factors associated with increased mean h-index and total number of publications for programs and faculty on multivariate analysis

Predictor	H-index		Total Publications	
	p-value	RC (95% CI)	p-value	RC (95% CI)
Program				
Academic Affiliation	0.001	14.1 (6.8–21.6)	0.033	295.3 (25.5–565.0)
Number of Faculty				
4–5	0.003	11.5 (4.3–18.7)	0.002	433.9 (172.2–695.5)
>5	0.030	8.2 (0.8–15.5)	<0.001	658.2 (390.6–925.7)
Faculty				
Research Staff	0.041	7.6 (0.3–14.9)	0.028	55.6 (6.2–105.1)
Academic Title				
Professor	0.007	18.9 (5.3–32.4)	0.006	127.8 (37–218.5)
Years in Practice	<0.001	0.7 (0.4–1.0)	0.005	2.9 (0.9–4.9)

RC, Regression coefficient; CI, confidence interval.

DISCUSSION

As many orthopedic programs emphasize and strive for academic excellence, research productivity has become an important factor in determining career success, institutional ranking, promotion or hire for surgeon physicians, and recruitment of applicants interested in shoulder and elbow fellowship. This study aims to describe the academic productivity within the field of shoulder and elbow surgery, and identify factors associated with increased research output and impact using the h-index as a metric. The h-index is an extensively studied and validated measure of academic productivity that accounts for both quantity and quality.[15]

Our study found that shoulder and elbow surgeons associated with ASES-recognized fellowship programs displayed a high level of academic productivity, that was, in fact, superior to fellowship-associated faculty of other orthopedic subspecialties. Our findings showed a mean h-index of 26.9 and a mean number of publications of 125.4 among 156 fellowship-associated shoulder and elbow faculty. In comparison, the average h-index and average number of publications were 22.8 and 80.1 among 310 fellowship-associated spine surgeons,[16] 12.8 and 50.1 among 375 fellowship-associated adult joint reconstructive surgeons,[2] and 10.2 and 44 among 366 fellowship-associated hand surgeons.[12] The mean faculty years in practice in these studies were 17.2, 17.7, and 17, respectively,[2,12,16] which was comparable to the 18.3 years of shoulder and elbow faculty in our study. In addition, 689 fellowship-associated sports medicine faculty and 247 musculoskeletal tumor faculty had average h-indexes of 15.02 and 12.8, respectively.[5,17] However, the cohort size of faculty members in this study was less than that of other studies in different subspecialties; this lower cohort size may have resulted in a higher mean productivity. The median h-index and number of publications were 21 and 74, respectively, which may be more representative of the academic productivity of shoulder and elbow surgeons, as the mean may be skewed by surgeons who are exceptionally productive.

While this study is the first to utilize h-index as a measure of academic productivity in the field of shoulder and elbow surgery, few studies have explored this topic using alternative measures. Cope et al investigated factors associated with publication impact among ASES-recognized fellowship programs using citation frequency of publications between the years 2010–2014 as the outcome measure.[14] The authors found that both total years of faculty experience in a fellowship program and medical school affiliation were independent factors associated with increased total citations, which was in parallel with findings of our study using the h-index.[14] However, their study included only 28 programs and 84 surgeons, which was less than the 32 programs and 156 surgeons of our study.[14] Sudah et al also performed a study assessing the academic productivity of ASES fellowship faculty using a novel metric developed by the National Institutes of Health (NIH) known as the relative citation ratio (RCR).[18] The RCR aims to measure overall research impact and can be defined as the total number of citations per year of a publication divided by the average number of citations

per year received by NIH-funded papers in the same field.[18] The authors demonstrated that the 145 ASES fellowship faculty members of 33 programs produced highly impactful research with a median RCR of 1.8 relative to the standard NIH RCR value of 1.0, and a median weighted RCR of 67.0 representing high overall research productivity.[18] Longer career duration and academic rank both had a significant effect on the weighted RCR score, suggesting that faculty with more experience have greater overall research productivity and impact, in line with findings of our study.[18]

Assessing the overall academic productivity of ASES fellowship programs, the mean h-index and total number of publications per program were found to be 24.9 and 520.3, respectively, and academic affiliation and higher number of faculty were identified as independent factors associated with increased mean h-index and total publications of a program [**Table 5**]. The association between increased productivity and fellowship program affiliation with a medical school appears intuitive as surgeons at these programs often have a heightened interest in conducting research and contributing to the field. To add to that, these programs may have the appropriate research infrastructure as well as greater resources and personnel available to dedicate to research. Programs with a greater number of faculty members also had an expectedly higher research output and impact. However, a greater number of fellows did not have a significant effect. While not significant in the multivariate analysis, programs with a research requirement for fellows and the presence of a research staff had a higher mean h-index and total number of publications.

With regard to factors influencing the academic productivity of fellowship-associated shoulder and elbow surgeons, the academic rank of "Professor", increased years in practice, and the presence of research staff were found to be independent factors associated with increased h-index and total publication number of faculty members [**Table 5**]. The increased productivity observed among professors and those with more years in practice can be attributed to their accumulated experience and the extended duration available to generate publications with a higher number of article citations. In their study, Sudah et al also found that full professors were the most productive subgroup.[18] Interestingly, the availability of research staff in the form of research coordinators or fellows was a significant factor for faculty member productivity, but not for the overall productivity of a program. This could be elucidated by the fact that research staff often work directly with specific faculty members rather than with every member within a program.

Moreover, financial research support is another important factor that has been shown to influence surgeon research productivity. Haislup et al evaluated the relationship between academic influence, industry payments, and NIH funding among ASES fellowship faculty.[19] The authors found that NIH funding highly correlated with increased research productivity, with surgeons with NIH funding having a significantly greater h-index and total number of publications.[19] Although industry research payments was not associated with increased h-index, surgeons had a significantly greater total number of publications, suggesting that industry research funding may increase quantity but not necessarily research influence.[19] Industry non-research payments were not significantly associated with h-index or total publication number.[19]

On the other hand, although not significant in the multivariate analysis, numerous factors including male gender, academic affiliation, departmental position, fellow research requirement, and region were found to result in an increased mean h-index and total number of publications among faculty members [**Table 4**]. Males have been shown to outnumber females at every academic rank, and as a result, outproduce females in research output.[17] In our study, only 3.8% of fellowship-associated faculty members were females, highlighting a significant under-representation of women in ASES-recognized shoulder and elbow fellowship programs. Faculty members in the Northeast and Midwest regions had higher average h-indexes and total publications than other US regions, as shown in **Table 4**.

Furthermore, while faculty members who did not undergo a formal shoulder and elbow fellowship training had a higher mean h-index and total number of publications than those that did, this finding was also not statistically significant [**Table 4**]. This increase may be attributed to the historical rarity of conducting a fellowship following residency graduation for certain faculty members, as well as faculty with fellowship training in other orthopedic subspecialties, resulting in publications unrelated to shoulder and elbow surgery. In addition, among faculty members that underwent formal shoulder and elbow fellowship training, undertaking a second fellowship in another orthopedic subspeciality was not found to significantly affect academic productivity [**Table 4**].

Our study has limitations. First, while the h-index is a robust predictor metric of research impact, it is not the only metric by which academic productivity can be measured. The h-index heavily relies on the number of citations, irrespective of their context or quality, and can thus be confounded by self-citations as well as limited by a discipline's citation potential. Additional limitations of the h-index include the inability to consider author order number, the lack of sensitivity to publication recency, and bias towards established researchers with longer research activity. Second, our study cohort included only ASES-recognized fellowship faculty members, and hence our findings may not be generalizable to the entire field of shoulder and elbow surgery. Some faculty members may have academic interests outside of shoulder and elbow in other orthopedic subspecialties. Data collected from the ASES website and program-specific websites may change over time as well. While the SCOPUS database has an extensive Medline coverage and provides abundant publication data, some articles may be wrongly attributed to authors with similar or the same name as the actual author.

CONCLUSION

Shoulder and elbow surgeons affiliated with ASES-recognized fellowship programs displayed a high level of academic productivity, with a mean h-index of 26.9 and a mean total number of publications of 125.4. Factors associated with increased academic productivity of a faculty member included academic title of Professor, increased years in practice, and the presence of a research staff. The collective average h-index and total number of publications for a fellowship program was 24.9 and 520.3, respectively, and academic affiliation and increased number of faculty members were found to significantly increase research productivity. Understanding the academic productivity within the field of shoulder and elbow surgery, along with the contributing factors, allows fellowship programs and surgeons to benchmark their research performance and pursue enhanced productivity.

References

1. Ence AK, Cope SR, Holliday EB, Somerson JS. Publication Productivity and Experience: Factors Associated with Academic Rank Among Orthopaedic Surgery Faculty in the United States. JBJS. 2016;98(10):e41. doi:10.2106/JBJS.15.00757
2. Khan AZ, Kelley B V., Patel AD, McAllister DR, Leong NL. Academic productivity among fellowship associated adult total joint reconstruction surgeons. Arthroplasty Today. 2017;3(4):298-302. doi:10.1016/j.artd.2017.05.007
3. Gast KM, Kuzon WM, Waljee JF. Bibliometric Indices and Academic Promotion within Plastic Surgery. Plast Reconstr Surg. 2014;134(5):838e-844e. doi:10.1097/PRS.0000000000000594
4. Stidham RW, Sauder K, Higgins PDR. Using Bibliometrics to Advance Your Academic Career. Gastroenterology. 2012;143(3):520-523. doi:10.1053/j.gastro.2012.07.024
5. Mayfield CK, Bolia IK, Ihn H, et al. Evaluation of Sports Medicine Fellowships in the United States Based on Academic Productivity. J Am Acad Orthop Surg Glob Res Rev. 2021;5(10):1-7. doi:10.5435/JAAOSGlobal-D-21-00165
6. Hirsch JE. An index to quantify an individual's scientific research output. Proc Natl Acad Sci U S A. 2005;102(46):16569-16572. doi:10.1073/pnas.0507655102
7. Eloy JA, Svider P, Chandrasekhar SS, et al. Gender disparities in scholarly productivity within academic otolaryngology departments. Otolaryngol–Head Neck Surg Off J Am Acad Otolaryngol-Head Neck Surg. 2013;148(2):215-222. doi:10.1177/0194599812466055
8. Gast KM, Kuzon WM, Adelman EE, Waljee JF. Influence of training institution on academic affiliation and productivity among plastic surgery faculty in the United States. Plast Reconstr Surg. 2014;134(3):570-578. doi:10.1097/PRS.0000000000000476
9. Lee J, Kraus KL, Couldwell WT. Use of the h index in neurosurgery. Clinical article. J Neurosurg. 2009;111(2):387-392. doi:10.3171/2008.10.JNS08978
10. Paik AM, Mady LJ, Villanueva NL, et al. Research productivity and gender disparities: a look at academic plastic surgery. J Surg Educ. 2014;71(4):593-600. doi:10.1016/j.jsurg.2014.01.010
11. Schoenfeld AJ, Bhalla A, George J, Harris MB, Bono CM. Academic productivity and contributions to the literature among spine surgery fellowship faculty. Spine J Off J North Am Spine Soc. 2015;15(10):2126-2131. doi:10.1016/j.spinee.2015.03.026
12. Lopez J, Susarla SM, Swanson EW, Calotta N, Lifchez SD. The Association of the H-Index and Academic Rank Among Full-Time Academic Hand Surgeons Affiliated With Fellowship Programs. J Hand Surg. 2015;40(7):1434-1441. doi:10.1016/j.jhsa.2015.03.026
13. Makhni EC, Buza JA, Byram I, Ahmad CS. Academic characteristics of orthopedic team physicians affiliated with high school, collegiate, and professional teams. Am J Orthop Belle Mead NJ. 2015;44(11):510-514.
14. Cope SR, Holliday EB, Somerson JS. Factors Associated With Publication Impact at Shoulder and Elbow Surgery Fellowships. J Surg Educ. 2017;74(5):883-888. doi:10.1016/j.jsurg.2017.02.008
15. Bastian S, Ippolito JA, Lopez SA, Eloy JA, Beebe KS. The Use of the h-Index in Academic Orthopaedic Surgery. J Bone Jt Surg. 2017;99(4):e14. doi:10.2106/JBJS.15.01354
16. Lambrechts MJ, Heard JC, Lee YA, et al. Predictors of Academic Productivity Among Spine Surgeons. JAAOS - J Am Acad Orthop Surg. 2023;31(10):505. doi:10.5435/JAAOS-D-22-01011
17. Martinez M, Lopez S, Beebe K. Gender Comparison of Scholarly Production in the Musculoskeletal Tumor Society Using the Hirsch Index. J Surg Educ. 2015;72(6):1172-1178. doi:10.1016/j.jsurg.2015.06.020
18. Sudah SY, Faccone RD, Denard PJ, Menendez ME. Evaluation of the National Institutes of Health–supported relative citation ratio among American Shoulder and Elbow Surgeons fellowship faculty: a new bibliometric measure of scientific influence. J Shoulder Elbow Surg. 2022;31(9):e444-e450. doi:10.1016/j.jse.2022.03.017
19. Haislup BD, Trent S, Sequeira S, Murthi AM, Wright MA. The relationship between academic influence, NIH funding, and industry payments among academic shoulder and elbow surgeons. J Shoulder Elbow Surg. 2022;31(11):2431-2436. doi:10.1016/j.jse.2022.06.019

Authors

Peter Boufadel, MD, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.Jad Lawand, BS, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.

Jad Lawand, BS, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.

Tarishi Parmar, BS, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.

Mohammad Daher, BS, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.

Mohamad Y. Fares, MD, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.

Adam Z. Khan, MD, Department of Orthopaedic Surgery, Southern California Permanente Medical Group, Panorama City, CA.

John G. Horneff 3rd, MD, Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA.Joseph A. Abboud, MD, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.

Joseph A. Abboud, MD, Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA.

Disclosures

PB, JL, TP, MD, MYF: The authors do not have any potential conflicts of interest for this manuscript.

AZK would like to disclose research support from Stryker and DePuy. Paid presenter or speaker from Enovis.

JGH would like to disclose: Board or committee member AAOS, American Shoulder and Elbow Surgeons, Phoenix Shoulder Society; Paid Consultant: Catalyst, Tigon; Financial Support: Springer Nature.

JAA would like to disclose: Royalties from a company or supplier; Disclosures; Osteocentric Technologies, Enovis, Zimmer-Biomet, Stryker, Globus Medical, Inc. Stocks in: Shoulder Jam, Aevumed, Oberd, Ots Medical, Orthobullets, Atreon, Restore 3d. Research support from a company or supplier as a PI; Disclosures; Enovis, Arthrex. Royalties, financial or material support from publishers; Disclosures; Wolters Kluwer, Slack Orthopaedics, Elsevier. Board member/committee appointments for a society; Disclosures; American Shoulder And Elbow Society, Mid Atlantic Shoulder And Elbow Society, Shoulder 360, Pacira.

Funding Statement: The author(s) received no financial support for the research, authorship, and/or publication of this article.

Correspondence

Peter Boufadel, MD, Postdoctoral Research Fellow
Division of Shoulder and Elbow Surgery
Rothman Orthopaedic Institute
925 Chestnut St, Philadelphia, PA 19107
paboufadel@gmail.com

Evaluation of a Clinical Practice Algorithm for Pediatric Complicated Pneumonia: A Retrospective, Observational, Single-Center Study

CLAIRE A. OSTERTAG-HILL, MD; OLIVIA W. CUMMINGS, MD; ELIZABETH J. RENAUD, MD, FACS, FAAP

ABSTRACT

OBJECTIVE: The diagnostic evaluation, antibiotic treatment, and type and timing of surgical intervention for pediatric patients with complicated pneumonia is not standardized and may lead to increased length of stay, more radiation exposure, and higher cost. A multidisciplinary team at our institution developed a clinical practice algorithm for pediatric complicated pneumonia to align and optimize care. The aim of this study was to examine the effectiveness of this algorithm in improving overall patient care while minimizing changes in physician workload.

STUDY DESIGN: A clinical practice algorithm for pediatric complicated pneumonia was created and implemented at our institution in February 2018 based on expert opinion and literature review, providing guidance on options for imaging, antibiotics, and interventions based on clinical characteristics. Retrospective data were collected for 31 months before and after implementation excluding a six-month transition period.

RESULTS: Forty patients were identified (pre-protocol implementation=25, post-protocol implementation=15). There were no differences in age, race/ethnicity, and size of pleural effusion between groups. Following protocol implementation, the time to pediatric surgery consult, number of consulting services, ICU admission, number and types of radiologic studies, and readmission rates remained unchanged. Protocol implementation was associated with a significant decrease in the need for repeat procedures (32% vs. 0%, p=0.02). There was a trend toward decreased length of stay (10.0 vs. 9.0 days, p=0.31).

CONCLUSIONS: Implementation of our institutional protocol did not increase utilized services and was associated with a decrease in the need for additional procedures after treatment failure. Larger prospective studies may help optimize the approach to complicated pneumonia.

INTRODUCTION

Community-acquired pneumonia (CAP) remains a worldwide leading cause of morbidity and mortality in children aged between 28 days and five years despite a decrease in the incidence of CAP in the last two decades.[1,2] Complicated CAP includes the development of parapneumonic effusion, empyema, multilobar disease, cavitary abscess, necrotizing pneumonia, pneumothorax, and bronchopleural fistula.[1,2] Up to one third of children with pneumonia may develop these complications,[3,4] and the proportion of pneumonia hospitalizations attributed to complicated CAP has increased over time and now accounts for more than 8% of all pneumonia admissions.[2,5] Pediatric patients with complicated CAP incur higher resource use with longer hospitalization, higher intensive care unit (ICU) admission rates, higher rates of mechanical ventilation, increased 30-day readmissions, and increased costs compared to uncomplicated CAP.[2] However, the diagnostic evaluation, choice and duration of antibiotic therapy, and type and timing of surgical intervention for pediatric patients with complicated pneumonia is not standardized; significant controversy and practice variation remain across institutions.[6–10]

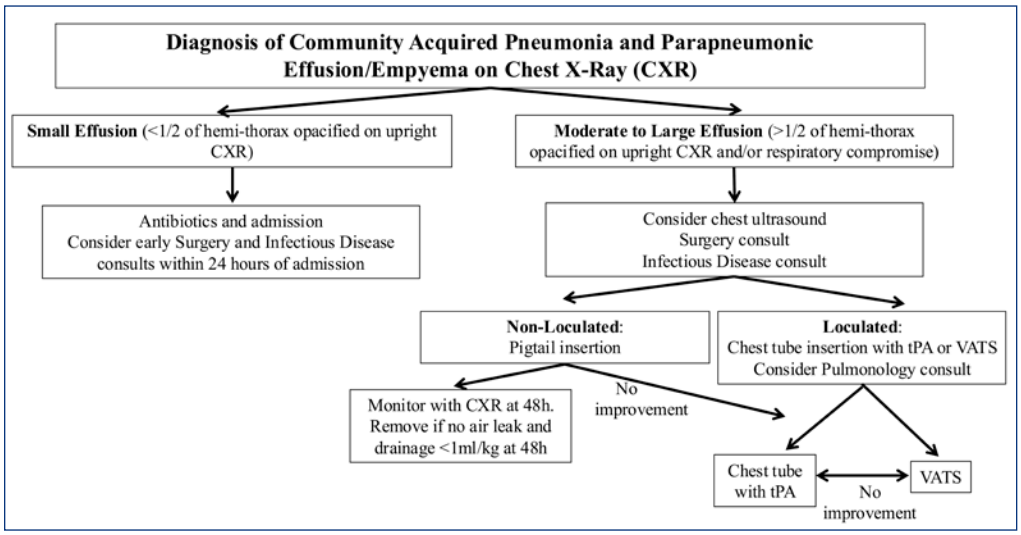
Review of practice patterns and outcomes at our institution demonstrated significant variability in the management of patients presenting with complicated CAP. In 2018, a multidisciplinary team including representatives from pediatric hospital medicine, infectious disease, pulmonology, radiology, critical care, emergency medicine, and surgery developed a clinical practice algorithm for pediatric complicated CAP with the goals of aligning and optimizing care and decreasing the hospital length of stay. The aim of this study was to determine the effectiveness of this clinical practice algorithm in improving overall patient care while minimizing changes in physician workload.

METHODS

Study Design

We performed a retrospective cohort analysis of pediatric patients seen at our institution, a tertiary care pediatric hospital, during the 31 months both before and after the implementation of the clinical practice algorithm. The six months immediately following the implementation of the pathway (February 2018–July 2018) were excluded to allow for full system integration. This retrospective study was approved by our institutional review board. Patients were identified using the pediatric surgery billing database through ICD-10 codes (J12, J13, J14, J15, J16, J17, J18, J85, J86, J90, J91) and CPT codes (32550, 32556, 32557, 32560, 32607, 32650)

Figure 1. Clinical Care Pathway for the Management of Pediatric Complicated Community-Acquired Pneumonia



Abbreviations: CXR, chest X-ray; tPA, tissue plasminogen activator; VATS, video-assisted thoracoscopic surgery

(further information on ICD-10 and CPT codes). Patients were excluded if they did not have a diagnosis of CAP, were immunocompromised, were less than two months of age, had chronic lung disease, or were tracheostomy or ventilator dependent.

Charts were reviewed for demographic information, clinical data, and outcomes. Data was managed using REDcap (Research Electronic Data Capture) software. Data was expressed as medians with interquartile ranges. All p-values were calculated by the Mann-Whitney U and Chi-Squared Tests with $p < 0.05$ considered as statistically significant. Statistical analysis was conducted using Graph Pad Prism (version 9.5.1).

Institutional pediatric complicated pneumonia clinical practice algorithm

The clinical practice algorithm for pediatric complicated CAP was developed by a multidisciplinary team of experts at our institution with consultation of the available literature.[11,12] The algorithm was adopted by our institution on February 1, 2018 and is depicted in **Figure 1**. Prior to protocol implementation, the approach to imaging, decision to consult surgery (and other services), and interventions was decided according to clinical preference and the judgement of the providers caring for the child. General education regarding the algorithm was provided by the attending-level representative involved in algorithm development for each specialty to their respective teams. The algorithm was made available to all providers on the hospital-wide website. This algorithm provides management guidance for patients found to have a parapneumonic effusion or empyema on chest X-ray (CXR).

Following diagnosis of CAP with the presence of an effusion or empyema, patients are stratified based on the size of the effusion into either small effusion (less than half of the hemi-thorax opacified on upright CXR) or moderate to large effusion (more than half of the hemi-thorax opacified on upright CXR and/or presence of respiratory compromise). Effusion size is quantified by the on-call reading pediatric radiologist. Patients with small effusions receive intravenous antibiotics and are admitted. Early surgery and infectious disease consults (i.e., within 24 hours of admission) are recommended. For patients with moderate to large effusions, surgery and infectious disease consults are recommended, as well as obtaining a chest ultrasound (US). If a non-loculated effusion is identified, pigtail chest tube insertion is recommended. A repeat CXR is obtained 48 hours following pigtail placement, and removal is considered if there is no air leak and drainage is less than 1ml/kg at 48 hours. If the patient has not improved, the guidelines for a loculated effusion should be followed. If chest US identifies a loculated effusion, chest tube insertion with tissue plasminogen activator (tPA) administration or video-assisted thoracoscopic surgery (VATS) is recommended (VATS consists of both effusion drainage and decortication); choice is based on surgeon preference. The pathway also recommends that a pulmonology consult be considered. Chest tube removal is guided by repeat CXR obtained 48 hours following procedure, and removal is considered if there is no air leak and drainage is less than 1ml/kg at 48 hours. tPA is administered at a dose of 40mg/4mL with a dwell time of one hour. tPA is repeated once daily for three consecutive days. Improvement is assessed clinically (absence of fever, decreased work of breathing), radiographically (improvement on CXR), and by decrease in chest tube output (without increased accumulation on CXR). Depending on the initial procedure and physician preference, lack of improvement may prompt further treatment with either VATS or chest tube and tPA.

RESULTS

Patient demographics and clinical features at presentation

During the defined study period, 40 pediatric patients were treated for complicated CAP and met inclusion criteria. As shown in **Table 1**, of these 40 patients, 25 patients were in the pre-implementation group and 15 in the post-implementation group. Median age at presentation ($p = 0.47$), race/ethnicity ($p = 0.31$), size of pleural effusion at time of surgical consult ($p = 0.67$), and days from effusion first noted to surgical consult were similar between the two groups. Measures

Table 1. Patient Demographics and Baseline Clinical Characteristics

	Pre-Implementation (n=25)	Post-Implementation (n=15)	p-value
Age at presentation, years	4.6 (2.3, 7.2)	5.8 (4.0, 9.4)	0.47
Race/Ethnicity Caucasian Hispanic African American Other	 13/25 (52.0%) 9/25 (36.0%) 0/25 (0%) 3/25 (12.0%)	 5/15 (33.3%) 5/15 (33.3%) 1/15 (6.7%) 4/15 (26.7%)	0.31
Size of effusion when consulted Small Moderate Large	 6/25 (24%) 9/25 (36%) 10/25 (32%)	 5/15 (33%) 6/15 (40%) 4/15 (27%)	0.67
Days to Pediatric Surgery Consult from Effusion	0 (0, 2.0)	0 (0, 0.5)	0.59
Maximum measured temperature, °C	39.4 (38.6, 40.0)	38.8 (38.1, 39.8)	0.36
Days of Fever (≥ 38.0°C)	5.0 (2.0, 9.0)	3.0 (0.5, 6.0)	0.06
Lowest oxygen saturation (%)	91.0 (86.0, 95.0)	94.0 (89.0, 96.0)	0.23
Highest white blood cell count (x10^9 cells/L)	17.7 (11.8, 20.6)	16.7 (13.3, 25.2)	0.51

Table 2. Clinical Outcomes Pre- and Post-Implementation

	Pre-Implementation (n=25)	Post-Implementation (n=15)	p-value
Types of initial procedures Chest tube VATS	 6/19 (32%) 13/19 (68%)	 1/8 (13%) 7/8 (87%)	0.30
Number of drainage procedures	1.0 (1.0, 2.0)	1.0 (0, 1.0)	0.04*
Second procedural intervention	8/25 (32%)	0/15 (0%)	0.02*
No drainage procedures	6/25 (24%)	7/15 (47%)	0.14
Median number of images per patient pre-procedure	3.0 (2.0, 5.0)	3.0 (2.0, 4.0)	0.67
ICU admission Days in ICU	12/25 (48%) 0 (0, 5.0)	5/15 (33%) 0 (0. 2.5)	0.82 0.81
Supplemental oxygen Days of supplemental oxygen	20/25 (80%) 4.0 (2.0, 6.0)	7/15 (47%) 0 (0, 2.0)	0.03* 0.01*
Median number of consulting services per patient	3.0 (3.0, 4.0)	4.0 (2.5, 4.5)	0.60
Intubation Days of intubation	8/25 (32%) 0 (0, 1.0)	1/15 (7%) 0 (0, 0)	0.06 0.23
Length of stay, days	10.0 (6.0, 12.0)	9.0 (2.0, 11.5)	0.31
Readmission	2/25 (8%)	2/15 (13%)	0.59

Abbreviations: VATS, video-assisted thoracoscopic surgery; ICU, intensive care unit

of vital signs, including the maximum temperature (p = 0.36), days with a fever (p = 0.06), and the lowest oxygen saturation (p = 0.23), were also similar between the two groups. Finally, there was no significant difference between the maximum white blood cell count in each group (pre-implementation 17.7 [11.8, 20.6] x10^9 cells/L, post-implementation 16.7 [13.3, 25.2] x10^9 cells/L; p = 0.51).

Analysis of Protocol Implementation

As shown in **Table 2**, after clinical practice algorithm implementation there was an associated, non-significant increase in the performance of VATS as the primary procedure (68% pre-implementation versus 87% post-implementation), although this did not reach statistical significance (p = 0.30). None of the patients who underwent VATS received tPA administration post-operatively, and there were no associated post-operative complications following VATS in this cohort. Following implementation, patients underwent a lower total number of procedural intervention (p = 0.04; note that although medians are 1.0 for both groups, the mean number of procedural interventions was 1.5 ± 1.3 versus 0.5 ± 0.5 procedures), and no patient required a second drainage procedure (32% pre-implementation versus 0% post-implementation; p = 0.02). The proportion of patients not requiring any drainage procedure (p = 0.14), requiring ICU admission (p = 0.82), and undergoing intubation (p = 0.06) were similar between the two cohorts. There was an increased proportion of patients requiring supplemental oxygen pre-implementation (80% compared to 47%; p = 0.03). No change in the number of radiologic studies obtained prior to the first procedure (p = 0.67) or the total number of consulting services (p = 0.60) for each patient was observed. There was a trend towards decreased length of stay following implementation (10.0 [6.0, 12.0] days pre-implementation versus 9.0 [2.0, 11.5] days post-implementation; p = 0.31), though this trend was not statistically significant. Pneumonia-related 30-day readmission rates were similar (p = 0.59). There were no deaths in either group.

DISCUSSION

Despite an increase in complicated CAP in the pediatric population,[2,5,13] considerable variation in the management and consequently the outcomes of these patients persists across institutions.[6–9] This stems from a lack of standardized management guidelines for this condition, in turn reflecting the lack of strong evidence-based literature regarding diagnostic work-up, optimal antibiotic therapy, appropriate surgical intervention, and long-term care.[2] With the goals of improving timeliness of care, and thereby improving the outcomes of pediatric patients with complicated CAP treated our institution, we developed a multidisciplinary consensus-based

clinical practice algorithm for the diagnosis and management of this condition. Importantly, representatives from all specialties that may be involved in the care of these patients (including pediatric hospital medicine, infectious disease, pulmonology, radiology, critical care, emergency medicine, and surgery) provided specialty-specific input and expertise and reviewed and approved the algorithm prior to implementation. In the present study, we sought to evaluate the approach to and clinical outcomes of complicated CAP following institution-wide implementation of this care pathway.

While the British Thoracic Society (BTS) and the American Pediatric Surgical Association (APSA) acknowledged the limited and often poor-quality available evidence, they both developed guidelines on various aspects of care in complicated CAP.[12,14] Further, several clinical care algorithms have been proposed, some of which have undergone evaluation following institutional implementation.[1,7,9,10] In brief, APSA recommends pleural fluid evacuation for large effusions, loculated effusions, and moderate effusions with failure to progress or symptoms (grade C recommendation), whereas BTS recommends drainage for enlarging effusions and those that compromise respiratory function. Both APSA and BTS posit that chemical debridement should be first trialed, when available, as it involves decreased resource utilization compared to VATS.[12,14] Neither provide guidelines on which consulting services should be involved and when consultation should be initiated; this has been standardized as part of our algorithm to promote timeliness of care. Pillai et al devised a comprehensive literature-based diagnosis and management algorithm offering guidance in the emergency department/outpatient setting for uncomplicated pneumonia in children, as well as inpatient care, discharge, and outpatient care for complicated pneumonia.[7] Using a cross-sectional study design, they found decreased computed tomography (CT) scan usage, decreased VATS, and decreased readmission without increased length of stay or vancomycin use following implementation of their protocol.[7] Similarly, Quick et al developed an evidence-based inpatient complicated CAP pathway and noted similar findings following implementation: decreased CT scan usage, increased US usage, and decreased use of VATS as the initial procedure without effects on length of stay or readmission.[9]

Following implementation of our institutional clinical practice algorithm, the number of drainage procedures decreased significantly. This is reflective of the finding that none of the patients in the post-implementation cohort required a second drainage procedure, compared to a 32% re-intervention rate (chest tube or VATS) in the pre-implementation cohort due to incomplete treatment of their effusion or empyema. Although consults to the surgery, infectious disease, and/or pulmonology services were recommended in portions of the algorithm, the number of consulting services per patient did not increase following protocol implementation suggesting that the overall work burden for consulting services did not increase. There was a trend towards decreased length of stay after implementation with patients in the post-implementation period staying a median of one day (mean: three days) less than those in the pre-implementation period. Despite algorithm emphasis on chest US with chest CT only indicated in very specific situations, we did not see a decrease in chest CT usage, unlike in the studies by Pillai et al and Quick et al. However, it must be noted that the initial CT usage rates were much higher in their studies (67–100% of patients) compared to 20% in our pre-implementation cohort. Despite this lower rate, as there is no proven advantage for imaging with chest CT instead of chest US for most pediatric patients with complicated CAP,[5,12,15] it may be possible to reduce radiation exposure further at our institution.

Significant institution-level and potentially provider-level variation remains in the selection of the first drainage procedure for complicated CAP.[8] The optimal surgical approach has been the focus of multiple studies; however, the current literature provides heterogenous, sometimes conflicting, data on outcomes. Two recent randomized controlled trials as well as a retrospective study found that there was no difference in outcomes of primary VATS versus chest tube with fibrinolytic therapy, except an increase in hospital cost associated with VATS.[9,16,17] Of note, these studies reported a 14.7–16.6% failure rate of primary fibrinolysis, subsequently requiring VATS as definitive intervention. However, other studies (including systematic review, randomized control trial, and retrospective cohort studies) report that VATS is associated with decreased hospital mortality, need for reintervention, length of stay, time with chest tube, and antibiotic duration in children.[6,8,18–21] Some authors suggest primary VATS is associated with a similar or lower cost than chest tube and antibiotic therapy alone.[6,18,21] The use of VATS can facilitate visualization, evacuation of pleural fluid, and mechanical debridement.[22,23] Following implementation of our institutional clinical care pathway, there was a non-significant higher rate of performance of VATS as the initial procedure (68% pre-implementation versus 87% post-implementation) compared to chest tube with or without fibrinolytics. Notably, our clinical practice algorithm did not suggest superiority of chest tube or VATS as the primary intervention, so that the increased rate of VATS post-implementation likely reflects provider preference that became apparent once the algorithm suggested either procedure was an acceptable first choice.

This study has several limitations, including those inherent to a retrospective study design. Patients were identified using billing codes and therefore we are reliant on the accuracy of the codes utilized. We attempted to minimize these effects by searching by both ICD and CPT codes and then screening patients for inclusion and exclusion criteria. Given the design of the study, it is not possible to determine causality between algorithm intervention and the clinical decisions, management approach, and outcome of patients.

The possible influence of provider and family preference cannot be ascertained. We were unable to obtain access to hospitalization costs and therefore cannot determine the financial effect this algorithm may have had. Additionally, the variables assessed in this study (chosen based on most direct relevance to pediatric surgeons) represent a portion of a larger implemented algorithm that also provided guidance on antibiotic choice and duration. These potential confounders were not specifically evaluated in this study.

In conclusion, the period after implementation of our algorithm for pediatric complicated CAP was associated with a reduced need for secondary interventions without an associated increase in the overall intervention rate or the work burden for consulting services. Standardization of care can promote improved quality of care, but larger prospective studies are needed to help optimize the approach to pediatric complicated pneumonia.

References

1. de Benedictis FM, Kerem E, Chang AB, Colin AA, Zar HJ, Bush A. Complicated pneumonia in children. *Lancet*. 2020;396(10253):786-798. doi:10.1016/S0140-6736(20)31550-6
2. Gross CJ, Porter JJ, Lipsett SC, Monuteaux MC, Hirsch AW, Neuman MI. Variation in Management and Outcomes of Children With Complicated Pneumonia. *Hosp Pediatr*. 2021;11(3):207-214. doi:10.1542/hpeds.2020-001800
3. Byington CL, Spencer LY, Johnson TA, et al. An epidemiological investigation of a sustained high rate of pediatric parapneumonic empyema: risk factors and microbiological associations. *Clin Infect Dis*. 2002;34(4):434-440. doi:10.1086/338460
4. Tan TQ, Mason EO, Wald ER, et al. Clinical characteristics of children with complicated pneumonia caused by Streptococcus pneumoniae. *Pediatrics*. 2002;110(1 Pt 1):1-6. doi:10.1542/peds.110.1.1
5. Jaffe A, Calder AD, Owens CM, Stanojevic S, Sonnappa S. Role of routine computed tomography in paediatric pleural empyema. *Thorax*. 2008;63(10):897-902. doi:10.1136/thx.2007.094250
6. Aziz A, Healey JM, Qureshi F, et al. Comparative analysis of chest tube thoracostomy and video-assisted thoracoscopic surgery in empyema and parapneumonic effusion associated with pneumonia in children. *Surg Infect (Larchmt)*. 2008;9(3):317-323. doi:10.1089/sur.2007.025
7. Pillai D, Song X, Pastor W, et al. Implementation and impact of a consensus diagnostic and management algorithm for complicated pneumonia in children. *J Investig Med*. 2011;59(8):1221-1227. doi:10.2130/JIM.0b013e318231db4d
8. Shah SS, DiCristina CM, Bell LM, Ten Have T, Metlay JP. Primary early thoracoscopy and reduction in length of hospital stay and additional procedures among children with complicated pneumonia: results of a multicenter retrospective cohort study. *Arch Pediatr Adolesc Med*. 2008;162(7):675-681. doi:10.1001/archpedi.162.7.675
9. Quick RD, Auth MJ, Fernandez M, et al. Decreasing Exposure to Radiation, Surgical Risk, and Costs for Pediatric Complicated Pneumonia: A Guideline Evaluation. *Hosp Pediatr*. 2017;7(5):287-293. doi:10.1542/hpeds.2016-0077
10. Shomaker KL, Weiner T, Esther CR. Impact of an evidence-based algorithm on quality of care in pediatric parapneumonic effusion and empyema. *Pediatr Pulmonol*. 2011;46(7):722-728. doi:10.1002/ppul.21429
11. Bradley JS, Byington CL, Shah SS, et al. The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. *Clin Infect Dis*. 2011;53(7):e25-76. doi:10.1093/cid/cir531
12. Islam S, Calkins CM, Goldin AB, et al. The diagnosis and management of empyema in children: a comprehensive review from the APSA Outcomes and Clinical Trials Committee. *J Pediatr Surg*. 2012;47(11):2101-2110. doi:10.1016/j.jpedsurg.2012.07.047
13. Grijalva CG, Nuorti JP, Zhu Y, Griffin MR. Increasing incidence of empyema complicating childhood community-acquired pneumonia in the United States. *Clin Infect Dis*. 2010;50(6):805-813. doi:10.1086/650573
14. Balfour-Lynn IM, Abrahamson E, Cohen G, et al. BTS guidelines for the management of pleural infection in children. *Thorax*. 2005;60 Suppl 1(Suppl 1):i1-21. doi:10.1136/thx.2004.030676
15. Kurian J, Levin TL, Han BK, Taragin BH, Weinstein S. Comparison of ultrasound and CT in the evaluation of pneumonia complicated by parapneumonic effusion in children. *AJR Am J Roentgenol*. 2009;193(6):1648-1654. doi:10.2214/AJR.09.2791
16. Sonnappa S, Cohen G, Owens CM, et al. Comparison of urokinase and video-assisted thoracoscopic surgery for treatment of childhood empyema. *Am J Respir Crit Care Med*. 2006;174(2):221-227. doi:10.1164/rccm.200601-027OC
17. St Peter SD, Tsao K, Spilde TL, et al. Thoracoscopic decortication vs tube thoracostomy with fibrinolysis for empyema in children: a prospective, randomized trial. *J Pediatr Surg*. 2009;44(1):106-111; discussion 111. doi:10.1016/j.jpedsurg.2008.10.018
18. Shah SS, Ten Have TR, Metlay JP. Costs of treating children with complicated pneumonia: a comparison of primary video-assisted thoracoscopic surgery and chest tube placement. *Pediatr Pulmonol*. 2010;45(1):71-77. doi:10.1002/ppul.21143
19. Scarci M, Zahid I, Billé A, Routledge T. Is video-assisted thoracoscopic surgery the best treatment for paediatric pleural empyema? *Interact Cardiovasc Thorac Surg*. 2011;13(1):70-76. doi:10.1510/icvts.2010.254698
20. Avansino JR, Goldman B, Sawin RS, Flum DR. Primary operative versus nonoperative therapy for pediatric empyema: a meta-analysis. *Pediatrics*. 2005;115(6):1652-1659. doi:10.1542/peds.2004-1405
21. Kurt BA, Winterhalter KM, Connors RH, Betz BW, Winters JW. Therapy of parapneumonic effusions in children: video-assisted thoracoscopic surgery versus conventional thoracostomy drainage. *Pediatrics*. 2006;118(3):e547-553. doi:10.1542/peds.2005-2719
22. Liu HP, Hsieh MJ, Lu HI, Liu YH, Wu YC, Lin PJ. Thoracoscopic-assisted management of postpneumonic empyema in children refractory to medical response. *Surg Endosc*. 2002;16(11):1612-1614. doi:10.1007/s00464-001-8293-5
23. Kercher KW, Attorri RJ, Hoover JD, Morton D. Thoracoscopic decortication as first-line therapy for pediatric parapneumonic empyema. A case series. *Chest*. 2000;118(1):24-27. doi:10.1378/chest.118.1.24

Authors

Claire A. Ostertag-Hill, MD, Department of Surgery, Brown University; Rhode Island Hospital, Providence, Rhode Island.

Olivia W. Cummings, MD, The Warren Alpert Medical School of Brown University, Providence, Rhode Island.

Elizabeth J. Renaud, MD, FACS, FAAP, Division of Pediatric Surgery, The Warren Alpert Medical School of Brown University; Hasbro Children's Hospital/Rhode Island Hospital, Providence, Rhode Island.

Disclosure

Prior Presentation: Presented at the 2023 American Academy of Pediatrics (AAP) Experience in Washington, D.C.

Correspondence

Elizabeth J. Renaud, MD

593 Eddy Street, Providence, Rhode Island, 02903

elizabeth.renaud@brownphysicians.org

Incorporating Teamwork Strategies for Internal Medicine Residents in Training to Mitigate Hospital Utilization for High-Risk Patients

DINO MESSINA, MD, PhD; ALISON CHAMBERS, PhD; MARK SCHLEINITZ, MD; ANGIE SEO, MD; LAURA McAULIFFE, PharmD, BCAP, CDCES

ABSTRACT

Complex, high-risk patients experience poor health outcomes, and many utilize the emergency room for routine primary care in lieu of outpatient visits. In 2017, we created the Comprehensive Care Clinic (C3) at Brown University Health, Providence, Rhode Island to identify and address the factors responsible for excess emergency room and hospital utilization for patients identified as high utilizers. This study evaluated the outcomes of a group of 159 patients who participated in C3 during the time period of 2017–2019. Emergency Department (ED) and Inpatient (IP) utilization is measured before and after the index C3 visit and compared with our control group of similar patients who did not participate in the C3 visit. Assistance with point-of-care issues such as transportation, medications, and addressing health literacy and the provision of targeted health coaching are the major interventions. A reduction of 56% for combined ED and IP utilization was measured for a group of 159 patients compared with our control group. A team-based approach to the care of high-risk patients in a residency ambulatory clinic allows for targeted interventions that resulted in reduced ED use and IP admissions. Internal Medicine resident physicians also learn the benefits of team-based care.

KEYWORDS: hospital utilization; residency training; high-risk patients; team-based primary care

INTRODUCTION

Population health studies in the United States have identified high-risk patients as a relatively small group of complex patients that account for a large percentage of health care expenditures.[1-3] Inpatient hospital services and emergency department care account for a large proportion of these expenditures.[4,5] Common characteristics of high-risk patients include multiple medical problems, polypharmacy, being a person of color, and lack of adequate health insurance and other socioeconomic challenges. In addition, high-risk, complex patients tend to have disproportionate and un-met psychiatric needs that include substance use disorders.[6-9] Greater support and access to treatment is clearly needed for these patients. Physicians struggle to provide care for complex patients due to lack of time, the presence of multiple medical and social comorbidities and fragmented health care. Internal Medicine residents face additional challenges during their ambulatory clinic experience including lack of consistent patient continuity, administrative burdens and lack of familiarity with team-based care. These issues can lead to resident dissatisfaction with outpatient care. Comprehensive Care Clinic (C3) was created in 2017 to help our Internal Medicine residents identify and address the factors responsible for over utilization of hospital resources and give them additional assistance.

Our clinic is a Patient-Centered Medical Home (PCMH) that provides care for a mostly underserved population. We incorporate a nurse care manager model across care settings and are an integral partner in our Medicare Accountable Care Organization (ACO). The patient population we serve accounts for a large percentage of the most complex and costly patients in our healthcare system, many of which are frequent users of emergency department and inpatient services. We sought to leverage a team-based approach with a nurse care manager, social worker and pharmacist to help residents address the factors that account for utilization of the emergency room in lieu of our office for common health issues.

Internal Medicine residents provide care for the majority of the patients seen in our clinic. Many of the patients are underinsured, medically and socially complex and our no-show rate hovers in the 20% range. Residents don't have enough time to address these issues adequately during a typical 30-minute visit. A single primary care provider, especially one in training, can find it difficult to address transportation barriers, housing instability, and immigration forms in addition to the patient's actual medical issues. We hypothesized that our interdisciplinary team's structure and approach could help reduce emergency room utilization by identifying each patient's unique needs. Longer sessions (60 minutes) are critical for understanding a patient's priorities and allow for a deeper exploration of a patient's values and personal context. We hypothesized that hospital utilization, including ED visits and IP admissions, would decrease for C3 patients and remain unchanged for our control group (waitlist or general clinic patients who met the inclusion criteria but were not scheduled for C3). Additionally, we measured hemoglobin A1c (HbA1c) values in all three groups.

METHODS

Our study included collected data on patients seen between 9/14/17 and 2/14/19 at the Center for Primary Care of Rhode Island. The report data we used was extracted from EPIC, our electronic health record. The nurse care manager (NCM) identified those patients with the highest utilization—defined as more than three ED visits or two hospitalizations in a single year. Patients were excluded if they had significant psychiatric illness (such as schizophrenia), were enrolled in hospice care or had a history of ongoing substance use disorder, such as chronic alcoholism. The C3 clinic did not have the expertise to adequately address these problems. We compared the outcomes of patients seen in C3 to an identical population on a waitlist for a C3 appointment. The patients on the waitlist meet our inclusion criteria but have not been given a C3 appointment during the data collection time frame. Our NCM coordinated the visits, scheduling patients with their respective resident PCP. Patients were asked to bring in all their medications for review and asked if they needed assistance with transportation prior to the visit. Charts were reviewed in advance of the visit by all members of the C3 team and a pre-visit huddle was conducted by our nurse care manager. This gave our group an opportunity to discuss the patient's needs and to identify potential barriers in advance. Screening for non-medical determinants and identifying medication-related problems and care gaps were key components for group discussion. This process allowed us to develop targeted, individualized interventions. Our primary outcomes were directed at mitigating hospital utilization, including ED, and IP admissions. Secondary goals included improving chronic disease management, with a focus on diabetes (HbA1c measurement). Our pharmacist completed a thorough medication reconciliation with each patient, identified barriers to adherence and affordability, counseled patients, and provided recommendations to the team to address medication-related problems [**Table 1**]. Working directly with a pharmacist allows for the immediate resolution of medication related problems prior to discharge. This novel, collaborative effort with the patient ensured a thorough and accurate medication reconciliation process. We collected social determinants data using REDCap[9] for the C3 group indicating that most have stable housing (75.1%), receive disability benefits (67.6%), do not have a college degree (81%), and very few have their own car (80.3%). Our social workers screened patients for these issues as well as behavioral issues, such as depression and anxiety during the index C3 visit. We did not formally track this information and it was limited to our C3 intervention group only.

Table 1. Pharmacist Interventions: access, adherence, and therapeutic omission. Access includes cost, lack of adequate insurance coverage and difficulty obtaining medications. Therapeutic omission is failure to use EBM guidelines.

	Medication access	Medication adherence	Therapeutic omission
Total interventions	14%	17%	17%
Number of unique patients	20%	25%	36%

Calculating the Treatment Window for Pre- and Post-Intervention Periods

For C3 patients, the first C3 clinic visit was used as the intervention point. For the waitlist and the general clinic patients, the first ever visit to the clinic was used as the intervention point. For all patients, a 12-month window—with six months pre-intervention and six months post-intervention—was defined as the intervention point.

Statistical Methods

As a rudimentary way to compare comorbidities status of the different clinical groups, a new variable was created summing the presence of high-risk comorbidities (Congestive Heart Failure (CHF), Chronic Obstructive Pulmonary Disease (COPD), Hypertension (HTN) and Diabetes). This comorbidity count was then compared between the groups (generalized linear model for binomial). The percent of patients with each comorbidity, the mean age, the percent female, and the percent race composition were also calculated and presented by patient group [**Tables 2,3**].

A generalized linear model for a Poisson distribution was used to model number of visits per patient (ED and IP separately) by time (pre-post intervention) and by level of patient care (C3, C3 waitlist, general clinic patients). An interaction between time and level of patient care was included to allow for varying affects over time. Similarly, HbA1c values were modeled (log normal) for patients by time period and by level of patient care. An interaction term was included to allow for differences in HbA1c over time by group. From the models, estimated number of visits or HbA1C level was compared between pre- and post-intervention time periods for each level of patient care. All statistical models were run using Proc Glimmix (SAS Institute Inc., Cary, NC). Familywise alpha was maintained at 0.05 using the Holm adjustment. Repeated measures were accounted for using the random statement. We received Rhode Island Hospital Institutional Review Board approval to conduct this study.

Table 2. Percent of patients with comorbidities (CHF, COPD, HTN, and Diabetes) by patient group. These comorbidities are the constituent parts of the comorbidity score.

Comorbidity (% of group)	Group		
	C3	C3 Waitlist	General Clinic
CHF	33.96	22.22	0.93
COPD	30.82	21.8	0.86
HTN	79.25	77.89	34.39
Diabetes	59.12	49.69	17.16

Table 3. Percent of patients that identify by racial group, ethnicity and sex assigned at birth.

Race	Group		
	C3	C3 Waitlist	General Clinic
American Indian or Alaska Native	0.00%	0.57%	0.37%
Asian	1.18%	1.61%	2.6%
Black or African American	27.60%	25.65%	23.50%
Native Hawaiian or Other Pacific Islander	0.00%	0.26%	0.40%
Unknown/Refused/ Other	38.40%	36.57%	42.34%
Caucasian	30.18%	35.32%	30.67%
Total Patients	159	1922	6161
Ethnicity	**Group**		
	C3	**C3 Waitlist**	**General Clinic**
Hispanic or Latinx	42.76%	40.16%	46.11%
Not Hispanic or Latinx	57.23%	59.41%	52.42%
Patient Refused	0.00%	0.026%	0.74%
Unknown	0.00%	0.20%	0.71%
Total Patients	159	1922	6161
Gender	**Group**		
	C3	**C3 Waitlist**	**General Clinic**
Female	54.08%	45.05%	52.73%
Male	45.91%	54.94%	47.26%
Total Patients	159	1922	6161

RESULTS

Demographics

Our study analyzed visits for a total of 8,242 patients from 9/14/2017 until 2/14/2019. The C3 group included 159 patients, the C3 waitlist included 1,922 patients and the general clinic included 6,161 patients. The mean age for the C3, the C3 waitlist, and the general clinic patient groups was 60.0 [51.3, 68.9], 58.5 [49.6, 66.8], and 48.1 [34.0, 61.0], respectively. The mean percent female for the C3 group, the C3 waitlist group, and the general clinic patient group was 54.1%, 45.1%, and 52.7%, respectively. The mean comorbidity count for the C3, waitlist, and general clinic patient groups was 2.03 [1.88, 2.19], 1.72 [1.67, 1.76], and 0.53 [0.52, 0.55] comorbidities, respectively. Co-morbidity differences between all groups was significant (p<0.0001). The make-up of comorbidities by group can be seen in **Table 2**. The racial, ethnic and sex assigned at birth composition of each group can be seen in **Table 3**.

Patient Group Comparisons Pre- and Post-Intervention

The following results were obtained from our data collection time frame; 9/14/17 to 2/14/19. The C3 group saw a significant decrease in mean number of ED visits (2.17 [1.89, 2.5] to 1.27 [1.01, 1.6], p<0.0001). General clinic patients saw a decrease as well, but not significant (0.91 [0.84, 0.99] to 0.87 [0.83, 0.92], p=0.4228). Conversely, the waitlist patients saw a significant increase in ED usage (1.32 [1.08, 1.6] to 1.85 [1.55, 2.19], p<0.0001) [**Figure 1**]. The C3 group saw a significant decrease in mean number of inpatient visits per patient (1.71 [1.39, 2.09] to 1.28 [1, 1.65], p=0.0372). The general clinic patients also saw a significant decrease in inpatient visits (0.87 [0.83, 0.92] to 0.59 [0.54, 0.66], p<0.0001). The waitlist patients saw no detectable change in inpatient visits (0.93 [0.85, 1.02] to 0.95 [0.84, 1.08], p=0.7572) [**Figure 2**]. The C3 group saw a decrease in mean HbA1c values although

Figure 1. Mean number of ED visits per patient per time period and patient group. Blue and red dots represent the mean number of visits per patient; bars represent 95% confidence intervals.

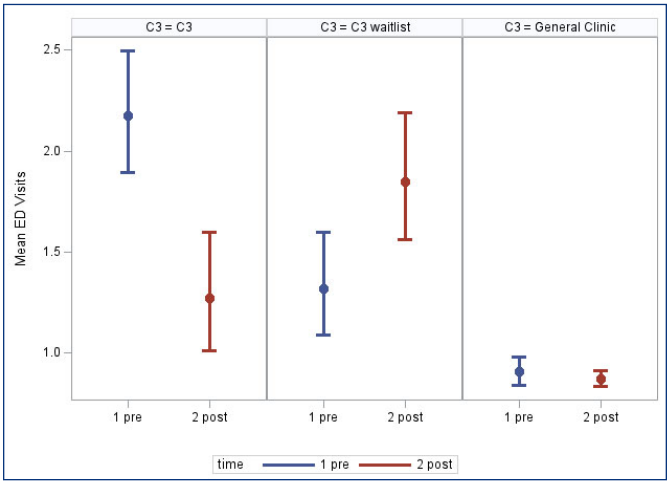


Figure 2. Mean number of Inpatient visits per patient per time period and patient group. Blue and red dots represent the mean number of visits per patient; bars represent 95% confidence intervals.

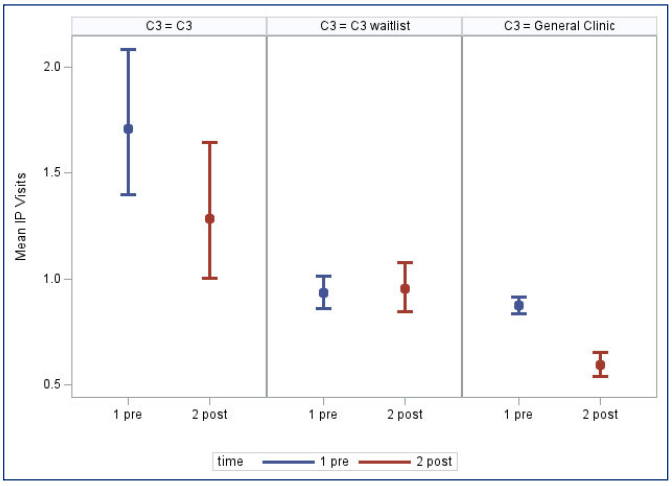
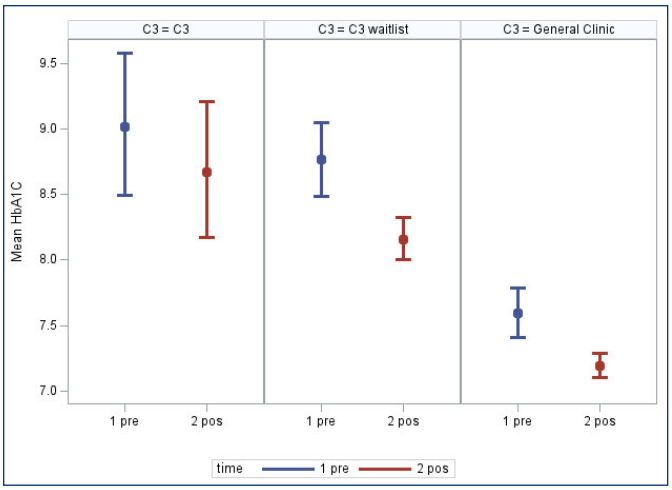


Figure 3. Mean HbA1c values per patient per time period and patient group. Blue and red dots represent the mean number of visits per patient; bars represent 95% confidence intervals.



this difference did not reach significance (9.02 [8.48, 9.59] to 8.67 [8.16, 9.22], p=0.1112). The general clinic patients saw a significant decrease in HbA1c values (7.6 [7.4, 7.8] to 7.2 [7.1, 7.3], p<0.0001). The waitlist patients saw a significant decrease in A1C values (8.76 [8.48, 9.06] to 8.16 [7.99, 8.33], p<0.0001) [**Figure 3**].

DISCUSSION

The C3 clinic was successful in reducing ED and IP admissions by 56% for a cohort of 159 complex patients seen in our facility between September 2017 and February 2019. These patients were compared with other complex patients who met our inclusion criteria but were not yet scheduled for C3 (C3 waitlist) and the rest of our clinic population seen during that same time period. Complex patients on the waitlist had an increased number of ED visits and no change in their IP utilization. For ED visits alone, the C3 patient average decrease was 0.9 (2.17–1.27), while those on the C3 waitlist saw an increase of 0.53 (1.32–1.85). All three groups had improvement in their HbA1c values, due to the fact that they were receiving attention for diabetic care. Patient scheduling was limited by patient and primary care resident availability since our clinic took place on Thursday mornings only.

The team-based organization of our group included input from the primary care resident physician, attending physician, social worker, pharmacist and nurse care manager. The nature of our clinic experience included pre-visit and post-visit chart huddles. These group discussions allowed for shared strategies tailored for the needs of each patient. The group was able to identify barriers to good care in most situations that resulted in action plans. These plans took the form of either immediate or long-term assistance. Immediate (point-of-care) assistance was provided for barriers such as transportation, help with medications and addressing care gaps such as immunizations, HbA1c testing and others. Our group filled our forms onsite for patients who qualified for special transportation programs. Taxi vouchers were provided for a limited number of patients who were overdue for a visit and had no other means of transportation; we would not have been able to see them otherwise. These interventions made it easier for C3 patients to be seen in clinic (rather than the ED) while those on the waitlist did not have these same resources.

The pharmacist intervention provided direct, point-of-care intervention covering a host of medication issues. Over 80% of the C3 patients experienced polypharmacy, defined as >8 medications. The other medication-related issues encountered were access (cost or lack of reliable transportation) (20%), adherence (25%) and omission (36%). Direct patient assistance from our pharmacist came in the form of education, provision of affordable alternatives, and improved access. The provision of low-cost medications, the elimination of medications that were no longer needed, home delivery and blister packs were key interventions in some cases.

Longer visits gave the primary care residents more time to explore the patient's personal needs on a deeper level. Only 19% of our cohort had a college degree or higher, and a little over 67% were receiving disability and/or Supplemental Nutrition Assistance Program (SNAP) benefits. A little less than 20% of our patients had their own car. Understanding the patient's life challenges allowed the resident more time to develop targeted care plans. The first question posed to the patient (using our C3 visit EPIC smart phrase) was "What's the most important health concern for you right now?" This question was asked to gain an understanding of the patient's perspective as we tried our best to align our goals with those of the patient.

The post-clinic huddle was utilized to summarize each case and generate targeted long-term assistance. Follow-up visits were scheduled in a timely manner with a NCM, social work, and pharmacist team members, with the patient sometimes seeing all three if needed. The follow-up educational sessions (coaching) with our nurse care manager were extremely beneficial for patients struggling with health literacy. Care plans were developed that met the specific needs of each patient. Patients were given the direct phone number to the NCM for any follow up concerns and patients were followed until their care goals were met.

Patients were given timely follow-up with their PCP resident physician to capture the momentum of the C3 intervention. Challenges with resident and patient scheduling impact continuity in our clinic and can have adverse consequences for chronic disease management. We made sure patients had timely follow up with their PCP to review the

recommendations of the C3 team. Although a formal survey was not conducted, resident-physicians expressed joy and satisfaction with these appointments through personal communication with Dr. Messina.

The Patient-Centered Medical Home (PCMH) model in Rhode Island (where this study was conducted) has demonstrated statistically significant reductions in utilization.[11] Properly organized and funded primary care practices are well poised to offer help to address the needs of high-risk patients. Studies have shown that decreased utilization and cost of care with improved health outcomes is possible when the proper care elements are in place. Programs with well-trained NCMs have been successful in reducing readmission and associated costs. Continuity with the same NCM, help with medication management, in-person encounters, and patient education (coaching) are elements associated with success decreasing utilization.[12-15] Intensive care management programs that address psychosocial problems have been able to decrease ED use and save money through a collaborative approach with the ED, inpatient (IP) and primary care providers.[16] When queried, complex patients valued care management that helped them manage their medical problems and medications and provided guidance with unmet social needs.[17] Trust between patients and their healthcare system is a difficult variable to measure; however, when present, it can positively affect cost. Patients and their families who trust their providers had lower costs for care for low-acuity medical problems.[9,14,15] Trust between patients and their providers can also increase patient activation (patient's ability to self-manage) and avoid overuse of the ED.[16]

Care coordination is a core element of a patient-centered medical home. To be successful, care coordination should be integrated across services and settings and personalized. A search of the medical literature found that not all care management approaches were successful in achieving their stated goals with respect to addressing readmissions and over-utilization. The characteristics that were associated with success included the following: continuity of care between the nurse care manager and patient; face-to-face patient contact between the nurse care manager and patient; physician engagement; and medication management.[12,18,19] Our clinic had these elements. Surveys of high-needs patients indicate that, with improved access and good patient-provider communication, patients are less likely to visit the ED.[20] Addressing and acting on Social Determinants of Health (SDH) is a major part of our C3 effort. Targeted interventions with active ED case management have also been shown to decrease ED utilization.[16] Going forward, we would like to expand our NCM numbers and open our inclusion criteria to include more patients with behavioral needs that include substance use disorders.

Limitations

Our clinic is only open one morning per week for residents on their block rotation. The patients selected for inclusion were based on nurse care manager discretion and patient/provider availability and are thus subject to selection bias and limited to one hospital system. It is likely that an analysis with pre-selected inclusion criteria would not yield the same degree of reduced utilization achieved here. It is likely that our results may reflect regression to the mean, as seen on other similar efforts,[20] based on our sampling error, making the case for following our patients' progress for a longer time frame.

CONCLUSIONS

Interprofessional approaches to complex patient care that address social determinants, medication issues, health literacy and care gaps can help decrease hospital utilization when coordination of care and continuity are provided. Residents in training learn the benefits of team-based care.

References

1. Riley G, Lubitz J, Prihoda R, Stevenson MA. Changes in distribution of Medicare expenditures among aged enrollees, 1969-82. *Health Care Financ Rev.* Spring 1986;7(3):53–63.
2. Lieberman S, Lee J, Anderson T, Crippen D. Reducing the Growth of Medicare Spending: Geographic Versus Patient-Based Strategies: The Evidence Suggests That a Focus on High-Spending Patients May Yield the Most Savings to Medicare. *Health Aff.* Jul-Dec 2003;SupplWeb Exclusives::W3-603-613. Available from: https://doi.org/10.1377/hlthaff.W3.603
3. Cohen S. Differentials in the Concentration of Health Expenditures across Population Subgroups in the U.S., 2013. In *Statistical Brief (Medical Expenditure Panel Survey (US))*. Rockville (MD): Agency for Healthcare Research and Quality (US): 2001 Statistical Brief #480. 2015 Sep. Available from: http://www.ncbi.nlm.nih.gov/books/NBK447194/
4. Riley G. Long-Term Trends in the Concentration of Medicare Spending. *Health Aff.* May-Jun 2007;26 (3):808–16. Available from: https://doi.org/10.1377/hlthaff.26.3.808
5. Rentas K, Buckley L, Wiest D, Bruno C. Characteristics and Behavioral Health Needs of Patients with Patterns of High Hospital Use: Implications for Primary Care Providers. *BMC Health Serv Res.* 19(1):81. Available from: https://doi.org/10.1186/s12913-019-3894-7
6. Bodenheimer T, Berry-Millett R. Follow the Money — Controlling Expenditures by Improving Care for Patients Needing Costly Services. *N Engl J Med.* 2009 Oct 15;361(16):1521-1523. Available from: https://doi.org/10.1056/NEJMp0907185
7. Ryan J, Abrams M, Doty M, Shah T, Schneider E. How High-Need Patients Experience Health Care in the United States. Findings from the 2016 Commonwealth Fund Survey of High-Need Patients. *Issue Brief (Commonw Fund).* 2016 Dec;43:1-20. Available from: https://doi.org/10.26099/v712-y185
8. Wammes, JJG, van der Wees PJ, Tanke M, Westert G, Jeurissen P. Systematic Review of High-Cost Patients' Characteristics and Healthcare Utilisation. *BMJ Open* 2018 Sep 8;8(9):e023113. Available from: https://doi.org/10.1136/bmjopen-2018-023113
9. Ganguli I, Thompson R, Ferris T. What Can Five High Cost Patients Teach Us about Healthcare Spending? *Healthc.* 2017 Dec;5(4):204–13. Available from: https://doi.org/10.1016/j.hjdsi.2016.12.004

10. Harris, PA, Taylor, R, Thielke, R, Payne, J, Gonzalez, N, Conde, JG. Research Electronic Data Capture (REDCap). J Biomed Inform April:42 (2): 377-81, 2009
11. Cole M, Galárraga O, Wilson I. The Impact of Rhode Island's Multipayer Patient-Centered Medical Home Program on Utilization and Cost of Care. *Med Care.* 2019 Oct;57(10):801–8. Available from: https://doi.org/10.1097/MLR.0000000000001194
12. Coleman E, Parry C, Chalmers S, Min S. The Care Transitions Intervention: Results of a Randomized Controlled Trial. *Arch Intern Med.* 2006 Sep 25:166(17):1822-1828. Available from: https://doi.org/10.1001/archinte.166.17.1822
13. Brown R, Peikes D, Peterson G, Schore J, Razafindrakoto C. Six Features of Medicare Coordinated Care Demonstration Programs That Cut Hospital Admissions of High-Risk Patients. *Health Aff.* 2012 Jun;31(6): 1156–66. Available from: https://doi.org/10.1377/hlthaff.2012.0393
14. Berry L Rock B, Smith Houskamp B, Brueggeman J, Tucker L. Care Coordination for Patients with Complex Health Profiles in Inpatient and Outpatient Settings. *Mayo Clin Proc.* 2013 Feb;88(2):184–94. Available from: https://doi.org/10.1016/j.mayocp.2012.10.016
15. Naylor, M, Brooten D, Campbell R, Maislin G, McCauley K, Schwartz JS. Transitional Care of Older Adults Hospitalized with Heart Failure: A Randomized, Controlled Trial: FOLLOW-UP OF HOSPITALIZED ELDERS. *J Am Geriatr Soc.* 2004 May;52(5):675–84. Available from: https://doi.org/10.1111/j.1532-5415.2004.52202.x
16. Okin R, Boccellari A, Azocar F, Shumway M, O'Brien K, Gelb A, et al. The Effects of Clinical Case Management on Hospital Service Use Among ED Frequent Users. *Am J Emerg Med.* 2000 Sep:18(5);603-8. Available from: https://doi.org/10.1053/ajem.2000.9292
17. Ganguli I, Orav EJ, Weil E, Ferris T, Vogeli C. What Do High-Risk Patients Value? Perspectives on a Care Management Program. *J Gen Intern Med.* 2018;33(1):26–33. Available from: https://doi.org/10.1007/s11606-017-4200-1
18. Peikes D, Chen A, Schore J, Brown R. Effects of Care Coordination on Hospitalization, Quality of Care, and Health Care Expenditures Among Medicare Beneficiaries: 15 Randomized Trials. *JAMA.* 2009 Feb 11;301(6):603-618. Available from: https://doi.org/10.1001/jama.2009.126
19. Berry-Millett R, , Bodenheimer T. Care Management of Patients with Complex Health Care Needs. *Synth Proj Res Synth Rep.* 2009 Dec(19):52372. Available from: https://doi.org/52372
20. Finkelstein A, Zhou A, Taubman S, Doyle J. Health Care Hotspotting — A Randomized, Controlled Trial. *N Engl J Med.* 2020;382:152–62. Available from: https://doi.org/10.1056/NEJMsa1906848

Authors

Dino Messina, MD, PhD, Associate Professor of Medicine, Medical Director for the Center for Primary Care at Rhode Island Hospital, Alpert Medical School of Brown University, Providence, RI.

Alison Chambers, PhD, Assistant Professor of Medicine (Research), Alpert Medical School of Brown University, Providence, RI.

Mark Schleinitz, MD, Associate Professor of Medicine, Academic Hospitalist, Alpert Medical School of Brown University, Providence, RI.

Angie Seo, MD, PGY4, Chief Medical Resident, Alpert Medical School of Brown University, Providence, RI.

Laura McAuliffe, PharmD, BCAP, CDCES, Senior Clinical Pharmacist, Ambulatory Care Specialist, Rhode Island Hospital, Providence, RI.

Disclosures

All authors declare that they have no conflicts of interest.

This work was accepted as a poster presentation for the Society of General Medicine Annual Meeting 2020, Birmingham, Alabama.

Acknowledgments: We would like to thank Derek Burke and Susan Ramsey for their administrative assistance in reviewing our manuscript.

Correspondence

Dino Messina, MD, PhD, FACP
245 Chapman Street, Suite 300, Providence, RI, 02905
Dino_Messina@brown.edu

College Student Perceptions of Using a Symptom-Based Algorithm to Enhance Vending Machine Over the Counter (OTC) Medication Use

LUCAS NICOLAU, PharmD; JEFFREY BRATBERG, PharmD, FAPhA; KATHERINE HOULIHAN, PharmD; VIRGINIA LEMAY, PharmD

ABSTRACT

BACKGROUND: People use symptom checkers for clinical decision-making, including over the counter (OTC) product selection. Health and wellness vending machines (HWVM) that stock OTC medications are common on college campuses, including the University of Rhode Island (URI). No system integrates access to self-assessment health tools for OTC medication selection with HWVM.

OBJECTIVE: The study objective is to assess college students' preferences for using a symptom checking algorithm, either on a kiosk adjacent to the vending machine or online.

METHODS: Survey responses were collected via Qualtrics™ in the spring of 2025. Survey questions included demographic information, students' use of the HWVM, and whether a symptom algorithm could enhance their experience using the HWVM.

RESULTS: 303 unique students participated in the survey. Among this sample, 17% (n=53) reported HWVM use. When students have new health issues, 64% (n=136) reported a preference for contacting a person, while 30% (n=64) prefer using an online source. Overall, 75% (n=145) of students reported that a symptom-based algorithm could enhance their experience using the HWVM. More students would access the algorithm via their phones (78%, n=145) versus a kiosk (57%, n=109).

CONCLUSIONS: Only one in six respondents reported using the vending machine. While most students prefer talking to a person for health decision-making, most students would use a symptom-based algorithm prior to vending machine OTC medication selection. Future research should be performed to validate algorithms, compare their use with HWVM inventory trends, and document user satisfaction.

KEYWORDS: Vending Machine; Nonprescription Drugs; Students, Undergraduate; Public Health Informatics; Symptom Assessment

BACKGROUND

Over-the-counter (OTC) medications have been readily accessible to the public for decades and may be purchased without the requirement for consultation nor recommendations from a healthcare professional.[1] However, the selection of an OTC product is improved when pharmacists educate patients on appropriateness based on self-reported symptoms, allergies, contraindications, etc.[2,3] In 1999, the OTC Drug Facts Label regulations made OTC labels more user friendly by introducing a standardized format improving clarity and readability.[4] Since the general public considers OTC products safe for self-diagnosis and treatment, their willingness to seek or use available information may be limited and potentially harmful. An estimated three out of 10 people fully understand how to take OTC medications correctly, leaving 70% at risk.[5] Adults commonly engage in the problematic use of OTC medication, and need guidance on their potential risks. For college students, social media impacts the prevalence of OTC medication misuse. Students have been shown to use expired medications, double the dose of medications when ineffective, or not read the drug facts label altogether.[5,6]

For these emerging adults, transitioning to higher education settings without parental involvement is a developmental period for decision-making skills and autonomy regarding their healthcare.[7] This may be a time where new and more intense life stressors may affect their ability to seek out and make informed decisions regarding their health.[8] Students gravitate towards anonymous transactions, from online shopping to gathering information, and may prefer less interpersonal contact when accessing medical care specifically.[9] One method to access health information, services, and the products themselves is through self-service kiosks.[10] In 2022, a scoping review was published on the implementation of health kiosks within healthcare settings. Among the studies examined, the most common role of health kiosks was providing health information.[11] Health kiosks have been utilized on college campuses for appointment check-in at student health services; however, utilizing symptom algorithms could enhance their functionality and improve the user experience.[12] Algorithms may also be accessed on websites and mobile phones to further improve accessibility. Some university health services design their websites to provide medication and symptom management information.[13]

The most prevalent and recent use of symptom algorithms in higher education settings were daily COVID-19 symptom checkers requiring students to report symptoms prior to attending class.[14,15] Algorithms may be designed to expand beyond viral infection symptom tracking to additional disease states, including nonpharmacologic and OTC medication recommendations for treatment.

To enhance OTC medication accessibility on college campuses, Purdue University and the University of North Carolina at Chapel Hill (UNC) implemented health and wellness vending machines (HWVM). Purdue University researchers conducted quality improvement surveys to promote more widespread usage of their HWVM.[16,17] For the latter, UNC developed a webpage on their campus health services portal, including information on the medications within their vending machine, such as image, brand and generic names, and a link to a standardized medication guide.[18] At the University of Michigan, an algorithm was created where students may click on a body part and information is provided regarding common conditions and self-care measures for the specified area.[19] In February of 2024, the University of Rhode Island (URI) College of Pharmacy in collaboration with URI Health Services launched a Health and Wellness Vending Machine. This vending machine provided access to a variety of low-cost OTC and wellness products to students anonymously in a secure section of the Kingston campus library, available 24/7 [**Figure 1**]. An initial study was published evaluating the use, potential barriers, and medication inclusion of URI's HWVM.[9] However, this study did not determine how college students select OTC medication and whether a symptom algorithm would be useful to students.

Figure 1. Contents of Health and Wellness Vending Machine (HWVM)

Category	Display #	Item	Cost ($)
Sexual/Reproductive Health	103	Emergency Contraception	$6
	101	Pregnancy Test	$4
	303	Safer Sex Kit w/condoms and lubricant	10 cents
Pain Reliever	501	Acetaminophen	10 cents
	503	Ibuprofen	10 cents
	406	Ear Ache Relief Drops (Similasan or Hyland's)	$7
	505	Disposable Thermometer	10 cents
GI Health	109	Pepto-Bismol (Bismuth Subsalicylate) Tablets for Nausea	10 cents
	412	Tums Antacid tablets	10 cents
	111	Anti-Diarrheal (Loperamide HCL)	10 cents
Oral Health	403	Blistex, Medicated Lip Ointment	10 cents
	105	Dental Health Kit (Toothbrush, Toothpaste and Dental Floss)	$2
Respiratory health	203	Robitussin Cough syrup	10 cents
	410	Saline Nasal Spray for Congestion	10 cents
	205	Mucinex (Expectorant and Cough Suppressant)	$8
	207	Sunscreen	10 cents
Allergies	307	Benadryl (Banophen Diphenhydramine) Antihistamine/Allergy Relief	10 cents
	507	Zyrtec (Cetirizine) Antihistamine/Allergy Relief	$2
	309	Bug Spray	10 cents
Skin health	605	Spray Deodorant	FREE
	311	Antifungal Cream (Clotrimazole) for Athlete's Foot	10 cents
	201	Topical Hydrocortisone for Rash or Itch	10 cents
Eye health	404	Visine (Tetrahydrozoline) Eye Redness Reliever	$5
	405	Eye Itch Antihistamine Drops (Zaditor)	$5
Sleep Health	209	Sleep Kit: Lavender Sachets/Ear plugs/Eye mask/Tea	10 cents
Harm Reduction	607	Naloxone 4 mg	10 cents
	603	Fentanyl Test Strip Kit	10 cents
Wellness	511	Maxi Pad	10 cents
	509	Tampax	10 cents
	401	Glasses Repair Kit	$2
	301	Disposable Masks	10 cents
	402	Hand Sanitizer	10 cents
	407	Band-Aids	10 cents
	305	COVID Test Kit	10 cents
	601	Empty Sharps Container	10 cents
	411	Kleenex Tissues	10 cents

Accepts RAM card payments ONLY

All purchases on RAM card are reported as "Wellness Vending". Individual items purchased are not listed in RAM card account.

Questions? Contact Health Promotion urihealthpromotion@uri.edu or 401-874-5954

Purpose/Objectives

The objective of this study is to assess college students' preferences for using a symptom-checking algorithm, either on a kiosk adjacent to the vending machine or online, and whether they believe this resource would aid in selecting appropriate products based on their symptoms.

METHODS

The survey conducted was voluntary, anonymous, and did not contain any identifiable information. Survey responses were collected from January 24, 2025, to February 21, 2025. Prior to the university-wide distribution of the survey, the survey questions were piloted with 12 students and facilitators serving on the URI Health Services Student Health Advisory Council (SHAC). Students enrolled in classes at URI who were 18 years or older were eligible to complete the survey. The survey was distributed to students using a printed advertisement with a QR code posted in the library as well as other campus buildings. In addition, images and videos produced via TikTok were posted to social media accounts including URI Wellness (@uriwellness), flyer distribution to students within the student union, and distributed to students electronically via email.

Survey Development

The survey was developed utilizing Qualtrics, a web-based survey platform (Qualtrics, Provo, UT). Completing the 24-question survey took no more than 10 minutes. Demographic data collected included age, year of study, current academic major, gender, ethnicity, race, sexual identity/orientation, extracurricular involvement, and place of residence (e.g., dorm room, fraternity/sorority housing, off-campus housing in the surrounding area or commuting from home). The survey included questions about students' use of the HWVM and how additional services, such as a symptom algorithm, may enhance their experience in product selection. Survey data were analyzed using descriptive statistics. Respondents were not required to answer any of the questions to complete the survey. This study was approved by the URI Institutional Review Board.

RESULTS

Survey and Demographic Data

A total of 303 students accessed the survey. [**Table 1**]. One hundred eighty-two completed the survey in its entirety, 60 partially completed the survey, and 61 withdrew from the survey. Fifty-six percent of total respondents were between the ages of 18–20 and 38% between the ages of 21–23, with

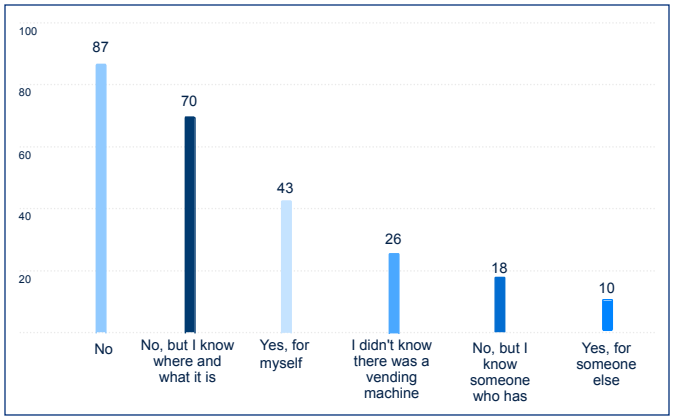
Table 1. Baseline Characteristics

	Number of Total Respondents (%) (n = 303)	Number of Respondents Who Used the HWVM (%) (n = 53)	Number of Respondents Who Did Not Use the HWVM (%) (n = 201)
Age (years)			
18–20	100 (56%)	30 (73%)	70 (52%)
21–23	68 (38%)	10 (24%)	55 (41%)
24–29	8 (4%)	1 (2%)	7 (5%)
30–39	2 (1%)	0 (0%)	2 (1%)
Gender			
Male	19 (12%)	3 (8%)	16 (13%)
Female	136 (83%)	30 (83%)	104 (83%)
Non-binary	5 (3%)	3 (8%)	2 (2%)
Grade level			
Freshman	26 (15%)	8 (20%)	18 (13%)
Sophomore	50 (28%)	14 (34%)	36 (27%)
Junior	37 (21%)	12 (29%)	24 (18%)
Senior	34 (19%)	3 (7%)	29 (21%)
Graduate level	30 (17%)	4 (10%)	26 (19%)
Ethnicity			
Hispanic, Latino/a, or Spanish origin	10 (6%)	1 (3%)	8 (6%)
Non Hispanic, Latino/a, or Spanish	147 (90%)	33 (92%)	113 (90%)
Race			
White/Caucasian	150 (86%)	33 (83%)	115 (88%)
Black or African American	8 (5%)	0 (0%)	8 (6%)
Asian or Pacific Islander	11 (6%)	4 (10%)	6 (5%)
American Indian or Alaskan Native	1 (1%)	1 (3%)	0 (0%)
Other	1 (1%)	1 (3%)	0 (0%)

Respondents were not required to answer any of the demographic questions to complete the survey.

most students in their sophomore year of study. Of all respondents, 83% were female. When asked about their major, 43% of students reported the College of Pharmacy followed by the College of Health Sciences (17%). A similar number of students reported living in on-campus dorms (36%) as compared to students who lived off-campus in the Kingston, Narragansett, or Wakefield, Rhode Island areas (37%).

Figure 2. Use of Health and Wellness Vending Machine (HWVM)



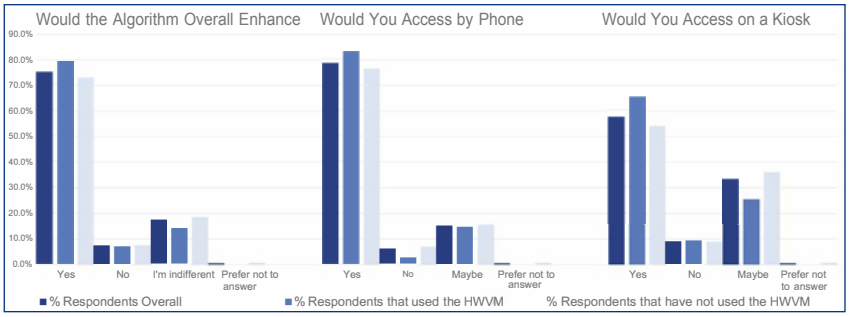
Current use of the HWVM

Fifty-three students (17%) reported using the HWVM for themselves or someone else while 201 students (66%) had not used the HWVM. Of the 201 students who had not used the HWVM, 70 were aware of its existence and 18 students knew someone who had previously used the HWVM [**Figure 2**]. Respondents were provided with a list of current medications and products within the HWVM. At the time of the survey, over half of the students who previously utilized the vending machine preferred its use instead of going elsewhere to get the products provided. Students reported a preference to utilize the vending machine over other locations due to reduced prices of products (42%), ease of access and location (19%), and/or privacy (17%). These preferences were similar between HWVM users and total respondents.

Algorithm Benefit and Use

Of the total respondents, 75% believe the symptom algorithm and drug information kiosk would enhance their experience with the HWVM [**Figure 3**]. This was slightly higher in the HWVM user group (79%). A greater number of total student respondents preferred accessing the symptom algorithm via their cell phones (78%) versus a kiosk (57%). Of the HWVM users, there was a greater percentage of those who believed accessing the algorithm via cellphones (83%) would be more beneficial than kiosks (65%) as well.

Figure 3. Algorithm Responses

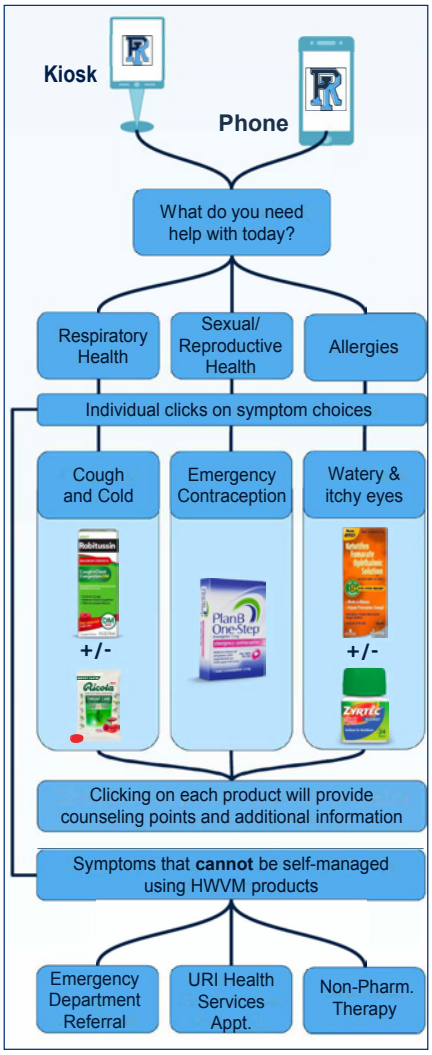


A significant number of total respondents were unsure whether accessing the symptom algorithm via the kiosk (33%) was preferred over accessing the algorithm via their cellphones (15%).

DISCUSSION

Our research is the first to specifically survey college students on their likelihood to use a symptom algorithm and health kiosk to help select OTC products in health and wellness vending machines (HWVM). While only one in six respondents reported using the vending machine, we found that 75% of students believed their experience would be enhanced if they were to use a symptom-based algorithm. We observed that more students would access the algorithm via their phones (78%, n=145) versus a kiosk (57%, n=109). This suggests that many students may want to gather information about the products online prior to selection from the OTC vending machine. Vending machine use is an inherently different experience than accessing nonprescription medications at the pharmacy, as the products and their drug facts label are out of reach. When selecting medication in the pharmacy aisle, individuals may hold the product, review the label, and compare it to other products prior to purchasing. Offering this drug information through the symptom algorithm and health kiosk would allow for individuals to be more informed about their decision prior to purchase. While students noted a preference for accessing the algorithms via their phones, many reported an interest in utilizing a kiosk, despite not being fully aware of its appearance and functionality. Accessing the algorithm via the kiosk adjacent to the vending machine may serve as a visual reminder for real-time assistance. Further, this may aid in triaging students to seek an evaluation by a healthcare practitioner with the University's Health Services by identifying those whose symptoms are not appropriate for self-treatment [**Figure 4**].

Figure 4. Symptom-Based Algorithm Example



The symptom algorithm, whether accessed from the health kiosk or phone, can guide the user through a series of questions to determine if their symptoms may be managed by self-treatment, if a product is available in the HWVM, or if a referral to a healthcare provider is warranted. For the former, the questions may be tailored to the reported symptoms, such as "Headache" or "Cough." Once the questions are completed, the algorithm will identify an appropriate medication along with its location within the vending machine. To ensure the algorithm's accuracy, our research team relied on evidence-based references to distinguish between individuals who are "self-care treatable" and those who meet criteria for "self-care exclusions." An individual who is self-care treatable refers to symptoms that may be safely treated at home with over-the-counter medication; however, an individual with an exclusion for self-care has symptoms that require an evaluation by a healthcare provider. For example, a student with watery eyes may have seasonal allergies, which can often be treated with over-the-counter antihistamine eye drops, or conjunctivitis, which requires professional evaluation and a prescription for an ocular anti-infective. In order to optimize HWVM at other colleges and universities, an expert team of pharmacists and other providers should regularly develop, evaluate, and update symptom algorithms and available medications. Our university embarked on a collaboration between the College of Pharmacy and campus Health Services, including the College of Nursing, to maintain, update, and proactively restock products to ensure availability. In addition to recommending OTC medications and products, pharmacists can develop non-pharmacologic counseling points. For example, if a student reports a headache and the symptom algorithm determines they are appropriate for self-management, counseling may include recommendations such as limiting screen time in addition to taking acetaminophen at the correct dosage.

Our study revealed that less than 18% of total survey respondents used it yet 90% were aware it existed. Although awareness was high, actual usage remained low, indicating that certain barriers may be limiting students from fully utilizing the resource. Students report utilizing the vending machine for its reduced price, accessibility, and privacy, mirroring data collected in a pre-implementation survey at the University of Rhode Island.[9] These reasons are consistent with results from vending machine surveys conducted at other universities. Purdue University reported success with its OTC vending machine due to its convenience, affordability, and accessibility. The relocation of their vending

machine to an area with greater foot traffic further improved utilization.[18] Similarly, UNC found that increased accessibility to commonly used OTC products was appreciated by the students. Using their "Healthy Heels To Go" webpage, students could visualize all the products found within the vending machine. Their webpage also included each drug facts label, information regarding the medications, and additional resources on health information.[19]

Data support that pharmacists' active involvement in self-care consultations allows for higher satisfaction rates for individuals and provides them with more confidence in future self-treatment.[20] However, it is widely understood that not all individuals feel comfortable conversing with pharmacists or other medical professionals on personal topics and would prefer to utilize a private algorithm via a kiosk or phone. Both options should remain in place for students. For those seeking in-person consultation, all products within the HWVM are available within the campus pharmacy at Health Services, where a pharmacist and a Doctor of Pharmacy student intern are readily available for consultation.

The demographics of the survey sample were consistent with those of the overall University population. According to the URI Common Data Set for the 2024–2025 academic year, approximately 58.2% of campus students were women, with 70.9% White and Non-Hispanic.[21] With more than half of respondents in the survey identifying as underclassmen, this may suggest that younger students are more health conscious or curious, as they are newly navigating their own independent health decisions. Having a large population sample from the younger student body also reflects the target population for additional interventions aimed at improving access to OTC health resources at URI.

Limitations

Data collected was associated with a single university, which can limit generalizability to broader populations, especially those with different health resources available. Next, the sample size was relatively small with predominantly White/Caucasian female respondents, which may not accurately represent the diversity of the student body at other colleges and universities. Lastly, results reflected a lower-than-expected use of the HWVM, which may have limited the number of responses related to algorithm and kiosk use.

CONCLUSION

This study is the first to evaluate the potential use of a symptom-based algorithm and kiosk to guide OTC medication selection at a university health and wellness vending machine. Implementation of these tools can support college students in making informed, autonomous health decisions by providing access to product information, symptom guidance, and links to campus health services. Survey findings suggest that students prefer accessing the algorithm via their phones rather than the kiosk, highlighting the importance of multiple accessible options for OTC guidance.

References

1. Drug Diversion Toolkit: Patient Counseling - A pharmacist's Responsibility to Ensure Compliance. Published online November 2014. https://www.cms.gov/files/document/patientcounselingbooklet111414pdf#:~:text=An%20effective%20counseling%20session%20between,by%20law%20in%20most%20States
2. Gallagher A. pharmacists help educate patients on self care otc interventions. *DrugTopics.com*. Published online April 4, 2025. https://www.drugtopics.com/view/pharmacists-help-educate-patients-on-self-care-otc-interventions
3. Straw A, Mills J, Winters R, Van De Roovaart H, Chen AMH. Community pharmacies and the empowerment of self-care in the United States. *Explor Res Clin Soc Pharm*. 2023;10:100266. doi:10.1016/j.rcsop.2023.100266
4. Harrington K, Jarrell DL. Over-The-Counter Drugs Laws. In: *StatPearls*. StatPearls Publishing; 2025. Accessed July 9, 2025. http://www.ncbi.nlm.nih.gov/books/NBK603745/
5. Abdullah IS, Chaw LL, Koh D, et al. Over-the-Counter Medicine Attitudes and Knowledge among University and College Students in Brunei Darussalam: Findings from the First National Survey. *Int J Environ Res Public Health*. 2022;19(5):2658. doi:10.3390/ijerph19052658
6. Bekele KM, Abay AM, Mengistu KA, et al. Knowledge, Attitude, and Practice on Over-the-Counter Drugs Among Pharmacy and Medical Students: A Facility-Based Cross-Sectional Study. *Integr Pharm Res Pract*. 2020;Volume 9:135-146. doi:10.2147/iprp.s266786
7. Kim S, Sinn D, Syn SY. Analysis of College Students' Personal Health Information Activities: Online Survey. *J Med Internet Res*. 2018;20(4):e132. doi:10.2196/jmir.9391
8. Shi W. Health Information Seeking versus Avoiding: How Do College Students Respond to Stress-related Information? *Am J Health Behav*. 2019;43(2):437-448. doi:10.5993/ajhb.43.2.18
9. Houlihan K, Bratberg J, Scarpa RC, Cohen L, Lemay V. Health and wellness twenty-four seven: Student preferences for and utilization of a university vending machine. *J Am Coll Health*. Published online April 9, 2025:1-11. doi:10.1080/07448481.2025.2487610
10. Hill JR, Patel H, Gardner B, et al. A digital health kiosk is acceptable, usable, and improves decisions about high-risk over-the-counter medications when used by older adults: Results of formative user testing. *J Am Pharm Assoc*. Published online June 2025:102451. doi:10.1016/j.japh.2025.102451
11. Maramba ID, Jones R, Austin D, Edwards K, Meinert E, Chatterjee A. The Role of Health Kiosks: Scoping Review. *JMIR Med Inform*. 2022;10(3):e26511. doi:10.2196/26511
12. Top 10 Ways College Campuses Utilize Interactive Kiosks. *Adv Kiosks*. Accessed July 11, 2025. https://advancedkiosks.com/college-and-university/college-campuses-interactive-kiosks/
13. Wellness Kiosk Public Health Initiatives University of Illinois Chicago. Accessed July 11, 2025. https://publichealthinitiatives.uic.edu/health-hub/wellness-kiosk/
14. Zobel M, Knapp B, Nateqi J, Martin A. Correlating global trends in COVID-19 cases with online symptom checker self-assessments. V. E. S, ed. *PLOS ONE*. 2023;18(2):e0281709. doi:10.1371/journal.pone.0281709
15. Case Study: COVID-19 Symptom Checker and Triage Tool. Published online June 1, 2023. https://cdhi.ucsf.edu/case-study-covid-19-symptom-checker-and-triage-tool
16. Pharmacy Vending Machine FAQs. Accessed July 11, 2025. https://www.purdue.edu/rx/faq.php
17. Sidorowicz HM, Hughes AT, Trieloff AG, et al. Evaluating the Impact of a University Pharmacy Vending Machine Program. *Health Behav Res*. 2024;7(3). doi:10.4148/2572-1836.1232
18. Healthy Heels To Go Vending Machine Items. Accessed July 11, 2025. https://campushealth.unc.edu/services/pharmacy/healthy-heels-to-go-vending-machine-items/

19. University of Michigan Health Symptom Checker. Accessed July 11, 2025. https://www.uofmhealth.org/health-library/sx#
20. Schimmelfing JT, Brookhart AL, Fountain KMB, Goode JV "Kelly" R. Pharmacist intervention in patient selection of nonprescription and self-care products. *J Am Pharm Assoc*. 2017;57(1):86-89.e1. doi:10.1016/j.japh.2016.08.017
21. Common Data Set 2024-2025. Accessed July 11, 2025. https://web.uri.edu/ir/wp-content/uploads/sites/276/CDS-2024-2025-fillable.pdf

Authors

Lucas Nicolau, PharmD, URI College of Pharmacy, Kingston, Rhode Island.

Jeffrey Bratberg, PharmD, FAPhA, URI College of Pharmacy, Kingston, Rhode Island.

Katherine Houlihan, PharmD, URI College of Pharmacy, Kingston, Rhode Island.

Virginia Lemay, PharmD, URI College of Pharmacy, Kingston, Rhode Island.

Disclosures

Disclaimer: The views expressed herein are those of the authors and do not necessarily reflect the views of the University of Rhode Island. All authors agree to be accountable for all aspects of the work.

Acknowledgments: Division of Student Affairs, Information Technology Support Services, Health Services, Library Administration, Campus Store, College of Pharmacy Administration, student pharmacists from Dr. Bratberg's public health advanced pharmacy practice experiences, with special thanks to Emily Lancor, Amanda Blais, & Hanna Iarussi, (all PharmD'24) who originated, developed and presented the idea for a health and wellness vending machine at URI, as well as Abbey Strollo, BSPS'25, and Mia Ragosta, PharmD'26, for their assistance with survey deployment and algorithm development.

Correspondence

Virginia Lemay, PharmD
glemay@uri.edu

Hypothyroidism and Risk of Inflammatory Bowel Disease: Influence of Age and Race in a Global Cohort

DANIEL R. WIELAND; JULIA R. WIELAND; CHIEN-CHIH CHOU, MD, PHD; CHING-HENG LIN, PhD; CHIEN-HSIANG WENG, MD, MPH

ABSTRACT

BACKGROUND: Thyroid and gastrointestinal autoimmune conditions may share overlapping immunological, genetic, and microbial pathways, but the relationship between hypothyroidism and inflammatory bowel disease (IBD) remains unclear.

METHODS: We conducted a retrospective cohort study using electronic health record data from 125 healthcare organizations within a global research network to examine the association between hypothyroidism and IBD in a large, racially diverse, multinational population, stratified by age and race. Adults aged 18 to 100 years with or without hypothyroidism were included. Those with IBD risk factors or prior diagnoses were excluded. The primary outcome was a new diagnosis of Crohn's disease or ulcerative colitis within five years after the hypothyroidism or control index date. Propensity score matching was performed 1:1 based on age and sex. Odds ratios were calculated to assess the association, stratified by race and age.

RESULTS: Among nearly 30 million individuals, patients with hypothyroidism had a significantly increased risk of developing IBD in African American and Asian populations, with odds ratios of 1.329 and 1.662, respectively. In Caucasians, risk increased only in individuals over age 50, while those under 50 showed a slight reduction. The strength and direction of association varied by age and race.

CONCLUSIONS: Hypothyroidism is associated with increased IBD risk primarily among older adults in African American, Asian, and Caucasian populations, while younger Caucasians showed a modest reduction in risk. These findings suggest a complex autoimmune relationship influenced by both age and race.

KEYWORDS: hypothyroidism; inflammatory bowel disease; autoimmune disease; electronic health records; race

INTRODUCTION

Inflammatory bowel disease (IBD) refers to chronic inflammatory conditions of the gastrointestinal (GI) tract, primarily Crohn's disease (CD) and ulcerative colitis (UC). CD is characterized by transmural inflammation and skip lesions that can affect any part of the GI tract, typically presenting with colicky abdominal pain, weight loss, and watery diarrhea. Complications include strictures and fistulas. In contrast, UC involves continuous mucosal inflammation limited to the colon and rectum, often causing bloody diarrhea, tenesmus, and systemic symptoms such as fever and weight loss.[1,2]

Globally, IBD prevalence increased from 3.7 million in 1990 to nearly 7 million in 2017, with age-standardized rates rising from 79.5 to 84.3 per 100,000.[3] Given its typical onset between ages 15 and 30 and chronic nature, IBD imposes substantial costs—estimated at $9,000–12,000 per person in high-income countries and approximately $50 billion annually in the United States (U.S.).[4]

Given the rising global burden of IBD, numerous studies have explored its pathogenesis and risk factors. Although its exact etiology remains unclear, IBD is thought to result from a complex interplay of environmental, genetic, immunological, and microbial factors. However, few studies have specifically examined the link between hypothyroidism and IBD.

Hypothyroidism is a chronic thyroid disorder marked by deficient production of thyroxine (T4) and triiodothyronine (T3). Its prevalence in the U.S. is estimated at 3–7%, with similar upper-range estimates in Europe and parts of Asia. An additional 5% may have undiagnosed overt hypothyroidism. Globally, iodine deficiency is the leading cause of thyroid dysfunction, while in iodine-sufficient regions, Hashimoto's thyroiditis is most common.[5] Hypothyroidism is also associated with gastrointestinal symptoms such as constipation, dyspepsia, and delayed gastric emptying due to reduced GI motility.[6]

Given the importance of thyroid hormones on the gut and incompletely understood etiology of IBD, this paper examines the associated risks of developing IBD in patients with a history of hypothyroidism stratified by race and age. Here, we utilize the TriNetX Global Collaborative Network database, one of the most comprehensive global databases, to perform a retrospective cohort study to investigate this association.

MATERIALS AND METHODS

Data Source

We utilized a comprehensive, de-identified global federated health research network with data sourced from the TriNetX Global Collaborative Network, encompassing 125 healthcare organizations (HCOs) (data accessed in July, 2024). TriNetX continuously aggregates clinical data directly from participating HCOs, ensuring rigorous data quality and accuracy assessment. TriNetX does not provide identifiers for participating HCOs; typically, these organizations include large academic health centers offering inpatient, outpatient, and specialty care services.

Patient and Data Selection

We included all adult patients (aged 18–100 years) from the 125 HCOs globally in the TriNetX Global Collaborative Network, recording their age, sex, and race. Due to the large sample size exceeding the platform's computational limits, analyses were stratified by race—Caucasians (Whites), African Americans or Blacks (Blacks), and Asians (Asians). [**Figure 1**].

To mitigate confounding, we excluded patients with certain known or suspected risk factors for IBD, which could not be adequately adjusted for using multivariable regression or high-dimensional propensity score matching, as these were not supported on the platform at the time of analysis. Specifically, patients were excluded if they had a history of: mood disorders, anxiety, stress-related and other nonpsychotic mental disorders (ICD-10-CM codes F30–F39, F40–F48), vitamin D deficiency (E55), nicotine dependence (F17), or gastrointestinal cancers (ICD-10-CM: Z85.01–Z85.04, Z85.06; ICD-9-CM: V10.0, V10.09).

These conditions were selected based on their established or hypothesized associations with IBD in the literature and were identified using ICD-10/ICD-9 codes that are routinely mapped in the TriNetX platform. While TriNetX does not independently validate individual coding accuracy across its federated network, these diagnostic codes are derived from electronic health records of contributing institutions and have been used in numerous peer-reviewed studies leveraging this database.

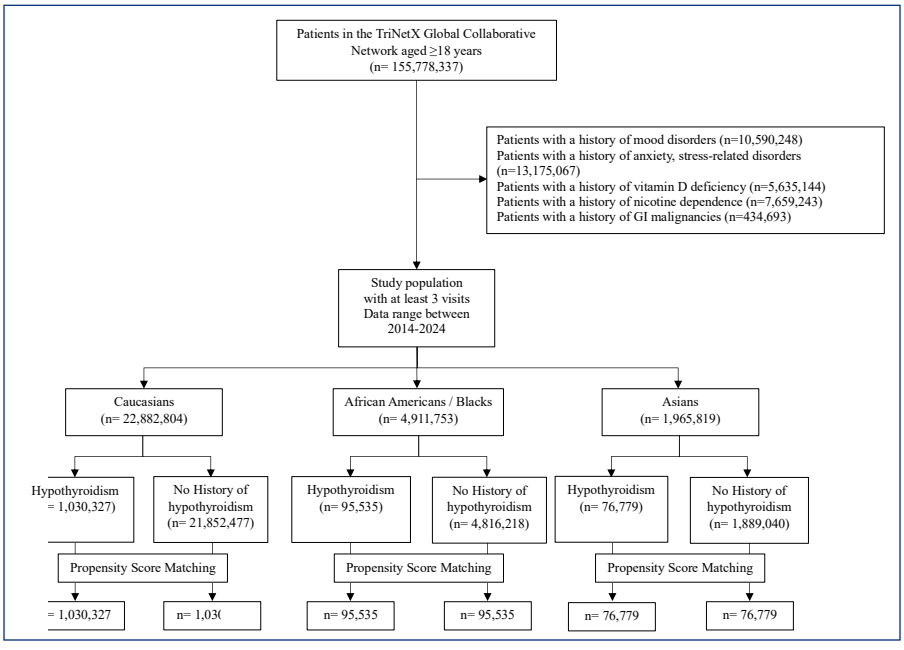
Hypothyroidism

Patients with a diagnosis of hypothyroidism (ICD 10-CM codes: E01-E03, E06.3) between July 1, 2014, and July 1, 2024, documented in three or more visits, were identified. Only patients aged 18 years and older at the time of their first hypothyroidism diagnosis were included in the analysis. Patients meeting the selection criteria but without a hypothyroidism diagnosis served as the control group.

Inflammatory Bowel Disease

Patients diagnosed with Crohn's disease (ICD 10-CM code: K50) or ulcerative colitis (ICD 10-CM code: K51) within five years after the diagnosis of hypothyroidism or the index date in the control group were identified as the outcome of interest.

Figure 1. Flowchart of cohort selection and matching. Adult patients aged 18 years or older with at least three clinical visits between 2014 and 2024 were identified from the TriNetX Global Collaborative Network. Exclusions included patients with prior mood or anxiety disorders, vitamin D deficiency, nicotine dependence, or gastrointestinal malignancies. Eligible patients were stratified by race (Caucasians, African Americans or Blacks, and Asians) and by hypothyroidism status. Propensity score matching was performed 1:1 by age and sex within each racial group.



STATISTICAL ANALYSES

Given the substantial sample size differences between cohorts (control: Whites, n=21,852,477, Blacks, n= 4,816,218, Asians, n=1,889,040; hypothyroidism: Whites, n=1,030,327, Blacks, n=95,535, Asians, n=76,779) and to account for potential confounders, we performed 1:1 propensity score matching without replacement based on age at index and sex. This method generates matched samples, balancing the distribution of observed characteristics between the hypothyroidism and control groups, thereby reducing the confounding effect of these factors and isolating the true effect of hypothyroidism on the study outcomes. Patients with missing data for any variables used in propensity score matching (e.g., age, sex, race in stratified analyses)

were automatically excluded from matching and subsequent analyses by the TriNetX platform. This ensures that only complete cases were included in the matched cohorts.

We examined differences in baseline characteristics before and after matching using standardized mean differences (SMDs), with an SMD less than 0.1 considered indicative of adequate covariate balance between groups. For descriptive purposes, continuous variables were summarized as means with standard deviations and categorical variables as frequencies with percentages. Outcome differences were evaluated using odds ratios (ORs) and 95% confidence intervals (CIs). All statistical tests were two-tailed, and a p-value of less than 0.05 was considered statistically significant. All analyses were performed within the TriNetX integrated analytics environment, which utilizes Java 11.0.16, R version 4.0.2, and Python 3.7 with relevant statistical libraries. The platform's analytic engine is proprietary and its underlying code is not publicly available.

To evaluate the robustness of our findings against potential unmeasured confounding, we calculated E-values for the observed associations between hypothyroidism and IBD. The E-value quantifies the minimum strength of association that an unmeasured confounder would need to have with both the exposure and the outcome to fully explain away the observed association. Additionally, we assessed consistency of the association across multiple racial and age-stratified subgroups to strengthen causal inference through triangulation of evidence.

Ethical Considerations

Institutional Review Board (IRB) approval was obtained (Taichung Veterans General Hospital IRB# CE24249A). This retrospective study is exempt from informed consent. The data reviewed is a secondary analysis of existing data, does not involve intervention or interaction with human subjects, and is de-identified per the de-identification standard defined in Section §164.514(a) of the HIPAA Privacy Rule.

RESULTS

A total of 29,760,376 patients were included for analysis: 22,882,804 Caucasians (Whites), 4,911,753 African Americans or Blacks (Blacks), and 1,965,819 Asians (Asians). Prior to propensity score matching (PSM), the mean age for hypothyroidism and control groups was 59.5 and 47.8 years (p<0.001) in Whites, 56.9 and 43.0 years (p<0.001) in Blacks, and 54.1 and 45.3 years (p<0.001) in Asians. Among Whites, 71.4% vs. 53.5% were female, 76.3% vs. 58.5% in Blacks, and 75.8% vs. 56.5% in Asians (all p<0.001) in the hypothyroidism and control groups, respectively [**Table 1**].

After PSM, the mean age was 59.5 years in Whites, 56.9 years in Blacks, and 54.1 years in Asians for both groups, with 71.4% female in Whites, 76.3% female in Blacks, and 75.8% female in Asians. The mean follow-up durations post-matching were 877.9 days for the hypothyroidism group and 866.7 days in the control group in Whites; 817.5 days and 836.4 days in Blacks; 845.9 days and 871.0 days in Asians [**Table 1**].

Table 1. Baseline demographics of hypothyroidism and control groups before and after propensity score matching, stratified by race

Caucasians	**Pre-matching**			**Post-matching**		
	Hypothyroidism (n=1,030,327)	Control (n=21,852,477)	SMD	Hypothyroidism (n=1,030,327)	Control (n=1,030,327)	SMD
Age, mean (SD), yr	59.5 (17.0)	47.8 (18.4)	0.661	59.5 (17.0)	59.5 (17.0)	<0.001
Sex, n (%)						
Female	736,140 (71.4)	11,073,454 (53.5)	0.378	736,140 (71.4)	736,140 (71.4)	<0.001
Male	293,020 (28.4)	9,614,097 (46.4)	0.378	293,020 (28.4)	293,020 (28.4)	<0.001
African Americans/Blacks	**Pre-matching**			**Post-matching**		
	Hypothyroidism (n=95,535)	Control (n=4,816,218)	SMD	Hypothyroidism (n=95,535)	Control (n=95,535)	SMD
Age, mean (SD), yr	56.9 (16.7)	43.0 (17.4)	0.813	56.9 (16.7)	56.9 (16.7)	<0.001
Sex, n (%)						
Female	72,892 (76.3)	2,690,578 (58.5)	0.387	72,892 (76.3)	72,892 (76.3)	<0.001
Male	22,577 (23.6)	1,904,245 (41.4)	0.386	22,577 (23.6)	22,577 (23.6)	<0.001
Asians	**Pre-matching**			**Post-matching**		
	Hypothyroidism (n=76,779)	Control (n=1,889,040)	SMD	Hypothyroidism (n=76,779)	Control (n=76,779)	SMD
Age, mean (SD), yr	54.1 (17.9)	45.3 (17.6)	0.496	54.1 (17.9)	54.1 (17.9)	<0.001
Sex, n (%)						
Female	58,229 (75.8)	998,341 (56.5)	0.418	58,229 (75.8)	58,229 (75.8)	<0.001
Male	18,536 (24.1)	767,992 (43.5)	0.417	18,536 (24.1)	18,536 (24.1)	<0.001

SD: standard deviation; SMD: standardized mean difference

Table 2. Associations between Hypothyroidism and Inflammatory Bowel Disease in Different Racial Groups

Caucasians	Hypothyroidism	Control	OR (95% CI)	*p* value
IBD, n (%)	3,682 (0.3)	4,185 (0.4)	0.886 (0.847, 0.926)	<0.001
Ulcerative colitis, n (%)	2,467 (0.2)	2,326 (0.2)	1.065 (1.007, 1.127)	0.029
Crohn's disease, n (%)	1,309 (0.1)	1,796 (0.2)	0.731 (0.681, 0.785)	<0.001
African Americans/Blacks	**Hypothyroidism**	**Control**	**OR (95% CI)**	***p* value**
IBD, n (%)	271 (0.3)	205 (0.2)	1.329 (1.108, 1.593)	0.002
Ulcerative colitis, n (%)	190 (0.2)	101 (0.1)	1.887 (1.482, 2.403)	<0.001
Crohn's disease, n (%)	109 (0.1)	78 (0.1)	1.400 (1.047, 1.873)	0.023
Asians	**Hypothyroidism**	**Control**	**OR (95% CI)**	***p* value**
IBD, n (%)	205 (0.3)	124 (0.2)	1.662 (1.330, 2.078)	<0.001
Ulcerative colitis, n (%)	145 (0.2)	79 (0.1)	1.843 (1.401, 2.425)	<0.001
Crohn's disease, n (%)	58 (0.1)	46 (0.1)	1.263 (0.858, 1.860)	0.236

All results were calculated after propensity score matching. CI: confidence interval; SD: standard deviation

In Whites, 3,682 (0.3%) in the hypothyroidism group and 4,185 (0.4%) in the control group had IBD, with an OR of 0.886 (p<0.001). In Blacks, 271 (0.3%) in the hypothyroidism group and 205 (0.2%) in the control group had IBD, yielding an OR of 1.329 (p=0.002). In Asians, 205 (0.3%) in the hypothyroidism group and 124 (0.2%) in the control group had IBD, with an OR of 1.662 (p<0.001) [**Table 2**].

Table 3. Associations between Hypothyroidism and Subtypes of Inflammatory Bowel Disease in Different Age Groups

	Hypothyroidism vs control	OR (95% CI)	*p* value
Caucasians			
IBD	18 ≤ Age < 50 (yr)	0.891 (0.809, 0.980)	0.018
	50 ≤ Age ≤ 100 (yr)	1.229 (1.161, 1.301)	<0.001
UC	18 ≤ Age < 50 (yr)	0.886 (0.783, 1.002)	0.054
	50 ≤ Age ≤ 100 (yr)	1.178 (1.106, 1.255)	<0.001
CD	18 ≤ Age < 50 (yr)	0.607 (0.529, 0.696)	<0.001
	50 ≤ Age ≤ 100 (yr)	0.769 (0.708, 0.835)	<0.001
African Americans/Blacks			
IBD	18 ≤ Age < 50 (yr)	0.962 (0.644, 1.435)	0.848
	50 ≤ Age ≤ 100 (yr)	1.646 (1.291, 2.099)	<0.001
UC	18 ≤ Age < 50 (yr)	1.622 (1.057, 2.488)	0.025
	50 ≤ Age ≤ 100 (yr)	2.317 (1.731, 3.100)	<0.001
CD	18 ≤ Age < 50 (yr)	0.893 (0.558, 1.428)	0.636
	50 ≤ Age ≤ 100 (yr)	1.692 (1.184, 2.418)	0.004
Asians			
IBD	18 ≤ Age < 50 (yr)	0.886 (0.596, 1.319)	0.552
	50 ≤ Age ≤ 100 (yr)	1.642 (1.251, 2.155)	<0.001
UC	18 ≤ Age < 50 (yr)	0.801 (0.503, 1.276)	0.349
	50 ≤ Age ≤ 100 (yr)	1.549 (1.179, 2.036)	0.002
CD	18 ≤ Age < 50 (yr)	0.731 (0.445, 1.200)	0.213
	50 ≤ Age ≤ 100 (yr)	1.364 (0.887, 2.098)	0.156

A subgroup analysis was conducted to examine the association across different age groups, using 50 years as the cut-off. Among White patients, those diagnosed with hypothyroidism before the age of 50 had a lower likelihood of developing inflammatory bowel disease (IBD) (OR 0.891, p=0.018). Conversely, for those aged 50 years and older with hypothyroidism, there was a significantly increased risk of IBD in Whites (OR 1.229, p<0.001), Blacks (OR 1.646, p<0.001), and Asians (OR 1.642, p<0.001) [**Table 3**].

To assess the robustness of our findings against potential unmeasured confounding, we calculated E-values for the observed associations between hypothyroidism and IBD. Among Asians, the observed odds ratio (OR=1.662) corresponded to an E-value of 2.71, indicating that an unmeasured confounder would need to be associated with both hypothyroidism and IBD by a risk ratio of at least 2.71 each, above and beyond the measured covariates, to explain away the observed association. The lower bound of the 95% confidence interval (CI=1.330) yielded an E-value of 1.99. Similarly, for Blacks (OR=1.329), the E-value was 1.99 (lower CI bound=1.454), and for Whites aged ≥50 years (OR=1.229), the E-value was 1.76 (lower CI bound=1.593). These E-values suggest that only unmeasured confounders with relatively strong associations would be capable of fully accounting for the observed effects.

DISCUSSION

In this large, multinational cohort study of nearly 30 million patients, hypothyroidism was significantly associated with increased risk of IBD among African American and Asian individuals, and among Caucasians aged 50 years and older. In contrast, younger Caucasians with hypothyroidism showed a modest reduction in IBD risk. These findings highlight a complex, age- and race-dependent relationship between hypothyroidism and IBD.

Hypothyroidism is linked to alterations in gut microbiome, including reduced bacterial diversity, increased in pro-inflammatory species, and slowed gut motility. Growing evidence that gut microbiota influences thyroid hormone synthesis, conjugate hydrolysis, and immune modulation, potentially impacting autoimmune thyroid diseases, particularly Hashimoto's thyroiditis.[7,8] Additionally, short-chain fatty acids produced by gut bacteria can influence the conversion of T4 to T3.[9] Microbial metabolites may impact thyroid malignancies by affecting DNA damage, apoptosis, and chronic inflammation.[8] Conversely, studies have also shown that thyroid function can affect intestinal microbial

population, where overt hypothyroidism is associated with a greater chance of bacterial overgrowth development.[10] The complex bidirectional relationship of the thyroid-gut axis highlights the need for further investigation into their interaction and its potential therapeutic implications for thyroid-related disorders.

Hashimoto's thyroiditis, the most common type of hypothyroidism, and IBD are autoimmune diseases, suggesting a common underlying immune dysregulation. Many complications of IBD are extra-intestinal and affect other organ systems, such as dermatologic, musculoskeletal, ocular, renal, and pulmonary systems.[11] Therefore, it seems reasonable to conclude a link between thyroid disorders and IBD. However, previous literature had inconclusive results regarding the relationship between thyroid disorders and IBD. A 2016 review of 46 total cases of thyroid disorders and IBD found no difference in the prevalence of the diseases.[12] One study suggests an inverse relationship between IBD and thyroid disorders, while another suggests an increased risk of developing Graves' disease (GD) with Crohn's disease, but UC might reduce the likelihood of developing GD.[13,14] A 2018 study concluded that patients with congenital hypothyroidism have an increased risk of developing IBD, and another suggested a significant association between UC and thyroid disorders, particularly simple goiter and hyperthyroidism.[15,16] These conflicting findings highlight the complexity of the relationship between IBD and thyroid disorders, suggesting that different mechanisms may be at play depending on the specific subtype of IBD and the type of thyroid dysfunction

Hypothyroidism leads to systemic low-grade inflammation, which could exacerbate gut inflammation and contribute to IBD. Both hyperthyroidism and hypothyroidism are associated with oxidative stress and dual oxidases (DUOX), which are essential for thyroid peroxidase-catalyzed hormone synthesis.[17,18] Loss-of-function mutations in DUOX2 are common genetic sources of congenital hypothyroidism that has been linked to an increased risk of developing IBD.[16] DUOX2 also plays a crucial role in the barrier epithelial cells of the gastrointestinal tract, helping to defend against potential microbial threats, such as limiting *Helicobacter* colonization.[19] This dual role of DUOX2 in both thyroid hormone synthesis and gastrointestinal epithelial defense suggests a potential link between thyroid disorders and inflammatory bowel diseases.

Additionally, Grasberger et al have shown an association between loss-of-function DUOX2 variant mice and increased plasma levels of interleukin-17C, a proinflammatory cytokine released by activated T cells, which has been associated with exacerbating intestinal inflammation and IBD.[20,21]

Other genes play a crucial role in the development of both thyroid disorders and IBD, with several being implicated in the pathogenesis of both conditions. For example, cytotoxic T-lymphocyte-associated protein 4 (CTLA-4) has been associated with increased susceptibility to thyroid autoimmunity.[22] CTLA-4 is an immune checkpoint regulator that influences T-cell activation, and its polymorphisms have been linked to several autoimmune diseases, including hypothyroidism and IBD.[23] Genetic variations can influence immune system regulation, making individuals more susceptible to developing autoimmune diseases, such as hypothyroidism and IBD. They can help explain the overlap between thyroid disorders and IBD. One study by Wu et al utilized genome-wide association studies to determine that elevated levels of TSH found in hypothyroidism were associated with reduced risk of CD, with the interferon-inducible protein-10 (IP-10) being linked as one of the main suspected causal factors.[24] This is consistent with the decreased odds ratio for Caucasians for all age groups in our dataset.

Subgroup analysis showed that age at hypothyroidism diagnosis significantly influenced IBD risk. Among Caucasians, those diagnosed before age 50 had a slightly reduced risk, while those diagnosed at 50 or older had a significantly increased risk. Similarly, older African American and Asian patients exhibited markedly elevated IBD risk. These findings suggest that later-onset hypothyroidism may reflect greater immune dysregulation or cumulative inflammation, while earlier-onset cases may involve different mechanisms or benefit from earlier management. This age-dependent pattern highlights the complex interplay between thyroid function, immunity, and gut inflammation.

To further evaluate the potential impact of unmeasured confounding on our findings, we performed E-value analysis. The results indicated that the observed associations, particularly those in Asians and older African Americans, were relatively robust to unmeasured confounding. For example, the association between hypothyroidism and IBD in Asians (OR=1.662) had an E-value of 2.71, and even the lower limit of the confidence interval (1.330) corresponded to an E-value of 1.99. These thresholds imply that an unmeasured confounder would need to have a strong, dual association with both exposure and outcome to nullify the observed relationship. Given the rigor of our inclusion criteria and exclusion of known IBD risk factors, it is unlikely that residual confounding alone could explain these associations. The use of E-value analysis adds quantitative support to the robustness of our findings.

Strengths and limitations

This study benefits from a large, ethnically diverse population drawn from the TriNetX Global Collaborative Network, supporting the generalizability of findings across multiple healthcare settings. The application of rigorous propensity score matching enhanced internal validity by reducing confounding related to demographic characteristics, and the requirement for hypothyroidism to be documented at three or more separate clinical visits likely improved diagnostic specificity.

Despite these strengths, several limitations should be acknowledged. First, as an observational study, causality between hypothyroidism and IBD cannot be definitively

inferred. Although statistical matching and exclusion criteria were applied, residual confounding may persist due to unmeasured variables such as family history of IBD, medication use (including levothyroxine), and socioeconomic status, which were not available on the TriNetX platform for matching at the time of analysis. For medication use specifically, we were unable to ensure compliance, account for dose adjustments, or determine the adequacy of disease management; therefore, these variables were not included. To address the possibility of unmeasured confounding, we performed E-value analysis, which suggested that only confounders with relatively strong associations with both hypothyroidism and IBD would be capable of fully explaining away the observed associations. Second, the reliance on ICD-10-CM codes for disease identification introduces potential for misclassification bias. While our definition of hypothyroidism required multiple diagnostic codes to increase specificity, the same robustness could not be applied to IBD as biopsy confirmation was not available. However, prior validation work in U.S. Veterans Health Administration datasets found that using ICD-10-CM codes for Crohn's disease (K50) or ulcerative colitis (K51), with at least one outpatient encounter, achieved a positive predictive value of approximately 89% for overall IBD, with especially high concordance for ulcerative colitis (~94%) and moderate concordance for Crohn's disease (~80%).[25] Third, missing data were handled using a complete-case approach inherent to the TriNetX platform: patients with missing values for matching or stratification variables (e.g., age, sex, race) were automatically excluded from propensity score matching and subsequent analyses. This ensures that all included cases had complete information, but may reduce sample size and could introduce selection bias if data were not missing at random. Finally, the actual duration of hypothyroidism prior to diagnosis could not be reliably determined. Many patients may have had subclinical or undiagnosed hypothyroidism for years before formal documentation in the EHR, which could affect the timing and magnitude of observed associations.

CONCLUSION

In this large, multinational cohort study, hypothyroidism was associated with an increased risk of IBD, particularly among older adults in African American, Asian, and Caucasian populations. In contrast, younger Caucasians with hypothyroidism showed a modestly reduced risk. These findings suggest an age- and race-dependent relationship between thyroid dysfunction and IBD, potentially driven by shared autoimmune, genetic, or microbial mechanisms. Further research is needed to clarify causality and explore whether early management of hypothyroidism could influence IBD risk.

References

1. Tse CS, Melmed GY, Siegel CA, et al. Bidirectional Correlations Between Health Confidence and Inflammatory Bowel Disease Activity: A Nationwide Longitudinal Cohort Study. Inflamm Bowel Dis 2023;29(1):161-166. DOI: 10.1093/ibd/izac107.
2. Bruner LP, White AM, Proksell S. Inflammatory Bowel Disease. Prim Care 2023;50(3):411-427. DOI: 10.1016/j.pop.2023.03.009.
3. Collaborators GBDIBD. The global, regional, and national burden of inflammatory bowel disease in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet Gastroenterol Hepatol 2020;5(1):17-30. DOI: 10.1016/S2468-1253(19)30333-4.
4. Burisch J, Claytor J, Hernandez I, Hou JK, Kaplan GG. The Cost of Inflammatory Bowel Disease Care: How to Make it Sustainable. Clin Gastroenterol Hepatol 2025;23(3):386-395. DOI: 10.1016/j.cgh.2024.06.049.
5. Chaker L, Bianco AC, Jonklaas J, Peeters RP. Hypothyroidism. Lancet 2017;390(10101):1550-1562. DOI: 10.1016/S0140-6736(17)30703-1.
6. Ebert EC. The thyroid and the gut. J Clin Gastroenterol 2010;44(6):402-6. DOI: 10.1097/MCG.0b013e3181d6bc3e.
7. Virili C, Fallahi P, Antonelli A, Benvenga S, Centanni M. Gut microbiota and Hashimoto's thyroiditis. Rev Endocr Metab Disord 2018;19(4):293-300. DOI: 10.1007/s11154-018-9467-y.
8. Ejtahed HS, Angoorani P, Soroush AR, et al. Our Little Friends with Big Roles: Alterations of the Gut Microbiota in Thyroid Disorders. Endocr Metab Immune Disord Drug Targets 2020;20(3):344-350. DOI: 10.2174/1871530319666190930110605.
9. Fang L, Ning J. Recent advances in gut microbiota and thyroid disease: pathogenesis and therapeutics in autoimmune, neoplastic, and nodular conditions. Front Cell Infect Microbiol 2024;14:1465928. DOI: 10.3389/fcimb.2024.1465928.
10. Lauritano EC, Bilotta AL, Gabrielli M, et al. Association between hypothyroidism and small intestinal bacterial overgrowth. J Clin Endocrinol Metab 2007;92(11):4180-4. DOI: 10.1210/jc.2007-0606.
11. Levine JS, Burakoff R. Extraintestinal manifestations of inflammatory bowel disease. Gastroenterol Hepatol (N Y) 2011;7(4):235-41. (https://www.ncbi.nlm.nih.gov/pubmed/21857821).
12. Shizuma T. Concomitant Thyroid Disorders and Inflammatory Bowel Disease: A Literature Review. Biomed Res Int 2016;2016:5187061. DOI: 10.1155/2016/5187061.
13. Xian W, Wu D, Liu B, et al. Graves Disease and Inflammatory Bowel Disease: A Bidirectional Mendelian Randomization. J Clin Endocrinol Metab 2023;108(5):1075-1083. DOI: 10.1210/clinem/dgac683.
14. Dore MP, Fanciulli G, Manca A, et al. Clinically relevant thyroid disorders and inflammatory bowel disease are inversely related: a retrospective case-control study. Scand J Gastroenterol 2021;56(2):171-176. DOI: 10.1080/00365521.2020.1861323.
15. Jarnerot G, Azad Khan AK, Truelove SC. The thyroid in ulverative colitis and Crohn's disease. II. Thyroid enlargement and hyperthyroidism in ulcerative colitis. Acta Med Scand 1975;197(1-2):83-7. DOI: 10.1111/j.0954-6820.1975.tb04882.x.
16. Grasberger H, Noureldin M, Kao TD, et al. Increased risk for inflammatory bowel disease in congenital hypothyroidism supports the existence of a shared susceptibility factor. Sci Rep 2018;8(1):10158. DOI: 10.1038/s41598-018-28586-5.
17. Varela V, Rivolta CM, Esperante SA, Gruneiro-Papendieck L, Chiesa A, Targovnik HM. Three mutations (p.Q36H, p.G418 fsX482, and g.IVS19-2A>C) in the dual oxidase 2 gene responsible for congenital goiter and iodide organification defect. Clin Chem 2006;52(2):182-91. DOI: 10.1373/clinchem.2005.058321.
18. Mancini A, Di Segni C, Raimondo S, et al. Thyroid Hormones, Oxidative Stress, and Inflammation. Mediators Inflamm 2016;2016:6757154. DOI: 10.1155/2016/6757154.

19. Grasberger H, El-Zaatari M, Dang DT, Merchant JL. Dual oxidases control release of hydrogen peroxide by the gastric epithelium to prevent Helicobacter felis infection and inflammation in mice. Gastroenterology 2013;145(5):1045-54. DOI: 10.1053/j.gastro.2013.07.011.
20. Fujino S, Andoh A, Bamba S, et al. Increased expression of interleukin 17 in inflammatory bowel disease. Gut 2003;52(1):65-70. DOI: 10.1136/gut.52.1.65.
21. Grasberger H, Magis AT, Sheng E, et al. DUOX2 variants associate with preclinical disturbances in microbiota-immune homeostasis and increased inflammatory bowel disease risk. J Clin Invest 2021;131(9). DOI: 10.1172/JCI141676.
22. Chistiakov DA, Turakulov RI. CTLA-4 and its role in autoimmune thyroid disease. J Mol Endocrinol 2003;31(1):21-36. DOI: 10.1677/jme.0.0310021.
23. Neuman MG, Nanau RM. Single-nucleotide polymorphisms in inflammatory bowel disease. Transl Res 2012;160(1):45-64. DOI: 10.1016/j.trsl.2011.10.006.
24. Wu S, Yi J, Wu B. Casual associations of thyroid function with inflammatory bowel disease and the mediating role of cytokines. Front Endocrinol (Lausanne) 2024;15:1376139. DOI: 10.3389/fendo.2024.1376139.
25. Patel P, Sherman K, Bajwa S, et al. S998. Validation of ICD-10-CM Diagnosis Codes in Patients With Inflammatory Bowel Disease in the National Veterans Affairs Healthcare System. Official journal of the American College of Gastroenterology |ACG 2023;118(10S):S756. DOI: 10.14309/01.ajg.0000953632.76724.1e.

Authors

Daniel R. Wieland, University of Arizona College of Medicine, Phoenix, Arizona.

Julia R. Wieland, Creighton University School of Medicine, Phoenix, Arizona.

Chien-Chih Chou, MD, PhD, School of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan; Department of Ophthalmology, Taichung Veterans General Hospital, Taichung, Taiwan.

Ching-HengLin, PhD, Department of Medical Research, Taichung Veterans General Hospital, Taichung, Taiwan; Department of Public Health, College of Medicine, Fu Jen Catholic University, New Taipei City, Taiwan.

Chien-Hsiang Weng, MD, MPH, Department of Family Medicine, Warren Alpert Medical School of Brown University, Providence, Rhode Island; Brown Health Medical Group Primary Care, Brown University Health, Providence, Rhode Island.

Disclosures

Funding: None

Conflict of Interest Disclosures (includes financial disclosures): The authors have no conflicts of interest relevant to this article to disclose.

Ethics approval: Institutional Review Board (IRB) approval was obtained (Taichung Veterans General Hospital IRB# CE24249A). This retrospective study is exempt from informed consent. The data reviewed is a secondary analysis of existing data, does not involve intervention or interaction with human subjects, and is de-identified per the de-identification standard defined in Section §164.514(a) of the HIPAA Privacy Rule.

Prior presentations: None.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author, C-H W. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

Correspondence

Chien-Hsiang Weng, MD, MPH
Box G-MHRI, Brown University, Providence, RI 02912
chien-hsiang_weng@brown.edu

COVID Impact on Physician EHR Workload: A Hidden Epidemic?

ROSS W. HILLIARD, MD; JACQUELINE HASKELL, MS; NICHOLAS JONES, PhD; REBEKAH L. GARDNER, MD

ABSTRACT

OBJECTIVE: To examine whether electronic health record (EHR) workload for primary care and other physicians was associated with increases in COVID-19 cases by region of the United States (US).

MATERIALS & METHODS: Retrospective data analysis of Epic EHR workload measures for almost 500,000 outpatient physicians and other physicians across the US from May 2019 to May 2022.

RESULTS: The association of COVID-19 disease rates on time in the EHR varied by specialty. For primary care physicians, increases in regional disease prevalence were associated with significant increases in the time spent in the In Basket as well as "pajama time" (time outside of scheduled work hours); for other specialties, increases in COVID rates were associated with smaller increases in In Basket time and some region-specific decreases in pajama time. For all participants, regardless of specialty, overall EHR workload increased over the course of the pandemic.

DISCUSSION: Increases in COVID-19 cases were associated with increased EHR workload for outpatient physicians across the US, with the greatest impact on primary care physicians performing asynchronous patient care tasks. These findings capture the experience of almost half a million physicians and illuminate how mitigating burnout from a global pandemic likely also extends to efforts to reduce EHR workload.

CONCLUSION: Our results show direct impacts of COVID-19 rates on physician workloads, particularly in primary care, and can hopefully inform future efforts to manage workload should another pandemic occur.

KEYWORDS: physician workload; electronic health record; COVID-19; primary care; burnout

BACKGROUND AND SIGNIFICANCE

Healthcare workers faced numerous and diverse challenges during the SARS-CoV-2 (COVID) global pandemic. As the world endured changing information, new fears, novel restrictions, and daily frustrations, physicians also navigated limited resources, evolving science, and anxiety about exposure, among many other concerns.[1,2] In a remarkably short time, many, if not most, health systems either implemented or significantly expanded telehealth offerings.[3] This rapid transformation from in-person care to virtual care allowed physicians to continue ministering to their patients during periods of stay-at-home orders and ongoing needs for physical distancing. As parts of the healthcare system shifted to virtual visits and asynchronous care, an unexpected burden arose in the form of the electronic health record (EHR).[4]

Health systems and EHR vendors made significant efforts to expand the use of patient portals, which were in many cases under-utilized prior to the pandemic.[5] With the shift away from the traditional model of in-person periodic visits, some encounters were replaced by telehealth directly, and many additional elements of patient care, such as blood pressure and diabetes management, started to be managed asynchronously.[3] This shift, and the resulting volume of work, often coming in the form of messages in the EHR inbox, has been implicated as one of the drivers of physician burnout both during the pandemic and in the time since the US public health emergency ended.[6-9] Prior work has identified the impact of pandemic-related stress on the intent of physicians to either reduce work hours or leave practice completely.[10]

Even outside of the effects of the COVID pandemic, a growing body of literature has explored variations in the time that different physicians spend on discrete EHR tasks, including documentation and responding to patient messages, as well as the impact of EHRs on physician well-being.[11-19] Outpatient physicians now spend a majority of their scheduled patient care time in the EHR, in addition to the hours they log in the EHR outside of clinic. Primary care physicians are especially hard hit, spending 50% more time in their inbox compared to physicians in other outpatient specialties.[16] Given the impact of EHRs on physicians, some healthcare organizations have made efforts to improve efficiency and decrease the time burden of documentation.[11,13,20] For example, the adoption of team-based documentation may reduce time spent writing notes, but only for the highest-intensity adopters.[11] Use of transcription or dictation may also reduce note-writing burden.[18] Unfortunately, other EHR "efficiency tools" like templates and copy/paste have not been shown to consistently foster efficiency or reduce documentation time and likely also contribute to note bloat.[11,12,14,18]

To date, few studies have explored the impact of disease surges on specific EHR workload elements across the country; rather, they have focused on a single region or healthcare system, have examined only patient calls and messages, or have compared pre- and post-pandemic values in aggregate without incorporating disease prevalence.[3,5,9,21-25] We sought to explore the impact of the COVID pandemic on EHR workload volume in a large national sample to better understand the impact of the pandemic on primary care and other medical specialties.

We hypothesized that increases in COVID prevalence by region would be associated with significant increases in EHR workload metrics, particularly time in EHR system, time spent in In Basket, "pajama time," and time spent in clinical review. We worked with EPIC to obtain aggregated and de-identified EHR use data for almost 500,000 physicians across the US from 2019 to 2022. Our hope is that by better understanding the association between weekly disease rates and EHR workload that we can better prepare to support the healthcare workforce in the future.

MATERIALS AND METHODS

Study Design and Data

To examine the effect of weekly COVID-19 rates on our EHR-specific workload measures, we employed longitudinal regression models with region and physician specialty fixed effects. This analysis used retrospective user-level EHR data from the Epic data warehouse, spanning from May 2019 to May 2022. EHR systems, including EPIC Systems Inc. (Verona, WI), collect a significant amount of data regarding use of the system and the volume of various tasks and other elements that are managed by a variety of practitioners. These data include information on physicians' practicing region, specialty, appointment volume, and time spent in various activities and functions within the EHR. We included data prior to COVID onset to establish baseline EHR use patterns. The Epic workload data was available for monthly time periods from May 2019 to April 2021 and for weekly time periods from May 2021 to May 2022.

From the Centers for Disease Control and Prevention, we received weekly data on the number of new COVID cases.[26] From the United States Census, we received population statistics to calculate COVID rates per 100,000 people.[27] In the analytic dataset, we matched the weekly COVID rates to the weekly EHR workload data, when available. When only monthly Epic workload data was available, we held the workload variables constant across the weeks in each month. We excluded March-April 2020 from the regression analysis because adoption of telehealth into the EHR varied between systems and in some cases the public health emergency allowed for documentation in other systems or even on paper.[21]

Cohort

Physicians included in this cohort were aligned to a facility using Epic as their EHR. Physicians came from 42 states; Washington, D.C. was not included. Though all individuals were classified as physicians, we are aware that many institutions give this role within the EHR to other clinical roles that are purely independent, including podiatrists and optometrists. We suspect that due to the large number of physicians included that these small number of additional clinical roles will have minimal impact on our findings. These states were grouped into eight regions based on census-designations, with slight adjustments based on data size and availability, as detailed in **Table 1**, along with

Table 1. Sample characteristics (N=470,731 physicians)

	Frequency	Percent	Mean	Median
Specialty				
Primary care	127,248	27.0%	—	—
Medicine subspecialty	70,527	15.0%	—	—
Surgery	77,073	16.4%	—	—
Other	109,250	23.2%	—	—
Unknown	86,633	18.4%	—	—
Regions[†]				
Northeast	106,327	22.6%	—	—
Midwest: East North Central	79,128	16.8%	—	—
Midwest: West North Central	17,326	3.7%	—	—
South Atlantic	61,598	13.1%	—	—
South Central	58,543	12.4%	—	—
Mountain	15,372	3.3%	—	—
Pacific: Subset	33,899	7.2%	—	—
Pacific: California	98,538	20.9%	—	—
COVID Rate per 100,000	—	—	156.9	69.6
Appointments per Day	—	—	8.9	7.3
Time in System per Day[‡]	—	—	110.0	97.1
Time in Orders per Day[‡]	—	—	45.4	37.0
Time in In Basket per Day[‡]	—	—	12.1	7.7
Time in Clinical Review per Day[‡]	—	—	18.3	14.8
Pajama Time per Day[‡,§]	—	—	25.1	9.3

[†] Regions are comprised of the following states:
Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island
Midwest: East North Central: Illinois, Indiana, Michigan, Ohio, Wisconsin
Midwest: West North Central: Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma
South Atlantic: Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia
South Central: Alabama, Arkansas, Louisiana, Kentucky, Mississippi, Tennessee, Texas
Mountain: Arizona, Colorado, Nevada, Utah, Wyoming
Pacific: Subset: Hawaii, Oregon, Washington
Pacific: California: California
[‡] Each time metric was calculated in the Epic system as the number of minutes divided by the total number of days that the physicians logged in during the reporting period.
[§] Pajama time is defined as minutes spent in the EHR outside of weekdays between 7 a.m and 5:30 p.m. or outside scheduled hours on weekends or non-scheduled holidays.

participants' other demographic characteristics. Physicians are divided into five mutually exclusive specialty groups (Primary Care, Medicine Subspecialty, Surgery, Other, and Unknown). Though the unknown group is difficult to determine, the Other group included specific roles such as neurology and behavioral health specialties, meaning that it is very unlikely that primary care physicians were inadvertently included in this group. We excluded non-outpatient and non-physician specialties (e.g., dentistry) from the dataset. These specialties included: speech language pathology, dentistry, emergency medicine, diet and nutrition, radiology, pharmacology, podiatry, optometry, hospital medicine, intensive care medicine, genetics, pathology, and lab.

Outcomes and Covariates

Statistical analysis focused on EHR-specific outcomes calculated at the weekly level, chosen due to their direct relevance to physician workload and potential burnout. Each outcome can be described as the average time spent within the EHR by an individual practitioner. Outcomes included minutes spent in In Basket (e.g., reviewing or acting on results and messages), minutes spent in Clinical Review (such as reviewing the patient's chart prior to an appointment), minutes spent in System (i.e., total time a physician is actively logged into their EHR), minutes spent in orders, and pajama time (minutes spent in the EHR outside of weekdays between 7 a.m. and 5:30 p.m. or outside scheduled hours on weekends or non-scheduled holidays).

Each outcome was calculated in the Epic system as the number of minutes divided by the total number of days that the physician logged in during the reporting period. Data for two of these outcomes were only available for the last two years of the study period: data for pajama time started in July 2020 and data for time spent in orders started in November 2020. In all analyses, we controlled for a physician's workload by including their appointments per day.

Statistical Analysis

The analysis used longitudinal-data linear regression models with physician specialty and time-fixed effects (10). These models are stratified by region, and statistical analyses were conducted at the person-week level. Statistical significance is determined at the 99% level. The general specification of the model can be seen in the following equation:

$$yiws = \beta 0 + \beta 1 Ratew + \beta 2 Xiw + \gamma w + \zeta s + \varepsilon iws.$$

Here, y_{ijws} is an outcome experienced by an individual i working during week w belonging to specialty s. In each of the regressions, the primary explanatory variable ($Rate_w$) indicates the rate of new COVID cases per 100,000 people during week w in the region of interest. X_{iw} represents the average number of daily appointments for individual i during week w. The γ_w represents week fixed effects, and ζ_s represents physician specialty fixed effects. Analyses were performed using STATA MP 11.2 (College Station, TX). Regression models exclude observations where the outcome variable is equal to zero.

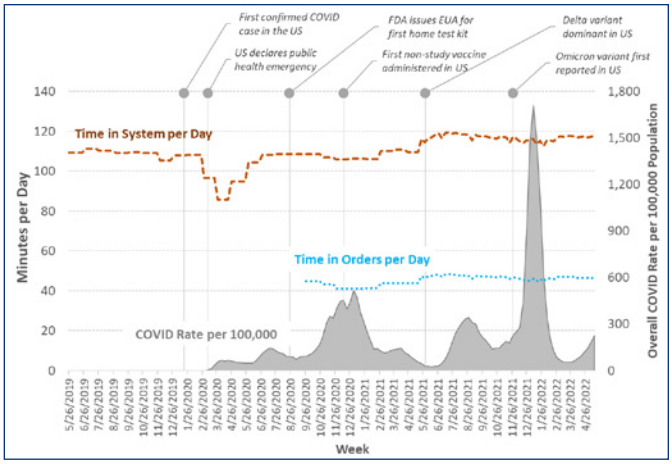
This study used de-identified data (both at the individual physician level and the health system level) and was approved by the Lifespan Health System Institutional Review Board.

RESULTS

Table 1 displays the demographics of our study sample. Primary care physicians comprise the largest portion of our sample, followed by physicians with other or unknown specialties. Regionally, the Northeast contains the most physicians, followed by California. **Table 1** also shows the average COVID rate, the mean appointments per day per physician, and the average time within various EHR work elements. The mean total time in Epic is 110 minutes per day, with more than half of this time being spent in Orders and Clinical Review.

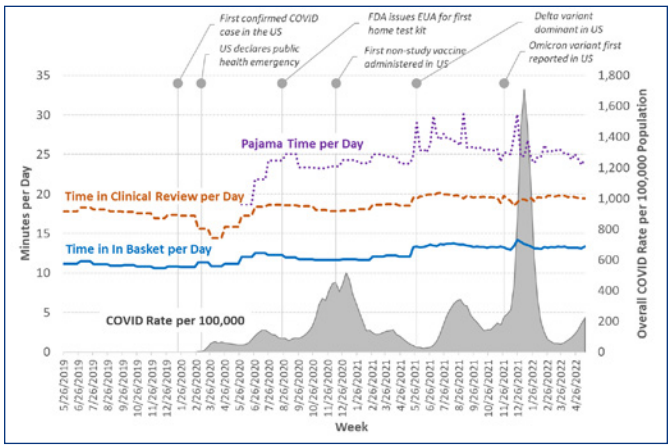
Figure 1 depicts how the average overall time spent in the EHR (Time in System) and the Time in Orders changed in relation to the aggregate mean COVID rate. Time in System decreased in March of 2020, but rebounded after a couple months, with an increase noted in May of 2021, when the EHR workload data in our dataset switched from monthly to weekly time periods. Time in Orders remained relatively consistent until May of 2021, when it also increased.

Figure 1. COVID rates vs. overall time in the system and time in orders —all regions combined



These observations hold for the outcomes depicted in **Figure 2**, which displays time in Clinical Review, time In Basket, and Pajama Time, which measures time spent in the EHR outside of scheduled working hours. Among these variables, Pajama Time in particular increased from May through August of 2020, and continued to increase through the end of the study period.

Figure 2. COVID rates vs. time spent in clinical review, time spent in in-basket, and pajama time—all regions combined



Tables 2 and **3** display regression estimates for Time in System and Time in In Basket, respectively. Primary care physicians serve as the reference group for the by-specialty interaction estimates, and the specialty coefficients have already been transformed in reference to primary care physicians. Time in System [**Table 2**] varied by specialty and by region. Within the Northeast, for example, an increase in the COVID rate of 1 per 100,000 people was associated with a 0.0012 minute per day decrease in time in the system for primary care physicians. Medicine sub-specialists observed a 0.0005 minute per day increase in time in system, and surgeons observed a –0.0001 minute per day decrease. In the Western Midwest, however, that same increase in COVID rate corresponded with a 0.0014 minute per day increase in time spent in the EHR system for primary care physicians, and 0.0001 and 0.0006 minute per day increases for Medicine subspecialists and surgeons, respectively.

Table 2. Time Spent in System (minutes per day) May 2020–May 2022

Coefficients	Northeast	Midwest East	Midwest West	South Atlantic	South Central	Mountain	Pacific Subset	California
COVID Rate (per 100,000)	–0.0012	0.0001‡	0.0014	–0.0010	–0.0002	–0.0024	0.0016	0.0002
COVID Rate * Specialty								
Primary care	ref	ref	ref	ref	ref	ref	ref	ref
Medicine subspecialty	0.0005	0.0016	0.0001	0.0003	0.0008	0.0008	0.0046	–0.0012
Surgery	–0.0001	0.0014	0.0006	0.0004	0.0007	0.0012	0.0022‡	–0.0011
Other	–0.0011‡	–0.0002‡	–0.0008	–0.0014	0.0004	0.0004	–0.0007	–0.0017
Unknown	–0.0034	–0.0021	–0.0009	–0.0030	–0.0021	–0.0013	0.0009‡	–0.0014
Appointments per day	2.401	3.675	3.508	2.937	3.093	3.724	2.778	0.006
Constant	87.339	74.935	76.022	78.892	76.250	81.269	99.328	0.061

Abbreviations: Midwest East = Midwest's East North Central division; Midwest West = Midwest's West North Central division; Pacific Subset = Hawaii, Oregon, and Washington.
‡ Indicates p-values >0.01. All other coefficients were significant at p<0.01.

Table 3. Time Spent in In Basket (minutes per day) May 2020–May 2022

Coefficients	Northeast	Midwest East	Midwest West	South Atlantic	South Central	Mountain	Pacific Subset	California
COVID Rate (per 100,000)	0.0019	0.0029	0.0030	0.0020	0.0022	0.0010	0.0037	0.0000
COVID Rate * Specialty								
Primary care	ref	ref	ref	ref	ref	ref	ref	ref
Medicine subspecialty	0.0010	0.0013	0.0010	0.0012	0.0009	0.0009‡	0.0019	-0.0018
Surgery	0.0006	0.0008	0.0006	0.0005	0.0004	0.0006	0.0012	-0.0023
Other	0.0005	0.0006	0.0006	0.0004	0.0005	0.0010‡	0.0011	-0.0022
Unknown	0.0009	0.0019	0.0020	0.0013	0.0014	0.0009‡	0.0031	-0.0017
Appointments per day	0.093	0.155	0.161	0.125	0.120	0.109	0.107	0.001
Constant	10.519	9.509	10.484	9.035	9.355	11.555	12.755	0.012

Abbreviations: Midwest East = Midwest's East North Central division; Midwest West = Midwest's West North Central division; Pacific Subset = Hawaii, Oregon, and Washington.
‡ Indicates p-values >0.01. All other coefficients were significant at p<0.01.

Results for time spent in In Basket [**Table 3**] were more uniform across regions and specialties. Within the Northeast for example, an increase in COVID rate of 1 per 100,000 people corresponded with a 0.0019 minute increase in time in In Basket for primary care physicians a 0.0010 increase for Medicine subspecialists, and a 0.0006 increase for surgeons. This pattern held across regions with the exception of California.

Supplemental tables

[Note: Supplemental tables are available by emailing corresponding author.]

Results for our other three outcomes (time in clinical review, pajama time, and time in orders) can be found in the supplement [**Tables S.1–S.3**]. Generally, increases in the COVID rate were associated with modest increases in time spent in clinical review, with a few region-specific exceptions for primary care physicians [**Table S.1**]. Increases in the COVID rate were associated with increases in Pajama Time for primary care physicians but decreases in Pajama Time for other specialties [**Table S.2**]. Finally, increases in the COVID rate were associated with decreases in time spent in orders for all specialties [**Table S.3**].

DISCUSSION

This study is the largest exploration of the impact of the COVID pandemic on physician EHR workload to date. We identified an association COVID rates and the amount of time physicians spent performing In Basket tasks, regardless of specialty. For primary care physicians, we also found a significant association between COVID rates and the time spent in the EHR outside of work hours (using Epic's updated "pajama time" metric).

Prior research has described the profound increase in In Basket volume due to the pandemic, as well as the fact that In Basket volume has continued to increase, despite an end to the public health emergency. Other literature has also highlighted the impact of inbox work after work on physicians' intent to reduce clinical effort or depart altogether.[28] Our study adds to this literature by analyzing different types of EHR tasks and by including multiple specialties, which, in turn, allows us to highlight the disproportional impact on primary care physicians across virtually every region of the country. A major strength of our study is the size and breadth of the study population. Though the magnitude of our estimates may be small, when applied to the entirety of our sample population, and then extrapolated to the entire practitioner community, the minutes become an incredibly large number of hours spent in the EHR, with a substantial impact on physicians across the country. This is particularly important considering the multiple efforts to decrease burden that occurred at the same time as the pandemic, including changes to ambulatory evaluation and management documentation requirements in 2021.[29]

Primary care shortages are at crisis levels in many areas of the US. Our findings provide useful context and highlight the critical importance of reducing and redistributing EHR-related tasks before they drive even more primary care physicians out of the field. Patients need to maintain electronic access to their EHR data and to their care teams, so efforts to manage EHR workload should focus on strategies that are simultaneously patient-centered and supportive of physician well-being. Additionally, the pandemic has likely exacerbated existing gender disparities in EHR burden among ambulatory physicians, with women physicians receiving an even greater proportion of patient messages compared to men.[25] Given the large sample size, translating what appear to be small coefficients to actual impact can be challenging. In the In Basket, for primary care physicians in the Northeast an increase of 500 per 100,000 in the COVID infection rate correlated to an increase of 0.95 minutes of In Basket time per PCP per day. This involved over 101,000 added minutes across all PCPs in New England.

Perhaps the most concerning finding is that the time spent in the EHR per day rose during the pandemic for all physicians, and it did not decrease, even as the pandemic progressed and reached an endemic state. This finding rings true for many physicians who find themselves working longer hours with the increase in In Basket volume and work outside of traditional visits.[15,22,24] Both the time spent in clinical review and time in In Basket also persistently remained higher than pre-pandemic levels, which is not surprising as these are significant parts of ambulatory clinical workflows. While regression estimates provide mixed results on time in system in relation to COVID rates, specific EHR areas (like In Basket) show more consistent evidence of increased EHR engagement.

We also identified interesting patterns of EHR work volume during traditional holiday periods for physicians in the US. This work volume, labeled pajama time, consistently increased during major holidays like Thanksgiving, Christmas, Memorial Day, and Independence Day. Given the significant spikes in pajama time, physicians may be working to catch up on their EHR and patient care work during holidays periods that are otherwise designated as time off, when they do not have patient visits scheduled. As recently illustrated, physician burnout rates are tightly linked to the inability to disconnect from clinical work and to lacking appropriate coverage for this work when away.[30] Though patients may need to access their physicians on holidays or weekends, the work volume in these times seems to be rising without a clear solution.

Our study does have several limitations. Due to limitations on our computational processing capacity, we had to break up the country-wide data into regions for the

regression analyses. Though we know that these regions did progress through the pandemic in ways that were relatively similar, we would have liked to present the regression analysis over the entire population. In addition, some data had to be provided by region to avoid identifying a particular healthcare system when there were very few systems in a given state. We also were not able to include data from a few large healthcare systems that operate in numerous states given that the data is only attributed within the Epic database according to the headquarters location. Lastly, the granularity of specialty attribution for physicians included in the dataset varied between regions, likely because of variable specificity in individual health systems. This limited our between-specialty comparisons and led to the rather large subgroups of "other" and "unknown."

CONCLUSION

This is the largest study that we are aware of focusing on the impact of the COVID-19 pandemic on EHR workload, with the inclusion of physicians across the US in multiple specialties. While individual impacts may be relatively small, the collective workload represented in the data and associated with COVID rates comprises a substantial burden on healthcare workers across the country. In addition, our findings on specific areas of EHR workload can guide health systems and individual practices to focus on reducing burdens on their physicians both now and in a future pandemic or other large health event.

References

1. Levine DM, Samal L, Neville BA, et al. The Association of the First Surge of the COVID-19 Pandemic with the High- and Low-Value Outpatient Care Delivered to Adults in the USA. *J Gen Intern Med*. Nov 2022;37(15):3979-3988. doi:10.1007/s11606-022-07757-1.
2. Heintzman J, O'Malley J, Marino M, et al. SARS-CoV-2 Testing and Changes in Primary Care Services in a Multistate Network of Community Health Centers During the COVID-19 Pandemic. *Jama*. Oct 13 2020;324(14):1459-1462. doi:10.1001/jama.2020.15891.
3. Patel SY, Mehrotra A, Huskamp HA, Uscher-Pines L, Ganguli I, Barnett ML. Trends in Outpatient Care Delivery and Telemedicine During the COVID-19 Pandemic in the US. *JAMA Intern Med*. Mar 1 2021;181(3):388-391. doi:10.1001/jamainternmed.2020.5928.
4. Alexander GC, Tajanlangit M, Heyward J, Mansour O, Qato DM, Stafford RS. Use and Content of Primary Care Office-Based vs Telemedicine Care Visits During the COVID-19 Pandemic in the US. *JAMA Netw Open*. Oct 1 2020;3(10):e2021476. doi:10.1001/jamanetworkopen.2020.21476.
5. Holmgren AJ, Downing NL, Bates DW, et al. Assessment of Electronic Health Record Use Between US and Non-US Health Systems. *JAMA Intern Med*. Feb 1 2021;181(2):251-259. doi:10.1001/jamainternmed.2020.7071.
6. Taş BG, Özceylan G, Öztürk GZ, Toprak D. Evaluation of Job Strain of Family Physicians in COVID-19 Pandemic Period- An Example from Turkey. *J Community Health*. Aug 2021;46(4):777-785. doi:10.1007/s10900-020-00950-5.
7. Schaffler-Schaden D, Mergenthal K, Avian A, et al. COVI-Prim Longitudinal Survey: Experiences of Primary Care Physicians During the Early Phase of the COVID-19 Pandemic. *Front Med (Lausanne)*. 2022;9:761283. doi:10.3389/fmed.2022.761283.
8. Holmgren AJ, Apathy NC. Assessing the impact of patient access to clinical notes on clinician EHR documentation. *J Am Med Inform Assoc*. Sep 12 2022;29(10):1733-1736. doi:10.1093/jamia/ocac120.
9. Holmgren AJ, Apathy NC, Sinsky CA, Adler-Milstein J, Bates DW, Rotenstein L. Trends in Physician Electronic Health Record Time and Message Volume. *JAMA Intern Med*. Apr 1 2025;185(4):461-463. doi:10.1001/jamainternmed.2024.8138.
10. Sinsky CA, Brown RL, Stillman MJ, Linzer M. COVID-Related Stress and Work Intentions in a Sample of US Health Care Workers. *Mayo Clin Proc Innov Qual Outcomes*. Dec 2021;5(6):1165-1173. doi:10.1016/j.mayocpiqo.2021.08.007.
11. Apathy NC, Hare AJ, Fendrich S, Cross DA. I had not time to make it shorter: an exploratory analysis of how physicians reduce note length and time in notes. *J Am Med Inform Assoc*. Jan 18 2023;30(2):355-360. doi:10.1093/jamia/ocac211.
12. Apathy NC, Rotenstein L, Bates DW, Holmgren AJ. Documentation dynamics: Note composition, burden, and physician efficiency. *Health Serv Res*. Jun 2023;58(3):674-685. doi:10.1111/1475-6773.14097.
13. Cross DA, Holmgren AJ, Apathy NC. The role of organizations in shaping physician use of electronic health records. *Health Serv Res*. Feb 2024;59(1):e14203. doi:10.1111/1475-6773.14203.
14. Hilliard RW, Haskell J, Gardner RL. Are specific elements of electronic health record use associated with clinician burnout more than others? *J Am Med Inform Assoc*. Jul 1 2020;27(9):1401-1410. doi:10.1093/jamia/ocaa092.
15. Holmgren AJ, Downing NL, Tang M, Sharp C, Longhurst C, Huckman RS. Assessing the impact of the COVID-19 pandemic on clinician ambulatory electronic health record use. *J Am Med Inform Assoc*. Jan 29 2022;29(3):453-460. doi:10.1093/jamia/ocab268.
16. Holmgren AJ, Sinsky CA, Rotenstein L, Apathy NC. National Comparison of Ambulatory Physician Electronic Health Record Use Across Specialties. *J Gen Intern Med*. Nov 2024;39(14):2868-2870. doi:10.1007/s11606-024-08930-4.
17. Rotenstein LS, Apathy N, Edgman-Levitan S, Landon B. Comparison of Work Patterns Between Physicians and Advanced Practice Practitioners in Primary Care and Specialty Practice Settings. *JAMA Netw Open*. Jun 1 2023;6(6):e2318061. doi:10.1001/jamanetworkopen.2023.18061.
18. Rotenstein LS, Apathy N, Holmgren AJ, Bates DW. Physician Note Composition Patterns and Time on the EHR Across Specialty Types: a National, Cross-sectional Study. *J Gen Intern Med*. Apr 2023;38(5):1119-1126. doi:10.1007/s11606-022-07834-5.
19. Sinsky CA, Rotenstein L, Holmgren AJ, Apathy NC. The number of patient scheduled hours resulting in a 40-hour work week by physician specialty and setting: a cross-sectional study using electronic health record event log data. *J Am Med Inform Assoc*. Jan 1 2025;32(1):235-240. doi:10.1093/jamia/ocae266.
20. Apathy NC, Hare AJ, Fendrich S, Cross DA. Early Changes in Billing and Notes After Evaluation and Management Guideline Change. *Ann Intern Med*. Apr 2022;175(4):499-504. doi:10.7326/M21-4402.
21. Tsai T, Boazak M, Hinz ERM. Increased Clinician Time Using Electronic Health Records During COVID-19 Pandemic. *AMIA Annu Symp Proc*. 2021;2021:1159-1168.
22. Lawrence K, Nov O, Mann D, Mandal S, Iturrate E, Wiesenfeld B. The Impact of Telemedicine on Physicians' After-hours Electronic Health Record "Work Outside Work" During the COVID-19 Pandemic: Retrospective Cohort Study. *JMIR Med Inform*. Jul 28 2022;10(7):e34826. doi:10.2196/34826.
23. Ruan E, Beiser M, Lu V, et al. Physician Electronic Health Record Usage as Affected by the COVID-19 Pandemic. *Appl Clin Inform*. Aug 2022;13(4):785-793. doi:10.1055/a-1877-2745.

24. Nath B, Williams B, Jeffery MM, et al. Trends in Electronic Health Record Inbox Messaging During the COVID-19 Pandemic in an Ambulatory Practice Network in New England. *JAMA Netw Open*. Oct 1 2021;4(10):e2131490. doi:10.1001/jamanetworkopen.2021.31490.
25. Rotenstein L, Jay Holmgren A. COVID exacerbated the gender disparity in physician electronic health record inbox burden. *J Am Med Inform Assoc*. Sep 25 2023;30(10):1720-1724. doi:10.1093/jamia/ocad141.
26. US Centers for Disease Control, COVID-19 Case Surveillance Public Use Data, https://data.cdc.gov/browse?tags=covid-19, Accessed Sept 1, 2022. https://data.cdc.gov/browse?tags=-covid-19
27. US Census Bureau, 2020 United States Census Data, https://www.census.gov/programs-surveys/decennial-census/decade/2020/2020-census-main.html, Accessed Sept 1, 2022. https://www.census.gov/programs-surveys/decennial-census/decade/2020/2020-census-main.html
28. Sinsky CA, Shah P, Carlasare LE, Shanafelt TD. Association Between Vacation Characteristics and Career Intentions of US Physicians-A Cross-Sectional Analysis. *Mayo Clin Proc*. May 2025;100(5):814-827. doi:10.1016/j.mayocp.2024.09.020.
29. Association AM. CPT Evaluation and Management Code and Guideline Changes. ama-assn.org/system/files/2019-06/cpt-office-prolonged-svs-code-changes.pdf
30. Sinsky CA, Trockel MT, Dyrbye LN, et al. Vacation Days Taken, Work During Vacation, and Burnout Among US Physicians. *JAMA Netw Open*. Jan 2 2024;7(1):e2351635. doi:10.1001/jamanetworkopen.2023.51635.

Authors

Ross W. Hilliard, MD, MaineHealth Maine Medical Center, Tufts University School of Medicine, Portland, ME.

Jacqueline Haskell, MS, Healthcentric Advisors, Providence, RI.

Nicholas Jones, PhD, Brown University School of Public Health, Providence, RI.

Rebekah L. Gardner, MD, The Warren Alpert Medical School of Brown University, Providence, RI.

Disclosures

Funding: This work was supported by an American Medical Association HER Use Research Grant (PI- R. Hilliard, MD).

Conflict of Interest Statement: The authors have no competing interests to declare.

Acknowledgments: The authors are grateful for the invaluable help from the Epic Physician Well-Being and Signal data team in obtaining the aggregated and de-identified data used in this study.

Correspondence

Ross W. Hilliard, MD
MaineHealth Maine Medical Center
22 Bramhall St, Portland, ME, 04102
Ross.Hilliard@mainehealth.org

FREE TO FOCUS ON KARLY.

With healthcare's constant complexities and distractions, it can be difficult to focus on patients. We can help, with proven medical professional liability insurance and so much more. So you are free to focus on delivering superior patient care.

- Medical Professional Liability Insurance
- Claims Analytics
- Risk Mitigation
- Medicare Contractual Risk Protection
- And more

coverys.com 800.225.6168

COVERYS FREE TO FOCUS℠

Data Modernization of Rhode Island Department of Health's Rabies Program: An Evaluation of Time Savings

ALEXIA GOODMAN, MPH; DANIELA N. QUILLIAM, MPH; SUZANNE BORNSCHEIN, MD

BACKGROUND

Rabies is a viral disease transmitted through contact with saliva or brain tissue of an infected animal typically via bite or scratch.[1] Rabies is nearly 100% fatal without vaccine intervention prior to the onset of symptoms.[1] Due to the high mortality rate of rabies, all animal bites and potential rabies exposures are required by state regulation to be reported to the Rhode Island Department of Health (RIDOH) immediately upon recognition by healthcare professionals. Once reported to RIDOH, a public health nurse evaluates each case to determine if a potential rabies exposure exists. If so, the nurse recommends rabies vaccine, otherwise known as post-exposure prophylaxis (PEP).

Reporting of animal exposures or rabies PEP releases is often required by health departments in the United States; however few health departments require reporting of both.[2] Rhode Island's rabies program is unique in that, in addition to requiring reporting of animal exposures, rabies PEP is administered only after assessment and recommendation by a RIDOH nurse. This process helps prevent unnecessary administration of PEP and provides RIDOH with a comprehensive dataset.

Between 2021 and 2025, there has been a steady increase of animal bite reports which corresponds with an increase in the number of rabies PEP releases [**Figure 1**]. In 2025, RIDOH received 3,571 animal exposure reports and released rabies PEP for 780 cases, both of which were record highs. Notably, the rate of rabies PEP recommendations has remained steady between 21% and 26%, supporting the effectiveness of RIDOH's rabies risk assessment process [**Figure 1**].

In 2023, RIDOH initiated the transition of the rabies program from paper-based reporting to an electronic reporting system. Between 2023 and 2024, animal bite reports, animal testing submission forms, and rabies PEP

Figure 1. Count of animal bite cases, rabies PEP recommendations, and rate of rabies PEP recommendations by year 2021–2025

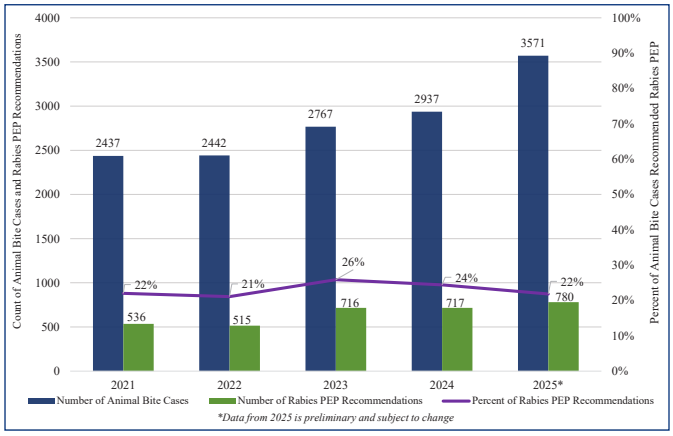
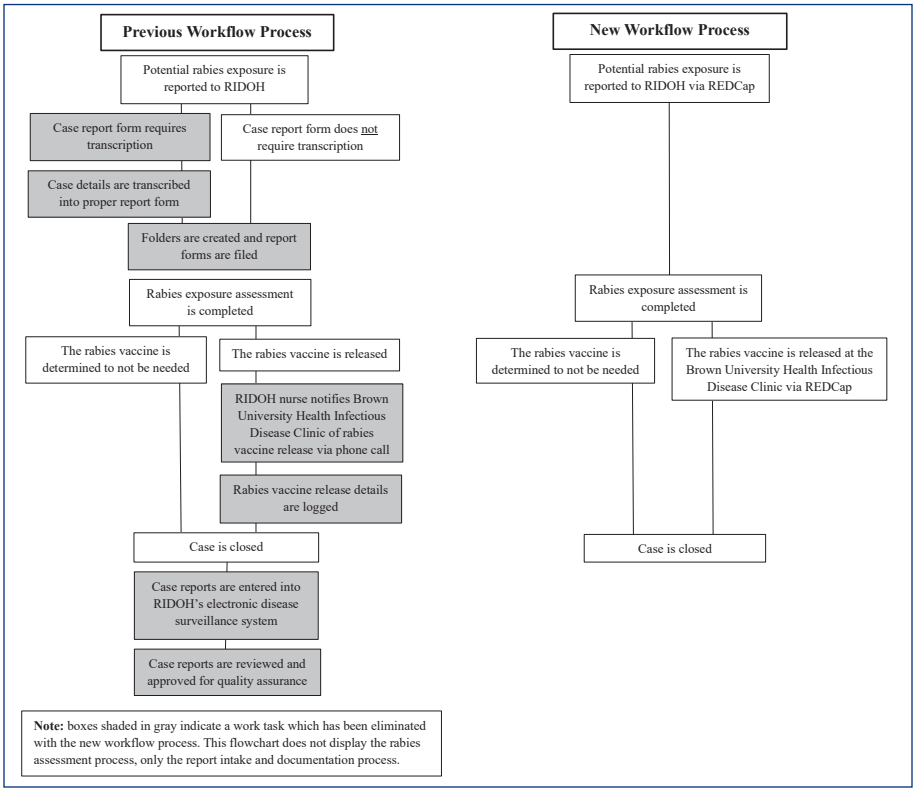


Figure 2. Comparison of case intake and documentation processes in discontinued Microsoft Teams versus new REDCap system.



release records were stored in Microsoft Teams, and PEP releases were communicated by phone to hospital pharmacies and emergency departments. While this represented an improvement, animal bite investigators continued to lose valuable time in certain areas. To further improve efficiency, the rabies program transitioned to REDCap on January 1, 2025. **Figure 2** displays the workflow processes in the Microsoft Teams system compared to REDCap and highlights work components that have been drastically reduced or eliminated. The goal of this evaluation is to measure the time saved by the animal bites team as a result of the modernization of the data system.

METHODS

To begin evaluating the time saved in the new system, a baseline was determined using 2024 animal bite reports, 2024 rabies testing reports, and 2025 rabies PEP releases at the Brown University Health Infectious Disease Clinic (BUH ID Clinic) [**Table 1**]. Only rabies PEP releases completed at the BUH ID Clinic were included in this analysis, as this is the only facility that has transitioned the PEP release process to REDCap. All case data were obtained from RIDOH's National Electronic Disease Surveillance System (RI-NEDSS), record filing system in Microsoft Teams, and REDCap.

Trials were conducted to measure the time previously required to transcribe and file case report forms (CRFs), log reports of animals submitted for rabies testing, and enter cases into RI-NEDSS. In each session, five-six participants completed a different type of data entry and timed each entry. Following completion of each timed trial, participants' times were combined, and an average was calculated. For each of the activities with timed trials, between 60 and 90 seconds was added to the average to account for the tasks which previously occurred but were not included in the timed trials (i.e., creating and naming folders). **Table 1** displays the number of timed trials completed for each discontinued work component and the average time spent on each task based on the timed trials.

Table 1. Description of time savings evaluation methods

Animal Bite Investigation Components	Evaluation Methods		
	Number of timed trials	Average time spent per task (Minutes)	Number of 2024/2025 animal bite cases
Transcribing and filing case report forms	100	8.25	2370
Filing duplicate case report forms	150	2	355
Logging reports of animals tested for rabies	120	4.5	731
Entering cases into RIDOH's electronic disease surveillance system	50	6	3385
Reviewing cases for quality assurance	Qualitative	4	3385
Recommending rabies PEP to the Brown University Health Infectious Disease Clinic	Qualitative	20	218*

*Reflects 2025 data. See methods for details.

Table 2. Animal bite investigation components evaluated for time saved in the new data system displayed by unit of time measured

Animal Bite Investigation Components	Unit of measurement (Time)			
	Minutes	Hours	Days (7 hours)	Weeks (5 days)
Transcribing and filing case report forms	19,553	326	47	9
Filing duplicate case report forms	710	12	2	0.3
Logging reports of animals tested for rabies	3,290	55	8	1.6
Entering cases into RIDOH's electronic disease surveillance system	20,310	339	48	10
Reviewing cases for quality assurance	10,155	169	24	5
Recommending rabies PEP to the Brown University Health Infectious Disease Clinic	4,360	73	10	2
Total time saved	**58,378 Minutes**	**974 Hours**	**139 Days**	**28 Weeks**

In the previous system, duplicate reports for the same case were common and required additional review and filing. To estimate the frequency of duplication, 150 case files were reviewed to identify cases with multiple initial reports and document the number of duplicates.

Finally, qualitative estimates of the time previously spent on conducting quality assurance reviews in RI-NEDSS and on rabies vaccine releases at the BUH ID Clinic were collected from members of the animal bites team [**Table 1**]. The animal bite nurses estimated that 85% of rabies PEP releases completed with the BUH ID Clinic did not require follow-up outside of REDCap. Based on this estimate, 15% of cases sent to the BUH ID Clinic were excluded from this analysis since there would have been no time saved when follow-up phone calls related to PEP were needed. These work components were measured with qualitative responses due to time constraints of the animal bites team and an inability to release rabies PEP at the BUH ID Clinic using the discontinued method.

Average times derived from each trial and from qualitative estimates were multiplied by the corresponding 2024 and 2025 case counts to calculate total time saved for each work component [**Table 1**]. Time savings were summarized

in minutes, hours, workdays, and workweeks [**Table 2**]. A workday was defined as seven hours, and a workweek as five workdays, consistent with RIDOH's work schedule.

RESULTS

In the year following the transition of RIDOH's rabies program from Microsoft Teams to REDCap, the animal bites team saved approximately 58,378 minutes of work time [**Table 2**]. On a larger scale, this equates to roughly 28 weeks or seven months of effort that is no longer required. Two work components eliminated under the REDCap system accounted for nearly 70% of total time savings: transcription and filing of case report forms (CRFs) and case entry into RI-NEDSS, which saved 19,553 minutes and 20,310 minutes, respectively [**Table 2**].

Previously, approximately 70% of animal bite cases (2,370 cases) were reported via fax, requiring animal bites team members to transcribe data into an internal case report form (CRF), a process that took an average of 8.25 minutes per report [**Table 1**]. Under the new system, providers and the public must report cases directly into REDCap, virtually eliminating the time previously required for transcription of case reports. Additionally, case entry into RI-NEDSS has been eliminated, as all required data are captured within REDCap. In addition, REDCap ensures higher data quality by reminding submitters of missing information prior to submission. With more complete data capture and the ability to export data from REDCap, which was not possible in Microsoft Teams, there is no longer a need to enter cases into a separate database.

Additional time savings resulted from discontinuing RI-NEDSS case quality assurance, logging reports of animals submitted for rabies testing, and filing duplicate CRFs which accounted for 10,155 minutes, 3,290 minutes, and 710 minutes saved, respectively [**Table 2**]. An additional 4,360 minutes were saved by recommending rabies PEP at the BUH ID Clinic through REDCap rather than by telephone [**Table 2**]. These time savings are notable, as they allow RIDOH nurses to devote more time to case assessment and also reduce administrative burden for BUH ID Clinic staff.

DISCUSSION

In cases where rabies PEP is recommended, timely initiation of the vaccine series is essential. To accommodate the steady increase of animal exposures requiring investigations and ensure that rabies assessments were not delayed, RIDOH spent three years streamlining the animal bites data system. Through the modernization of the rabies system, the animal bites team has been able to manage higher case counts while requiring fewer staff hours. During the summer, when reporting is highest, the animal bites team previously required the assistance of four to five full-time interns to assist with the transcription of CRFs and data entry into RI-NEDSS. With the cessation of these tasks, the animal bites team now requires only two full-time interns during the summer to cover phone intakes. This reduction in staffing has also improved the cost efficiency of the rabies program.

This evaluation did not capture all areas in which time savings have been realized under the REDCap system; therefore, the estimates presented here are likely underestimates of the total time saved. RIDOH intends to continue this evaluation by looking into time saved both internally and externally by partners such as the Rhode Island State Health Laboratories and medical professionals who have used the new system. RIDOH also plans to onboard additional healthcare facilities to REDCap to expand electronic rabies PEP releases and further reduce staff time previously spent on telephone-based processes.

The rabies vaccination process is time intensive, as a typical PEP regimen requires four medical visits for administration of human rabies immune globulin (HRIG) and four doses of rabies vaccine on days 0, 3, 7, and 14.[3] The rabies vaccine series is also costly. In 2023, patients seen at Brown University Health facilities incurred an average cost of $13,759 for the rabies vaccine series. In a manuscript forthcoming in the *Journal of Public Health Management and Practice*, RIDOH conducted an analysis to assess the healthcare cost saving resulting directly from our rabies assessment procedures. The analysis estimated that these procedures save the Rhode Island public approximately $6 to $13 million annually. Recognizing the significant time and financial burden placed on the public by rabies vaccination, Rhode Island has committed to ongoing modernization and improvement of the rabies program.

References

1. Centers for Disease Control and Prevention. About Rabies, 2025. [https://www.cdc.gov/rabies/about/index.html]
2. Whitehouse ER, Person MK, Brown CM, Slavinski S, Rao AK, Blanton JD. Evaluating Surveillance for and Estimating Administration of Rabies Postexposure Prophylaxis in the United States, 2012-2018. PLoS Negl Trop Dis. 2021 Oct 25;15(10):e0009878. doi: 10.1371/journal.pntd.0009878.
3. Centers for Disease Control and Prevention. Rabies Post-exposure Prophylaxis Guidance, 2025. [https://www.cdc.gov/rabies/hcp/clinical-care/post-exposure-prophylaxis.html]

Authors

Alexia Goodman, MPH, Public Health Epidemiologist in the Center for Acute Infectious Disease Epidemiology, Rhode Island Department of Health.

Daniela N. Quilliam, MPH, Chief of the Center for Acute Infectious Disease Epidemiology, Rhode Island Department of Health.

Suzanne Bornschein, MD, State Epidemiologist and Medical Director in the Center for Acute Infectious Disease Epidemiology, Rhode Island Department of Health.

Acknowledgments

Alyssa Amidei, MPH; Chuck McGinnis, RN; Steven LeBlanc, RN; Patricia Marshall, RN; Diann Sullivan, Cheryl Josephson, Joyce Johnson, Zuleika Melo, Luciana DeCarvalho, Catherine Wilson, Brandi Hansen, Catherine Donovan, PhD, SM, and interns.

Rhode Island Monthly Vital Statistics Report
Provisional Occurrence Data from the Division of Vital Records

VITAL EVENTS	REPORTING PERIOD		
	SEPTEMBER 2024	12 MONTHS ENDING WITH JUNE 2025	
	Number	Number	Rates
Live Births	964	10,913	10.3*
Deaths	842	10,791	10.2*
Infant Deaths	4	43	3.9#
Neonatal Deaths	3	30	2.7#
Marriages	718	7,040	6.6*
Divorces	193	2,488	2.3*

* Rates per 1,000 estimated population
# Rates per 1,000 live births

Underlying Cause of Death Category	REPORTING PERIOD			
	DECEMBER 2024	12 MONTHS ENDING WITH DECEMBER 2024		
	Number (a)	Number (a)	Rates (b)	YPLL (c)
Diseases of the Heart	200	2,368	215.8	2,877.5
Malignant Neoplasms	213	2,169	197.7	4,027.5
Cerebrovascular Disease	41	440	40.1	509.5
Injuries (Accident/Suicide/Homicide)	61	908	82.7	10,292.5
COPD	28	462	42.1	424.5

(a) Cause of death statistics were derived from the underlying cause of death reported by physicians on death certificates.
(b) Rates per 100,000 estimated population of 1,097,379 for 2020 (www.census.gov)
(c) Years of Potential Life Lost (YPLL).

NOTE: Totals represent vital events, which occurred in Rhode Island for the reporting periods listed above.
Monthly provisional totals should be analyzed with caution because the numbers may be small and subject to seasonal variation.

Why join RIMS?

The Rhode Island Medical Society is your voice at the State House and in the community. In 2025, we secured wins on prior authorization, clinician wellness, and primary care funding—but this work depends on physician support. Without membership, RIMS cannot continue to advocate, educate, and protect the profession. Join or renew today—and consider getting involved in one of our committees. Together, we are stronger. The Rhode Island Medical Society is the only organization dedicated solely to advocating for physicians and their patients in our state.

In 2025, RIMS members helped

- Eliminate prior auth for PCP-ordered services (3-year Medicaid pilot)
- Secure fair Medicaid rates—up to 100% of Medicare starting Oct. 2025
- Protect physician wellness with the Clinician Wellness & Support Act

We're not stopping here

RIMS is fighting for the future of telemedicine, tackling workforce shortages, and reducing administrative burdens.

Click to join

https://rhodeislandmedicalsociety.wildapricot.org/Join-us/

Wins for providers

RIMS worked to secure and support key budget investments.

Medicaid primary care rate increase

Up to 100% of medicare rates
Starting October 2025

Medicaid prior authorization pilot

Eliminates prior authorization for Medicaid for three years
Starting October 2025

Physician loan repayment funding

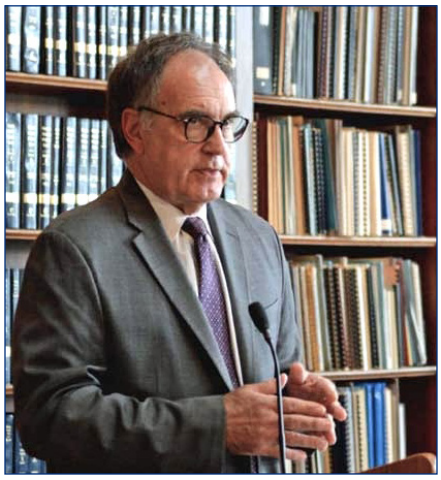
Includes $200,000 in funding to recruit and retain clinicians

Health center funding

Sustained investments in FQHCs and community health

Health services funding assessment

$30Mannually for primary care and other critical programs



Our priorities

RIMS focused on strengthening Rhode Island's healthcare system, protecting physicians' well-being, reducing administrative burdens, and improving access to care. Together with members, specialty societies, and partner organizations, we made significant progress on our top priorities.

The Rhode Island Prior Authorization Reform Act (SB 168/HB 5120)

Eliminates prior authorization for admissions, services, and procedures ordered by in-network primary care physicians in a three-year pilot.
Effective: October 1, 2025.
Status: Passed and signed
Sponsored by: Rep. Brandon Potter; Sen. Melissa Murray

The Rhode Island Clinician Wellness and Support Act (SB 695/HB 6036)

Recognizes RIMS' Physician Health Program in statute, strengthens confidentiality protections, and updates licensing language to encourage clinicians to seek care without fear.
Status: Passed and signed
Sponsored by: Rep. John "Jay" Edwards; Sen. Bridget Valverde

"I'm Sorry" Bill (H6210/S66)

Although not yet enacted, RIMS made significant progress this session on legislation to allow physicians to express sympathy or apologize after an adverse outcome without it being used as evidence of liability. We met twice with the Rhode Island Association for Justice (trial lawyers) and reviewed their suggested language—which we ultimately could not support—laying important groundwork for next session.
Sponsored by: Rep. Teresa Tanzi; Sen. Pamela Lauria

IT ALL STARTS HERE!
JOIN OR RENEW IN 2026
RHODE ISLAND MEDICAL SOCIETY

The Rhode Island Medical Society is the statewide home for physician advocacy, education, wellness, and leadership. This past year, RIMS vdelivered meaningful wins for Rhode Island physicians, including:

- **MAJOR PRIOR AUTHORIZATION REFORM**
- **STRONGER CLINICIAN WELLNESS PROTECTIONS**
- **MEDICAID RATES TO 100% OF MEDICARE**
- **12 SPECIALTY SOCIETIES SUPPORTED AND 35+ EDUCATION PROGRAMS**
- **CONFIDENTIAL SUPPORT THROUGH THE PHYSICIAN HEALTH PROGRAM**

Your membership strengthens our voice at the State House and supports the future of medicine in Rhode Island.

JOIN OR RENEW TODAY AT
rimedicalsociety.org/membership

Questions about individual or group membership?
EMAIL **membership@rimed.org**

YOUR VOICE.
YOUR PATIENTS.
YOUR PROFESSION.

RIMS gratefully acknowledges the practices who participate in our discounted Group Membership Program

ANCHOR MEDICAL ASSOCIATES

BROWN EMERGENCY MEDICINE
BROWN PHYSICIANS, INC.

BROWN MEDICINE
BROWN PHYSICIANS, INC.

BROWN SURGICAL ASSOCIATES
BROWN PHYSICIANS, INC.

COASTAL MEDICAL

CCAP
COMPREHENSIVE COMMUNITY ACTION PROGRAM
YOUR COMMUNITY'S HELPING HAND

east bay community action program
THE BRIDGE to SELF-RELIANCE

SKIN PROS

Thundermist!
HEALTH CENTER

UNIVERSITY ORTHOPEDICS
Healers. Innovators. Teachers.

University Otolaryngology

WellOne
Primary Medical and Dental Care

Wood River
Health Services
The Heart of South County since 1976

For more information about group rates, please contact Ali Walz, RIMS Director of Member Services

When ICE Comes to Work: Defending Access to Healthcare

DENISE MARTE, MD; PAUL MICHAEL WALLACE, MD; KIRA NEEL, MD; MEDHA D. MAKHLOUF, JD; ELYSE VYVY TRINH, MD, EdM

The first time we heard a colleague's patient had been detained by Immigration and Customs Enforcement (ICE), our hearts sank. This patient, a longtime New England resident, was detained while pregnant, and transferred to a facility in the South, where she was placed in a cell with 60 other women. In the mix of confusion, panic, anger, and sadness, a deep feeling of impotence also set in. Was there anything we could do to advocate for the patient's rights or preserve her access to healthcare? As physicians, we are concerned with rising ICE activity in Rhode Island and nationally. We urge healthcare workers to prepare to encounter ICE at your workplace and to care for people in or at risk of ICE detention.

Throughout 2025 we have witnessed the erosion of due process for immigrants and reports of conditions within ICE detention facilities that are inhumane, hazardous to health, and in some cases deadly.[1-4] There is a dearth of guidance on the practical aspects of providing care for patients who are in or at risk of ICE detention. Additionally, no consensus authority has emerged weighing various ethical, legal, and logistical considerations and how best to respond to these challenges. We ground the ideas herein based on our experiences as healthcare workers who care for immigrant patients, our review of ICE's written policies, guidance from sources such as the Rhode Island Attorney General, reputable national legal organizations, and a survey we conducted of high-quality journalism covering immigration enforcement. We frame this commentary with an exploration of legal and practice principles that apply to three scenarios you may encounter.

While the contents of this commentary have been reviewed by a legal expert, they should not be treated as a substitute for legal advice specific to your own clinical context. We encourage providers to reference their organization's policy handbooks or consult with their supervisors or legal counsel to learn about any institutional policies that provide guidance about responding to immigration enforcement onsite.

SCENARIO A: You are at work seeing patients, and your receptionist informs you that ICE is reported to be outside the facility. There are multiple unmarked vehicles and masked individuals wearing tactical gear with "DHS" insignia. Your staff believes they are targeting people leaving through the parking lot. Shortly afterwards, you learn that ICE officers are in the building.

Healthcare organizations should develop written policies and staff training about what to do in this scenario so that the organization complies with its legal and ethical obligations to protect patients' privacy, health, and well-being. While healthcare providers may not obstruct ICE officers in the performance of their duties, they are also generally not required to assist them.

The first action that should be taken in this scenario is to contact the organization's legal counsel or other designated staff member for guidance on how to proceed. The written policy should also include actions that the organization can affirmatively do to protect their patients in this scenario, such as the following:

- Develop protocols to inform staff and patients of ICE's presence at the facility in a timely fashion.
- Provide guidance on language staff should use if they receive requests for information or assistance from ICE, such as: "*I am not authorized to speak with you. Let me contact my supervisor.*" Organizations should clearly delineate whom staff should contact in this scenario. As noted in the Rhode Island Attorney General's detailed guidance from August 2025, "Providers are not permitted to disclose protected health information to federal law enforcement absent a judicial warrant, court order, or another valid exception to patient privacy rules."[5]

  Of note, ICE often carries an administrative warrant but not a judicial one. One distinction is that an administrative warrant does not authorize a law enforcement agency to enter private areas of a facility without consent, while a judicial warrant does. For more information on distinctions between these warrants, we encourage you to review the Attorney General's guidance on the topic.[5]
- Add signage to designate private spaces within the facility. ICE is allowed to question and ultimately may detain anyone they encounter in a public space, including waiting rooms, lobbies, elevators, cafeterias, and parking lots. By contrast, as noted in the Attorney General's guidance, "federal law enforcement can only access private, restricted areas of health care facilities with a judicial warrant or with a provider's consent —and providers are entitled to refuse consent." Clinic exam rooms and offices can be designated as private spaces.

The scene described in this scenario is just one example of how ICE activity could unfold. ICE officers may present in different ways, such as in plainclothes, in clothing labeled "POLICE," or in different vehicles.[6]

SCENARIO B: Your next patient arrives in handcuffs surrounded by ICE agents. They were injured during their arrest. You are informed that the patient is already in ICE custody.

If someone arrives at a facility immediately after being arrested by ICE, a healthcare provider may be one of the last individuals to interact with this patient before they are sent to a detention

center. Once detained, an individual may be transferred far from home and face hazardous conditions for a prolonged period. In hundreds of current cases, families remain unable to locate detained loved ones.[7] There are opportunities for providers to advocate for patients' health and rights.

Treatment

- Remember that you are first and foremost a healthcare provider and they are your patient. ICE should not obstruct your clinical care. Address the patient's primary medical issue as well as secondary issues as warranted. Be thorough and adhere to the typical standards of care for your field. Keep in mind that patients in ICE custody may lack appropriate access to follow-up care or medications.[8]

Communication

- Consider obtaining and documenting consent from the patient to communicate relevant health information and updates with the patient's family. The 2025 National ICE Detention Standards states "The facility and ICE will defer to the hospital's standard rules and procedures concerning the seriously ill, injured, and dying, including the hospital's procedures for determining and contacting next-of-kin".[9]
- Maintain patient privacy when discussing sensitive matters or performing sensitive exams.
- Provide health education and connect patients with resources as needed.

Discharge

- Strongly consider requesting a direct provider-to-provider report when discharging patients. ICE's Online Detainee Locator System may help locate your patient once they leave your facility.[10] You will need your patient's name, date of birth, address, country of origin, and A-number (alien registration number).
- Complete medication reconciliations for all patients discharged to ICE detention facilities and ensure these are included with their discharge paperwork.
- The 2011 National Detention Standards (NDS), revised in 2016, contain a list of medical conditions requiring special attention and medical clearance before detainees can be transferred between facilities.[11] While the 2025 NDS no longer include a detailed list, it is reasonable to believe these still apply. If any of the following apply to your patient, complete a direct provider-to-provider sign-out and explore options for continuity of care or medical exemption from detainment.
  - Pregnant, postpartum, or nursing
  - Communicable diseases such as active tuberculosis
  - Infectious diseases requiring IV or PO antibiotics
  - HIV/AIDS
  - Severe COPD with a baseline oxygen requirement
  - Severe CHF
  - ESRD requiring dialysis
  - Insulin-dependent diabetes
  - Seizure disorders
  - Substance use disorders at risk for withdrawal
  - Individuals with mental health disorders at high risk of suicide
  - Injuries requiring ongoing physical therapy
  - Complex wounds requiring frequent wound care
  - Acute DVT or PE precluding air travel
- Locally, people in ICE detention are often temporarily housed at the Wyatt Correctional Facility in Central Falls, RI, or the Plymouth Correctional Facility in Plymouth, MA, before transfer. Both facilities have onsite healthcare providers who should be available via phone or fax to communicate with you regarding a patient's health needs or status.

SCENARIO C: Your patient discloses to you that they are fearful of ICE.

Candid discussions with our patients about these concerns have helped patients learn their rights, take preparatory steps, and connect to resources. In one local case, during an emergency department visit for palpitations, an elderly female with coronary artery disease disclosed symptoms that began the day after her sons were detained by ICE. She was fearful for her safety and asked what she could do to prepare in case ICE came looking for her too. Some practices to consider:

- Place flyers in visible places with information on local resources. One example is the Rhode Island Deportation Defense Network which runs a hotline that community members can call if they are concerned about the presence of ICE nearby (401-675-1414). Another example is the Family Preparedness Plan from the Rhode Island Center for Justice which aims to help affected families prepare for ICE.[12]
- Provide "Know Your Rights" information to all patients in their preferred language, such as the materials available at Immigrant Legal Resources Center.[13] You can say, "*I don't know if you or someone you love needs this information, but I want all my patients to know their rights.*"
- Counsel patients to carry a list of their health conditions, daily medications with dosages, and allergies on their person always so they are in a better position to advocate for the medical treatment they need if they are detained by ICE.
- Offer telehealth visits as a substitute for in-person appointments when a patient feels unsafe presenting to your facility.
- Consider having a patient sign a Release of Information waiver giving you permission to discuss their health information with an emergency contact or with an ICE detention facility, in case they face detention and could potentially benefit from a provider's advocacy.
- Develop a medical-legal partnership or other relationship with an immigration legal services provider in the community, so that patients can be referred to free or low-cost attorneys who can provide individualized, expert advice. Some undocumented immigrants and immigrants with

precarious immigration statuses may be eligible to apply for more secure statuses, eliminating a source of stress and potentially improving access to employment and public benefits.

CONCLUSION

Healthcare workers have unique responsibilities and opportunities to help patients in times of crisis. The escalation of ICE activity in our region has already impacted the health of Rhode Islanders, and we must proactively prepare for scenarios like these in order to look after the health and well-being of our patients and communities. In addition to the Rhode Island Attorney General and the Rhode Island Department of Health, national organizations such as Physicians for Human Rights, the National Immigration Law Center, and the American Civil Liberties Union have published guidance to inform healthcare providers of their rights and responsibilities regarding immigration enforcement at healthcare sites.[14]

In another local case, a physician was successfully able to advocate for their patient to be released from ICE detention due to a medical condition; this would not have happened if the physician and their patient had not discussed the patient's concerns about ICE beforehand. Pushing back against the feeling of impotence in the face of these very real challenges starts with preparing our facilities and empowering ourselves and our colleagues with the necessary information to protect the health of our immigrant patients. ❖

References

1. Detainee Death Reporting [Internet]. www.ice.gov. Available from: https://www.ice.gov/detain/detainee-death-reporting
2. Erden B, Lum D, Sun A, Hamed Aleaziz, Bosman J, Ainara Tiefenthäler. How an Attempted ICE Arrest Near Chicago Turned Deadly. The New York Times [Internet]. 2025 Sep 23; Available from: https://www.nytimes.com/interactive/2025/09/23/us/ice-shooting-chicago-video.html
3. Vives R. Activist says video shows ICE rammed his truck. ICE says the opposite [Internet]. Los Angeles Times. 2025 [cited 2025 Oct 22]. Available from: https://www.latimes.com/california/story/2025-10-16/agents-accuse-activists-of-slamming-into-their-vehicle
4. Hurry D. ICE's use of full-body restraints during deportations raises concerns over inhumane treatment | The Associated Press [Internet]. The Associated Press. 2025. Available from: https://www.ap.org/news-highlights/spotlights/2025/ices-use-of-full-body-restraints-during-deportations-raises-concerns-over-inhumane-treatment/
5. AG Guidance to Rhode Island Health Care Providers and Facilities | Rhode Island Attorney General's Office [Internet]. Ri.gov. 2025 [cited 2025 Oct 23]. Available from: https://riag.ri.gov/media/7056/download
6. Erden B. Who are the federal forces behind Trump's Mass Deportations and Crime Crackdown? [Internet]. New York Times. 2025. Available from: https://www.nytimes.com/interactive/2025/10/24/us/us-federal-agents-national-guard-ice-fbi.html?smid=nytcore-ios-share&referringSource=articleShare&sgrp=c-cb
7. Wieder B, Dasgupta S. Hundreds of Alligator Alcatraz detainees drop off the grid after leaving site [Internet]. Miami Herald. 2025. Available from: https://www.miamiherald.com/news/local/immigration/article312042943.html
8. Pillai A, Pillai D, Artiga S. KFF Health Issues for Immigrants in Detention Centers|KFF [Internet]. KFF. 2025. Available from: https://www.kff.org/racial-equity-and-health-policy/health-issues-for-immigrants-in-detention-centers/
9. 2025 National Detention Standards [Internet]. Ice.gov. 2025. Available from: https://www.ice.gov/detain/detention-management/2025
10. Online Detainee Locator System. Ice.gov. 2024. Available from: https://locator.ice.gov/odls/#/search
11. 2011 Operations Manual ICE Performance-Based National Detention Standards [Internet]. www.ice.gov. Available from: https://www.ice.gov/detain/detention-management/2011
12. Family Preparedness Plan–Rhode Island Center for Justice [Internet]. Rhode Island Center for Justice. 2020 [cited 2025 Oct 23]. Available from: https://centerforjustice.org/fpp/
13. Immigrant Legal Resource Center [Internet]. Immigrant Legal Resources Center. 2025 [cited 2025 Dec 1]. Available from: https://www.ilrc.org/
14. RIDOH Providing Care and Services for Undocumented Immigrants|Rhode Island Department of Health [Internet] health.ri.gov. 2025. [cited 2025 Dec 1]. Available from: https://health.ri.gov/sites/g/files/xkgbur1006/files/publications/guidelines/Providing-Care-And-Services-For-Undocumented-Immigrants.pdf

Authors

Denise Marte, MD, is an Assistant Professor of Emergency Medicine at The Warren Alpert Medical School of Brown University in Providence, RI.

Paul Michael Wallace, MD, is a Clinical Assistant Professor of Psychiatry and Human Behavior at The Warren Alpert Medical School of Brown University in Providence, RI.

Kira Neel, MD, is an Assistant Professor of Family Medicine at The Warren Alpert Medical School of Brown University in Providence, RI.

Medha D. Makhlouf, JD, is the Elsie de R. and Samuel P. Orlando Distinguished Professor and Director of the Medical-Legal Partnership Clinic at Penn State Dickinson Law in Carlisle, PA.

Elyse VyVy Trinh, MD, EdM, is a Clinical Instructor of Obstetrics and Gynecology at The Warren Alpert Medical School of Brown University in Providence, RI.

Acknowledgments

This commentary would not have been possible without the work of Rhode Island Health Care Workers United for Immigrants, an ad hoc coalition of physicians, allied health professionals, and trainees from across the state who came together out of concern for patients given the increased ICE presence in Rhode Island. Through research, dialogue, and community building, we seek to understand the current landscape as it pertains to immigrant health and minimize the harms of anti-immigrant policies in the lives of our patients. To learn more or to get involved with efforts to protect immigrant patients' rights and access to healthcare, please contact the corresponding author.

Correspondence

Denise_marte@brown.edu

Why Firearm Injury Prevention Should Be a Core Component of Medical Training

NICOLE BURNS, BS, MD'28; ANITA KNOPOV, MD, MEHP

On December 13th, I should have been studying for my final exam of pre-clinical medical training. Instead, I spent nine hours in lockdown following the mass shooting at Brown University. Crammed in a CD closet with 18 other students in the music library, I hid silently just two blocks away from the site of two deaths and nine injuries, with the unidentified shooter at large. As students passed around a single bag of snack-size potato chips, I felt a chilling familiarity of my peers coming together in tragedy, alongside an eerie comfort in knowing that everyone in the room knew what to do.

For many students, this wasn't their first experience with gun violence. It wasn't mine either. In 2020, two bullets from an automatic rifle went through my living room window in Portland, Oregon. Before then, I participated in several lockdowns at my high school in Seattle, Washington, with active shooters in surrounding blocks or on school property.

Like many, I found myself thinking it was unlikely I would encounter gun violence again. In statistics, there is the concept of independent events: the occurrence of one event does not change the probability of another. For example, flipping a coin and getting heads once doesn't make you more likely to get heads on a second flip. But I am no exception to the statistics of shootings in this country, and neither are my peers. According to the Pew Research Center, in 2023 there were 46,728 deaths due to gun-related injuries in the United States.[1] In 2022, firearm injuries were the number one cause of death among 1–19-year-olds, and in the top five leading causes of death among 1–44-year-olds in the United States (US).[2] It pains me that Brown students MukhammadAziz Umurzokov, 18, and Ella Cook, 19, have become part of this statistic in 2025. It is imperative that medical schools and health professional training institutions recognize this reality and advocate for the incorporation of firearm injury prevention as a core component of medical training.

The Warren Alpert Medical School of Brown University is one of the few medical schools that provides longitudinal education in firearm injury epidemiology and prevention.[3,4] In 2020, after recognizing this gap in training, Drs. Anita Knopov and Megan Ranney, and collaborating faculty and students, incorporated firearm injury epidemiology, screening questions, and counseling into our first- and second-year pre-clinical doctoring curriculum.[3] During clinical rotations, third- and fourth-year students receive additional specialty-specific education on firearm injury prevention and counseling.

Last summer and fall, I helped teach a monthly session to students on their Brown Emergency Medicine Clerkship. Our focused curriculum—developed by Dr. Knopov, Anwen Lin (MS3), and Michael Brennan (MS3), and delivered by second-year medical students—emphasized gun terminology, safe storage techniques, physician-led harm reduction counseling, and Extreme Risk Protection Orders (ERPOs). ERPOs are laws in 22 states that allow clinicians, family members, or law enforcement to petition the court for the temporary removal of a person's firearm if they are at risk of hurting themselves or others.[5] In Rhode Island, only law enforcement agencies can file petitions for ERPOs, but seven states specifically allow healthcare professionals to petition for an ERPO (Colorado, Connecticut, Hawaii, Maryland, Massachusetts, Michigan, and New York).[5,6]

During our classes, I was struck by the stories of gunshot wounds students had encountered both within and outside the realm of their medical training. Visiting medical students from Germany were struck by the fact that those in the US don't need a reason, or a psychiatric evaluation, to own a gun. All in all, I found students eager to incorporate firearm screening, counseling, and advocacy into their clinical practice.

I mourn the deaths of my fellow students. I oscillate between devastation and numbness, accepting that this violence is part of our reality, and will be part of my career as a physician. Still, I feel grateful to be surrounded by a supportive community of educators who have implemented firearm injury prevention as a public health priority within my medical school curriculum. Even in a state like Rhode Island—which has the fourth-lowest rate of deaths by guns (murders and suicides combined) in the United States—we are shaken by the lives lost to shootings, reminding us that firearm violence is a threat to population health and not a regional anomaly.[1]

Firearm injury is a preventable cause of death, and clinicians have legal authority and professional obligation to intervene—including advocating at the state level, petitioning the court for an ERPO, counseling patients and families on safe firearm storage, screening for risk factors such as interpersonal violence or suicidality, or referring patients to mental health services. I urge medical educators and institutions to treat firearm injury prevention as an essential component of public health practice and medical training, addressing gun violence with the same rigor, advocacy, and evidence-based approach we apply to other leading causes of morbidity and mortality. ❖

References

1. Gramlich J. What the data says about gun deaths in the U.S. Pew Research Center. Published March 5, 2025. Accessed December 23, 2025. https://www.pewresearch.org/short-reads/2025/03/05/what-the-data-says-about-gun-deaths-in-the-us/
2. Centers for Disease Control and Prevention. Fast facts: firearm injury and death. CDC. Published July 5, 2024. Accessed December 23, 2025. https://www.cdc.gov/firearm-violence/data-research/facts-stats/index.html
3. Blackwood KL, Knopov A, Merritt R, Ranney ML. A 4-year longitudinal firearm screening and safety program for medical students. Acad Med. 2021;96(12):1626. doi:10.1097/ACM.0000000000004392
4. Weiner S. Fewer gun deaths: Medical schools prioritize prevention. AAMC-News. December 6, 2022. Accessed December 31, 2025. https://www.aamc.org/news/fewer-gun-deaths-medical-schools-prioritize-prevention
5. Institute for Firearm Injury Prevention. ERPO laws by state. University of Michigan. Updated 2025. Accessed December 23, 2025. https://firearminjury.umich.edu/erpo-by-state/
6. R.I. Gen. Laws § 8-8.3-3. Contents of petition. Rhode Island General Laws; 2024. Accessed December 30, 2025. https://webserver.rilegislature.gov/statutes/title8/8-8.3/8-8.3-3.htm

Authors

Nicole Burns, BS, MD'28, The Warren Alpert Medical School of Brown University, Providence, RI.

Anita Knopov, MD, MEHP, Assistant Professor of Emergency Medicine, The Warren Alpert Medical School of Brown University, Providence, RI.

Disclosures

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. None of the authors have any conflicts of interest to disclose.

Correspondence

Nicole Burns
The Warren Alpert Medical School of Brown University
222 Richmond Street
Providence, RI 02903
206-979-7783
nicole_burns@brown.edu

Functional Disorders

JOSEPH H. FRIEDMAN, MD

I recently took a look at online patient reviews of my doctoring, and came across the following post:

Unless you have Parkinsons or are quite seriously demented, do not go to this provider. If you do not fall into his areas of expertise, he is completely unable to diagnoses symptoms...and even dismissed my symptoms as "clearly having "no physiological" origin and told me that I could be "100% cured through cognitive behavioral therapy."

He did not even bother ordering any tests at all—just called me crazy and asked me to come back in 6 months so he could charge my insurance, again, for doing absolutely nothing.

Needless to say, I got a second opinion and am now being treated and evaluated for my symptoms CORRECTLY. Turns out, if I had listened to this man, I would have been incontinent and immobile in a year...all while being blamed for the progression of my chronic medical conditions (that he overlooked as the source of my symptoms!) because I didn't do well enough in psychotherapy. He set me up to fail because of his own inabilities as a medical professional.

BE AWARE OF HIS LIMITATIONS AS BOTH A HUMAN BEING AND A DOCTOR PRIOR TO YOUR APPOINTMENT.

Unless you either have Parkinsons or are demented and purposefully seeking to be a human test subject—AVOID THIS DOCTOR AND HOSPITAL LIKE THE PLAGUE.

I assume that some medical providers get reviews like this, but hopefully not this bad. We can't please all the people all of the time and have to tell our patients things they don't want to hear. I decided to follow the maxim, "When all you have is lemons, make lemonade," so I have taken this lemon and tried to use it constructively in the commentary which follows.

The word "functional" when applied to medical conditions is the current terminology we often use to label disorders that used to be called psychogenic, or non-physiologic. Long ago they were termed "hysteric." In the epilepsy field, functional seizures are often labeled as "non-epileptic seizures." These types of occurrences are not uncommon. In my sub-specialty, movement disorders, 2–5% of new referrals are diagnosed with this disorder (ICD 10 F44.4). The movements are varied, usually tremors or gait disorders, but Parkinson-like disorders, dystonic disorders, dysarthria and muscle jerks also occur. Diagnosing such disorders is sometimes easy but sometimes challenging or impossible. A few years ago a study was done of a rare entity called propriospinal myoclonus, in which myoclonic jerks (sudden jerks that we all experience when one's head falls forward when falling asleep during a lecture, or when dreaming of falling from a great height) spread up or down the back. Patients had electromyograms and were videotaped. A panel of experts were asked, each in isolation from the others, if they thought the disorder was physiologic or not, and there was disagreement on every case.

We can sometimes diagnose a case if we are fortunate enough to watch the patient when he is unaware and see the problem resolve, but even then we may err, as organic disorders, like tremor in Parkinson's disease, may only appear when the subject is anxious. PD patients may become suddenly unable to walk and freeze in place only when they are being watched, and, although there is an obvious psychological component to the disorder, there is an underlying organic pathology. In addition, there are rare episodic movement disorders.

One way to evaluate a possible diagnosis is to determine if the movement can be mimicked. I evaluated a man with a tremor of his epiglottis. It was remarkably persistent and rhythmic and seemed virtually diagnostic of a very rare disorder, until he showed me how he could stop these movements by adopting very odd postures of his trunk. I wondered then if he had an organic and a non-physiological problem and decided to try to mimic his disorder. After several minutes, I was able to, although not as well as he did; he had been at it for years. At our next meeting I explained to him why I thought this was a functional disorder, that these types of disorders were very serious but were treatable with behavioral therapy rather than medication. He was irate, told me that I was crazy if I thought he was crazy, and was unable to be mollified. I suggested that he see me again, if he was willing, and he stalked out. He later called me, yelling on the phone, calling me incompetent in a stream of denunciations that was non-stop, continuing for several minutes, despite my trying to interrupt him. Finally, I asked him to stop speaking for two minutes so that I could explain my thinking. He became quiet. I talked about two minutes, calmly explaining his problem as I saw it. I was gratified by his silence until I realized he had hung up.

The remarkable thing about this interaction was the resolution. Instead of denouncing me on the internet, he kept his appointment, apologized, and agreed to treatment, which has been very helpful.

This story is definitely an unusual one. Some patients embrace the functional diagnosis: "It's better than having

Parkinson's disease or a brain tumor." Others interpret the diagnosis as demeaning, an accusation of mental infirmity.

Like everyone else, I make mistakes. I never tell anyone they're crazy, nor do I ever imply it. I never tell anyone they will be healed "100%." My favorite medical motto is, "You can't always be right, but you can always be nice." Making a functional diagnosis is important. One is that there may be treatment that sometimes is helpful or even curative. It is a "real" diagnosis (with ICD codes) and should prevent needless testing and useless treatments.

Patient reactions posted on the internet, like the ones above, are examples of the stigma attached to mental illness and may keep some physicians from making this diagnosis even when they believe it is the correct one, preferring either to refer the patient elsewhere or to order some tests and shrug their shoulders. ❖

Author

Joseph H. Friedman, MD, Stanley Aronson Chair in Neurodegenerative Disorders and Professor, Department of Neurology at the Alpert Medical School of Brown University; Director of Butler Hospital's Movement Disorders Program; Editor-in-Chief *Emeritus* of the *Rhode Island Medical Journal*.

Correspondence

joseph_friedman@brown.edu

The Final Days and Unexpected Death of President George Washington

MARY KORR
RIMJ MANAGING EDITOR

George Washington, the first president of the United States [**Image 1**], serving from 1789 to 1797, died at his Mount Vernon, Virginia, home on December 14th, 1799, at the age of 67 [**Image 2**]. His death was unexpected; he had been in good health two days prior.

The sudden cascade of events leading to his death began on the morning of December 12th. While supervising his properties on horseback, light snow began to fall, and the weather soon worsened. Hail pelted down, and then sheets of rain. The former commander-in-chief of the nation and the Continental Army, however, continued his work for several hours, and then returned home to prepare to greet guests for dinner that evening. "Known for his punctuality, he remained in his damp attire," according to an article on the website, George Washington's Mount Vernon.[1]

The following day, despite awakening with a sore throat and hoarseness, he saddled up and inspected the woods on his property, marking trees to take down. That night his throat became increasingly painful and he had difficulty breathing. The next morning, his wife, Martha, asked his former aide-de-camp and now assistant, Col. Tobias Lear, to send for the president's longtime physician and physician general of the US Army, **DR. JAMES CRAIK**, a graduate of the University of Edinburgh medical school. In him, Washington had the utmost confidence. Martha also summoned two other physicians, **DRS. GUSTAVUS RICHARD BROWN** and **ELISHA CULLEN DICK**.

Image 1. George Washington/Weidenbach A, Stuart G, ca. 1876.
[RETRIEVED FROM THE LIBRARY OF CONGRESS, HTTPS://WWW.LOC.GOV/ITEM/2009633671]

Image 2. George Washington on his deathbed.
[PAINTED BY STEARNS. LITH. BY REGNIER. 1853. NATIONAL LIBRARY OF MEDICINE, LIBRARY CATALOG; MMS ID 9914080803406676; NLM UNIQUE ID 101408080, HTTP://RESOURCE.NLM.NIH.GOV/101408080]

Bloodletting & Blistering: the Modalities of the Times

While they waited for the doctors' arrival, bloodletting was initiated at Washington's request, by the estate's overseer. Col. Lear subsequently wrote an eyewitness account of Washington's final hours. "A mixture of molasses, vinegar and butter was given to try its effects on the throat, but he could not swallow a drop; whenever he attempted it he appeared to be distressed, convulsed, and almost suffocated."[2]

Dr. Craik arrived at Mount Vernon mid-morning. In an article written by **DR. HOWARD MARKEL** for the PBS News Hour, "After taking the medical history, he [Dr. Craik] applied a painful 'blister of cantharides,' to Washington's throat....The blisters raised by this toxic stuff would supposedly draw out the deadly humors causing the General's throat inflammation."[3]

Image 3. Old tomb at Mount Vernon in which Washington's remains were first placed, and from which they were removed in 1831 to the new tomb, which was built according to directions in Washington's will, and where they now lie.
[LIBRARY OF CONGRESS PRINTS AND PHOTOGRAPHS DIVISION WASHINGTON, D.C. 20540 USA HTTP://HDL.LOC.GOV/LOC.PNP/PP.PRINT]

Several subsequent bloodlettings were performed throughout the day, removing 40 percent of his total blood volume. An enema was administered, and gargling with a sage tea, laced with vinegar, proved unsuccessful. Washington was ambulatory and able to sit in his chair for a few hours. During this time, he and his wife reviewed his will, making some changes. However, breathing while lying on his back in bed proved extremely difficult.

Dr. Markel wrote in his article that "by 8 p.m., blisters of cantharides were applied to his feet, arms and legs while wheat poultices were placed upon his throat with little improvement. At 10 p.m., Washington murmured some last words about burial instructions to Col. Lear."[3]

Washington, in his extremis, thanked the doctors at his bedside for their efforts, and approached his death with equanimity. The last conversation he had was with Col. Lear. "Have me decently buried; and do not let my body be put into the vault in less than three days after I am dead. …Do you understand?" Upon receiving verbal confirmation that his last wishes would be honored, Washington spoke his final words: "Tis well."[1]

Cause of Death

Dr. Craik determined the cause of death to be inflammatory quinsy, or peritonsillar abscess. Modern-day differential diagnoses include diphtheria, streptococcal throat infection, pneumonia, or acute bacterial epiglottitis.

HEINZ H. E. SCHEIDEMANDEL, MD, in a JAMA article, "Did George Washington Die of Quinsy?" wrote that the president's problem "was first diagnosed as quinsy and later modified to Cynanche trachealis. A review of the signs, symptoms, and clinical course of his fatal illness suggests that the cause of death was most likely an otolaryngologic emergency known as acute epiglottitis."[4] Cynanche trachealis referred to an inflammation of the glottis, larynx, or upper part of the trachea.

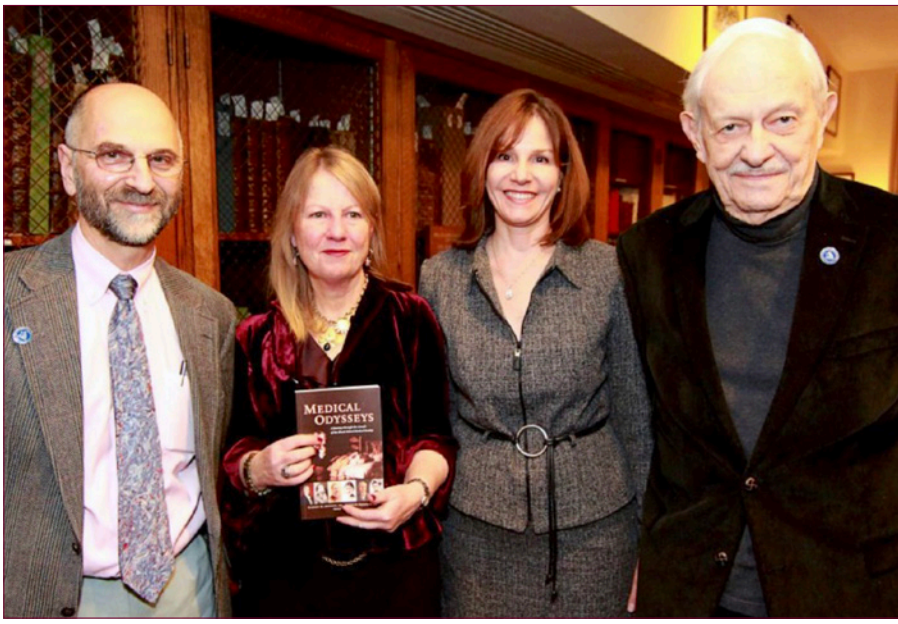
A solemn funeral was held at Mount Vernon four days later, when Washington was buried in the family tomb [**Image 3**]. Several weeks later, President John Adams declared a federal holiday in honor of the first president, on February 22nd, Washington's birthday. ❖

References

1. The Death of George Washington, https://www.mountvernon.org
2. https://founders.archives.gov/documents/Washington/06-04-02-0406-0002
3. Markel H. "Dec. 14, 1799: The excruciating final hours of President George Washington." PBS News Hour, Health. 2014. https://www.pbs.org/newshour/health/dec-14-1799-excruciating-final-hours-president-george-washington
4. Scheidemandel HHE. Did George Washington Die of Quinsy? Arch Otolaryngol. 1976; 102(9):519-521. 10.1001/archotol.1976.00780140051001

Au Revoir and *Bon Chance*

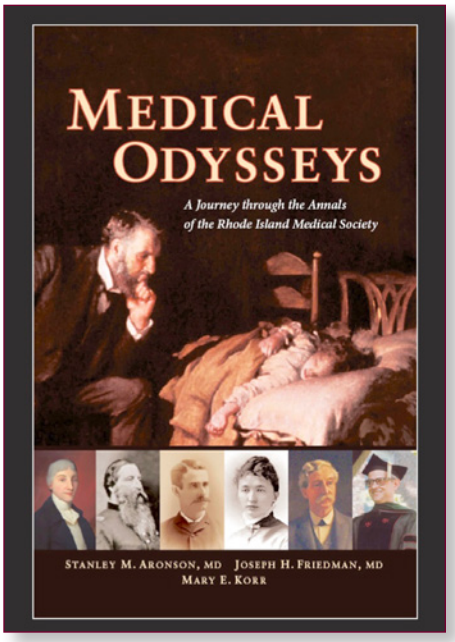
WILLIAM BINDER, MD; JOSEPH H. FRIEDMAN, MD



Medical Odysseys was published in celebration of the Rhode Island Medical Society's Bicentennial in 2012. From left are **Joseph H. Friedman, MD**; **Mary Korr**; graphic designer **Marianne Migliori**, and the late **Stanley M. Aronson, MD**, at the John Hay Library book-signing event.

The February issue of the *Rhode Island Medical Journal* (RIMJ) marks the end of an era. **DR. KEN KORR** and **MARY KORR**, our associate editor and managing editor respectively, are leaving the Journal to concentrate on grandchildren, gorgeous sunsets in the Bay area, and to pursue projects outside of medicine. Together, Ken and Mary have devoted almost 30 years to the Journal.

Dr. Korr began his Rhode Island journey as a cardiology fellow in 1978 at The Miriam Hospital. His talent was quickly recognized and he became the chief of Miriam's cardiac catheterization laboratory in 1981, a role he held for about 30 years. Dr. Korr started the interventional cardiology program at Miriam, and created the interventional fellowship program. He became the cardiology division director at Miriam, and later the director of inpatient cardiology services at the Lifespan Cardiovascular Institute (CVI). He also guest edited RIMJ three times in a span of 30 years, and became associate editor in 2015. He retired as an emeritus professor at Brown in 2016, and has continued as associate editor since his retirement.



During my first year as editor-in-chief of the Journal, Ken wrote a perspective piece looking back on the 50th anniversary of Woodstock, where he served as a medical volunteer. He cared for patients with lacerations and bad trips while feasting on veggies and beans during a sumptuous musical banquet that defined a generation. His guidance and wisdom has been invaluable during my tenure, and I am going to miss his steady hand. Enjoy playing more guitar! Turn it up to 11!

Simply put, the RIMJ would not exist without Mary Korr. Mary's path to the Journal came by way of a career in journalism. She worked for the *Attleboro Sun Chronicle* and then the *Providence Journal* between 1978–2002. She became the editor/senior writer of the *Jewish Voice and Herald* between 2003–2011, and edited Dr. Stan Aronson's columns. In 2010, the managing editor of the RIMJ did not have time to compile a book on the history of medicine in Rhode Island for the Rhode Island Medical Society's (RIMS) Bicentennial in 2012, and so Mary came to the rescue. *Medical Odysseys*, co-authored with **DRS. STANLEY M. ARONSON** and **JOSEPH H. FRIEDMAN**, is a remarkable work that provides a lens into the history of medicine not only in Rhode Island but also in the United States from the 18th–20th century.

Fortuitously, the position of managing editor became available in 2013, and she was the natural candidate for the position. As managing editor, Mary has been a rock. She organizes the Journal and our numerous submissions, prepares our annual report, and pays careful attention to every submission's grammar, punctuation, and compliance. Under her guidance, the Journal now receives manuscripts nationwide and has a national presence. But Mary understands our roots, and made the Journal invaluable—it

Graphic designer **Marianne Migliori**, and managing editor **Mary Korr**, presented the first nine issues of the redesigned *Rhode Island Medical Journal* at RIMS Annual Banquet and Inauguration of Officers in September 2013.

is a local source for information. She expanded the heritage section, which offers lessons from history; a people and places section, which keeps us abreast of our colleagues successes; a news section which updates us on events in our region, and she acknowledges passages through obituaries, allowing us to pay final respects to the men and women who have helped define the practice of medicine in Rhode Island. RIMJ has published remarkable and important case studies, research, reviews, and images over the years, but the flavor and essence of the Journal belongs to Mary Korr.

The RIMJ is now in its 109th year of publication, and the Rhode Island Medical Society, our publisher, is celebrating its 214th birthday. The Journal is thriving, and we reach almost 70,000 viewers from around the globe. We receive manuscripts from all corners of the United States. We are a state medical journal with a regional and national presence. However, it is Mary and Ken Korr who have helped guide the Journal and who found a way to make it a uniquely Rhode Island publication. We will miss them and wish them all the best as they start their next chapter. ❖

Authors

William Binder, MD, Editor-in-Chief,
Rhode Island Medical Journal

Joseph H. Friedman, MD, Editor-in-Chief *Emeritus*,
Rhode Island Medical Journal

A Heartfelt Farewell

MARY KORR

February is National Heart Month and in that theme, I would like to offer my heartfelt thanks to the publisher, the *Rhode Island Medical Society*, to graphic designer Marianne Migliori, and to the editors-in-chief, present and past, with whom I have worked with as managing editor of the *Rhode Island Medical Journal* (RIMJ) since 2013, when the Journal went "green" and became an online-only monthly publication.

My commitment to RIMJ during my tenure stems from a promise I made to Dr. Stan Aronson, its former editor-in-chief, and founding dean of Brown's medical school, during our final farewell —he passed away several months later. As Ken and I were leaving his home one evening, he beckoned me aside. "Promise me you will do all you can to keep the Journal going, for the medical students, to have their first work published."

"I will, Stan, I promise," I said.

He then pointed to Ken, a cardiologist, and placed his hand over his heart. "And promise me you'll take care of him."

And so it is in that spirit, and in this Heart Month, as RIMJ enters its 109th year, that I offer my heartfelt hopes that its legacy will endure. Let the beat go on for the present and future generations of healers to share their work. ❖

Author

Mary Korr, RIMJ Managing Editor (Jan. 2013–Feb. 2026)

We are read everywhere

In 2025, more than **60,000** unique viewers worldwide have read *Rhode Island Medical Journal* articles or researched topics from its archives, rimedj.org.

RANCHO PALOS VERDES, CALIFORNIA

The annual American Medical Associatrion (AMA) State Advocacy Summit, January 8–10.

Attendees heard from national experts on the critical issues impacting medicine at the state level, strategized with advocacy leaders on their organizations' state legislative and regulatory priorities, and networked with other physician leaders and colleagues from across the country.

Alexander Ding, MD, MS, MBA, Secretary of the AMA Board of Trustees and an interventional radiologist in Louisville, Kentucky.

Michael Migliori, MD, FACS, RIMS Chair of Public Laws and Ophthalmologist-in-Chief at Rhode Island Hospital, and **Steve DeToy**, RIMS government relations consultant, read RIMJ's January issue while attending The State Advocacy Summit.

New AMA survey spotlights top priorities, challenges in 2026 state health policy

AMA announces new grant program to deliver impact in state advocacy efforts

CHICAGO — Physician organizations are preparing for a dynamic state legislative landscape this year with health policy changes poised to reshape coverage, oversight, care delivery, and public health across the health system, according to a new survey released today by the American Medical Association (AMA).

The AMA's survey of 64 medical societies, including all 50 state medical societies and the District of Columbia, spotlights the leading health care priorities and challenges set to define state-level legislative action in 2026. Top issues include scope of practice, Medicaid policy pressures, and physician workforce challenges.

"Across the country, physicians are bracing for a year of consequential policy decisions that will directly affect patient care," said AMA CEO and Executive Vice President **JOHN WHYTE, MD**. "This survey shows that state medical societies are united around protecting patient safety, strengthening Medicaid, and addressing a workforce crisis that is straining access to care. Through our new State Advocacy Accelerator Grant Program, the AMA is delivering targeted resources to help physicians drive real impact at the state level and advance smart, evidence-based policies that put patients first."

Top concerns

Scope of practice: The top concern among the polled physician organizations is scope of practice, cited by 89 percent of respondents. Many anticipate new legislation from non-physician groups seeking expanded independent practice and prescription authority, with physicians emphasizing the need to protect patient safety and the integrity of team-based care.

Medicaid: Medicaid remains another pressing policy focus, as 72 percent of respondents plan vigorous engagement in Medicaid-related legislation. Key priorities common among many include enhancing physician reimbursement, stabilizing program funding, simplifying administrative processes, and adapting to federally mandated community engagement requirements. These issues are seen as central to high quality care and patient access.

Workforce shortages: Physician workforce shortages continue to challenge states, with 67 percent of respondents prioritizing solutions. Among the solutions many are expected to propose include expanding residency slots, improving graduate medical education funding, and supporting loan repayment programs. The need to remedy post-pandemic maldistribution and shortages remain acute.

Medical licensure and telehealth: Medical licensure and telehealth also rank high, as 67 percent of respondents plan to work on selected issues that range from establishing new licensing pathways for internationally trained physicians, promoting the Interstate Medical Licensure Compact, and increasing flexibility for cross-state telehealth care.

Public health: Public health, often marked by ongoing political polarization, remains a top-five priority with vaccination policy, reproductive health, tobacco control, and end-of-life care among key focus areas.

Other critical issues set to shape the policy landscape include private payer reform, such as prior authorization and payment transparency, and regulatory responses to the rapid rise of artificial intelligence and technological innovation in health care.

The survey underscores a unified and urgent call from physician organizations for policy solutions and AMA stands ready to help with expert resources and guidance, including the new AMA State Advocacy Accelerator Grant Program. State medical societies are eligible to apply for AMA grants to accelerate and advance state advocacy campaigns that protect patients, strengthen the practice of medicine, support physicians, and improve health care delivery. For additional grant program information, state medical societies can contact the AMA Advocacy Resource Center. ❖

AMA 2025 report on substance use and treatment sees drop in overdose deaths, calls on policymakers to remove obstacles to evidence-based care

CHICAGO — The American Medical Association (AMA) today released its 2025 report on the nation's overdose epidemic, showing that while opioid-related overdose deaths declined last year, the epidemic remains widespread and increasingly complex, driven by mixing opioids and other substances and an unpredictable illicit drug supply.

Overdose deaths declined from more than 110,000 in 2023 to about 75,000 in 2024, yet there is a tremendous amount of work to be done to sustain and accelerate this progress. The report emphasizes the life-saving role of naloxone and calls on policymakers and others to remove treatment barriers for substance use disorder and pain care.

The report highlights several key trends:

- **Pain care:** Opioid prescriptions have decreased 52% since 2012, falling from 260.5 million to 125.7 million in 2024. Yet, many patients still face barriers to non-opioid pain treatments because of restrictive insurance coverage, leaving them in pain and with reduced function. The AMA advocates for individualized, patient-centered care that preserves physician discretion and expands access to the full menu of therapies.
- **Treatment for opioid use disorder:** Medications for opioid use disorder

(MOUD), such as buprenorphine and methadone, save lives but remain underused due to stigma, regulatory barriers and insurance restrictions. Buprenorphine prescriptions increased 83% over the past decade, though utilization has plateaued in recent years. The report highlights key local, state, and federal policies needed to expand access to MOUD and ensure timely treatment.

- **Naloxone:** Nearly 2 million naloxone prescriptions were dispensed in 2024, and expanded distribution from community-based organizations continues to prevent overdose deaths. The AMA supports over-the-counter access and broader distribution from emergency departments and community settings.
- **Emerging threats:** Polysubstance use increasingly involves stimulants, xylazine, kratom, tianeptine and inhalants. The prevalence of cannabis use disorder is also growing, with associated mental health and pregnancy-related risks. The AMA calls for additional research and targeted policies to mitigate further harm, such as strong marketing and advertising regulations to protect young people.

"While the data points to meaningful progress, it also shows the overdose epidemic is evolving in dangerous ways," said AMA President **BOBBY MUKKAMALA, MD**. "Illicitly manufactured fentanyl and polysubstance use continue to put patients at risk, while barriers to pain care and addiction treatment persist. Every patient deserves timely, evidence-based care without stigma. State and national efforts must keep pace with the changing nature of this epidemic."

Over the past year, the AMA has worked to advance evidence-based policies to reduce overdose deaths, including efforts to eliminate prior authorization for MOUD, expand access to those medications, strengthen enforcement of parity laws for mental health and substance use coverage, and increase naloxone availability.

The AMA emphasizes that continued progress will require coordinated action among physicians, policymakers, insurers, and communities to remove barriers to care, respond rapidly to emerging threats, and save lives. ❖

RI awarded $156M federal grant to transform rural health care

PROVIDENCE — Governor **DAN MCKEE** announced in late December that Rhode Island has been awarded over $156 million in federal funding over five years to transform health care delivery in the state's 18 rural towns and provide critical support to local providers. The award follows a competitive federal application led by the McKee administration in partnership with state agencies, health care providers, and community stakeholders. The program will be over five years, and the announcement represents the first year of the award.

"This is a major win for Rhode Island," said Governor McKee. "My administration has secured $156 million to expand access to care by investing in primary care, preventive services, and behavioral health, and by partnering with hospitals and local health providers to bring lower-cost care options closer to home. This funding allows us to strengthen the foundation of our health system, improve outcomes, and ensure Rhode Islanders can get the affordable, high-quality care they deserve."

As outlined in Rhode Island's approved Rural Health Transformation Program (RHTP) framework, the state will work closely with the Centers for Medicare & Medicaid Services (CMS) over the next 30 days to finalize the detailed budget and implementation plan. While that process continues, the core priorities of the award are clear and reflect the strategies advanced in the state's application.

More details on implementation and next steps will be released following final CMS approval of the state's budget and operational plan.

The application was developed through a coordinated effort within the McKee Administration led by the Executive Office of Health and Human Services (EOHHS) in partnership with the Department of Health (RIDOH)'s Office of Primary Care and Rural Health and multiple state agencies, with engagement from hospitals, primary care providers, behavioral health agencies, municipal leaders, and the Narragansett Indian Tribe. The process also incorporated extensive public input through a statewide rural health survey, which captured the experiences and priorities of rural residents and providers, along with a series of community listening sessions held across northern and southern Rhode Island and on Block Island.

"This funding gives Rhode Island a chance to strengthen our health system, rethink how rural care is delivered, modernize public health infrastructure, and improve recruitment, training, and retention in our healthcare workforce," said Director of Health **JERRY LARKIN, MD**. "I'm grateful for all the collaboration that went into Rhode Island's application, and I am looking forward to all the good that will come of this opportunity in the years to come." ❖

Researchers achieve the first minimally invasive coronary artery bypass

ATLANTA, GA [NATIONAL INSTITUTES OF HEALTH (NIH)] — In a world first, a team of researchers at the National Institutes of Health (NIH) and Emory School of Medicine, Atlanta, has successfully performed a coronary artery bypass without cutting the chest wall. The team employed a novel intervention to prevent the blockage of a vital coronary artery, which is a very rare but often lethal complication following a heart-valve replacement. The results suggest that, in the future, a less traumatic alternative to open-heart surgery could become widely available for those at risk of coronary artery obstruction.

"Achieving this required some out-of-the-box thinking but I believe we developed a highly practical solution," said first author of the study **CHRISTOPHER BRUCE, MBChB**, an interventional cardiologist at WellSpan York Hospital and NIH's National Heart, Lung, and Blood Institute (NHLBI), as well as an adjunct assistant professor of cardiology at Emory School of Medicine.

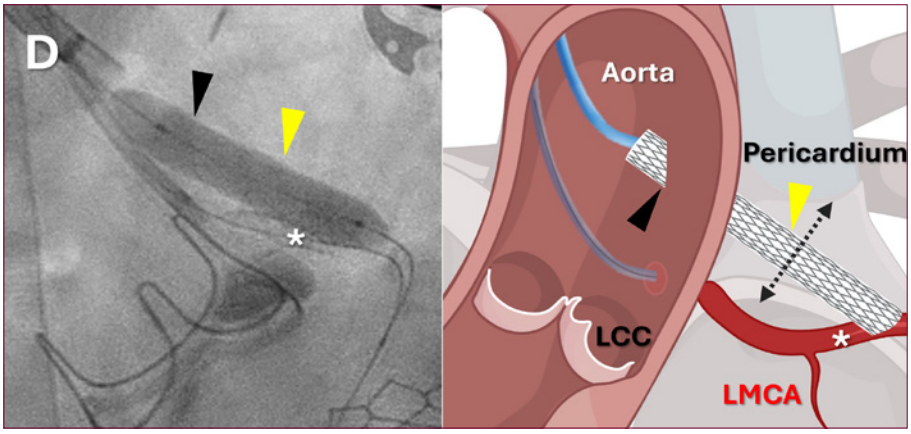
The patient was a 67-year-old man whose aortic valve had previously been replaced by a bioprosthetic, but, due to calcium build-up, the replacement now needed replacing. However, this patient's unique anatomy placed the ostium, of his left coronary artery so close to the valve that its life-sustaining blood flow would likely become blocked during the standard valve replacement procedure.

"Our patient had an extensive history of prior interventions, vascular disease, and other confounders, which meant that open-heart surgery was completely off the table. Having a minimally invasive alternative in a case like this is paramount," said **ADAM GREENBAUM, MD**, a senior author of the study and a physician at Emory School of Medicine.

Due to several anatomical quirks, the patient was also not a good candidate for existing minimally invasive solutions. Fortunately, Greenbaum and **VASILIS BABLIAROS, MD**, at Emory had recently begun developing a solution just for this kind of scenario.

"We thought, 'why don't we just move the ostium of the coronary artery out of the danger zone?'," Greenbaum said.

Bruce and **ROBERT LEDERMAN, MD**, who leads the Laboratory of Cardiovascular Intervention at NHLBI, joined the Emory physicians to help turn their concept into a viable medical procedure, having used it successfully in animal models.



A fluoroscopy image (left) and graphic representation (right) depict a stent graft (yellow arrowhead) being deployed, creating a new path for blood flow from the aorta (black arrowhead) to the left main coronary artery (asterisk). [BRUCE ET AL.[1]]

The procedure, called ventriculo-coronary transcatheter outward navigation and re-entry, or VECTOR, creates a new route for blood flow that is a safe distance away from the aortic valve. And rather than cracking open the chest to do it, the researchers use the body's natural vascular circuitry to reach the heart, slipping catheters through vessels in the legs. While this mode of access is not new, what the study authors do with their tools once they get there is.

With VECTOR, the researchers pass a wire through the aorta and into the at-risk coronary artery. From there, they steer the wire deep into one of the artery's branches, breaching the vessel into the right ventricle. There, they operate a separate catheter to ensnare that wire and then pull the wire's end out through the femoral vein. Now a continuous line from aorta to vein, this wire enables loading of more sophisticated tools into the target artery.

The next goal of VECTOR is to produce a new ostium for the coronary bypass. They create one hole in the aorta downstream from the valve, out of range of potential blockage. The researchers make a second opening by piercing through the coronary artery wall using a special catheter, which is braced by an expandable mesh tube, called a stent. They pass two loose ends through each of the holes and then, as in the previous phase, tie them together to create another bridge, this time tracing a safe path for the bypass.

Using this second wire, the team feeds a coronary bypass graft through the two new openings. Once deployed, the graft provides a new route for blood flow that is out of harm's way.

Greenbaum and Babaliaros at Emory, joined by Bruce, put these steps into practice in their patient.

Six months after the procedure, the patient showed no signs of coronary artery obstruction, meaning VECTOR's first outing in a human proved to be a success. Further deployments in more patients are still necessary before VECTOR is used more widely, but the team is hopeful of continued success following this major step forward.

The authors suggest the new technique may also find some footing in treating coronary diseases more broadly, in cases where other approaches, such as stents, fail to keep arteries open.

"It was incredibly gratifying to see this project worked through, from concept to animal work to clinical translation, and rather quickly too. There aren't many other places in the world that can move as quickly and successfully as we can at NIH in collaboration with our partners at Emory," Bruce said. ❖

Reference

C Bruce, et al. Percutaneous aorto-coronary bypass graft to prevent coronary obstruction following TAVR: First human VECTOR procedure. Circulation: Cardiovascular Inteventions. 2026. DOI: https://doi.org/10.1161/CIRCINTERVENTIONS.125.01613

University Orthopedics now offers advanced technology for precision in total knee replacement

EAST PROVIDENCE — University Orthopedics recently announced it is the first in the region to offer one of the most personalized approaches to joint restoration: the VELYS™ Robotic-Assisted Solution.

"By supporting a more natural balance and movement for joint replacement done in an ambulatory surgical center, this technology is a powerful tool that represents the next generation of personalized orthopedic care," said **VALENTIN ANTOCI, MD, PhD**, orthopedic surgeon and director of Outpatient Adult Reconstruction at University Orthopedics. "The feedback from our patients has been overwhelmingly positive."

The VELYS Robotic-Assisted Solution works alongside the ATTUNE™ Knee System, an innovative implant designed to help improve stability and reduce pain. The ATTUNE Knee supports better range of motion and helps prevent the unstable feeling some patients may experience during everyday activities, such as bending and walking up and down stairs.

VELYS™ Robotic-Assisted Solution [UNIVERSITY ORTHOPEDICS]

"Robotics gives us a level of consistency and accuracy, allowing us to individualize alignment and soft-tissue balance so patients can return to the active lifestyles they love with greater confidence," said **THOMAS BARRETT, MD**, orthopedic surgeon at University Orthopedics.

"This system helps us deliver both accuracy and efficiency—two essentials for modern outpatient joint replacement," said **MOUHANAD EL OTHMANI, MD**, orthopedic surgeon at University Orthopedics. "By combining robotics with enhanced recovery pathways, we're seeing patients get back on their feet faster and with a more natural-feeling joint." ❖

RIDOH, Infrastructure Bank awards grant to URI for manganese vulnerability study

PROVIDENCE — The Rhode Island Department of Health's (RIDOH) Center for Drinking Water Quality, in coordination with Rhode Island Infrastructure Bank (RIIB), has awarded a $199,856 Emerging Contaminants grant to the University of Rhode Island (URI) to conduct a statewide manganese vulnerability study.

The Manganese Vulnerability Study will evaluate manganese concentrations in drinking water within Rhode Island's public water systems. In partnership with URI, RIDOH will analyze data from 169 systems statewide and collect approximately 1,400 water samples to identify areas with elevated manganese levels and fill existing data gaps. This comprehensive analysis will provide a clearer understanding of manganese occurrence and distribution throughout Rhode Island's drinking water infrastructure.

"Work to ensure safe and healthy drinking water for all Rhode Islanders is a core focus for the Rhode Island Department of Health," said Director of Health **JEROME LARKIN, MD**. "This Manganese Vulnerability Study being conducted with our partners at the University of Rhode Island will help us better understand where communities may be at risk and how these contaminants move through drinking water systems. The findings will support our ongoing collaboration with the Rhode Island Department of Environmental Management and RIIB as we work to address and minimize the impacts of Emerging Contaminants, like manganese, in drinking water."

"Recent research has highlighted potential health risks associated with elevated manganese levels and that is why we are pleased to award this Emerging Contaminants grant to URI to conduct a statewide assessment of manganese levels in public drinking water systems," said Infrastructure Bank Executive Director **BILL FAZIOLI**. "Working in coordination with RIDOH, this study will provide critical insight into the occurrence and distribution of manganese, support the development of advanced treatment strategies, and offer guidance to drinking water systems most impacted."

"Manganese can be a challenging issue for water systems, particularly smaller systems with limited resources," said URI Civil and Environmental Engineering Associate Professor **JOSEPH GOODWILL, PhD, PE**. "As Rhode Island's university, URI has a responsibility to apply research and technical expertise to problems that directly affect our state, and this study will provide data and insights through a partnership with the Rhode Island Department of Health that will help communities better understand and manage manganese in their water."

RIIB is the State's central hub for financing infrastructure improvements for municipalities, businesses, and homeowners. ❖

Attorney General Neronha co-leads coalition in suing HHS for conditioning funding on transgender discriminatory policy

PROVIDENCE — Attorney General **PETER F. NERONHA** on January 13th co-led a coalition of 12 attorneys general in suing the U.S. Department of Health and Human Services (HHS) for unlawfully conditioning hundreds of billions of dollars in federal funding on states' agreement to discriminate against transgender people. Under a new HHS policy, recipients of federal health, education, and research funding must certify compliance with a presidential executive order that seeks to harm transgender people and impose rigid, unscientific definitions of sex.

"A year into this Administration and they continue to impose illegal conditions on federal funding; a colossal waste of time and resources on their part since we have yet to lose a case of this kind," said Attorney General Neronha. "A few issues are at play here. First, Congress has the power of the purse, not the President. It follows that discriminatory policies by the executive branch that attempt to condition funding and bully states into compliance are unlawful. Second, this new policy directly contradicts existing state law, in Rhode Island and elsewhere, which protects the rights of transgender people. This is yet another distraction from an Administration that would rather target marginalized groups than do anything to help the American people. It hasn't worked before and it won't work here."

This new HHS policy requires states, public universities, health agencies, hospitals, and other recipients of federal funds to certify compliance with Title IX protections, which it characterizes as "including the requirements" of the President's executive order redefining sex in a way that excludes transgender people. HHS has made this certification a condition of funding across the agency and has warned that recipients could face termination of grants, repayment of funds, and even civil or criminal liability if they are found to be out of compliance. The policy not only applies to new grants, but also to existing funding, placing ongoing programs at immediate risk. At the same time, HHS has failed to clearly explain what compliance requires.

The attorneys general argue that HHS lacks the authority to impose these conditions and is unlawfully attempting to rewrite Title IX through executive action and agency policy. The lawsuit alleges that the policy violates the U.S. Constitution by overriding Congress' power of the purse, breaks federal law by attaching vague and retroactive conditions to funding, and violates the Administrative Procedure Act by imposing a major policy change without notice or explanation. The policy also contradicts decades of court opinions and settled federal guidance recognizing that Title IX protects people from discrimination based on gender identity.

The President's discriminatory executive order conflicts with laws in many states, including Rhode Island, that protect the rights of transgender individuals. In Rhode Island, state law explicitly prohibits state agencies from discriminating on the basis of gender identity or expression (R.I. Gen. Laws § 28-5.1-7) and prohibits state hiring practices and state educational programs that discriminate on the basis of gender identity or expression (R.I. Gen. Laws §§ 28-5.1-4, 8).

This policy will have far-reaching consequences across healthcare and social services. Rhode Island receives billions of dollars in funding annually, a significant portion of which would be subject to the newly imposed gender conditions, and therefore at risk. Further, because these conditions are inconsistent with state law, Rhode Island state agencies would have to determine whether to reject the funding, to the detriment of the state, or to accept the funds at the risk of criminal action under the False Claims Act if the agencies do not comply with these certifications.

The coalition is asking the court to declare the policy unlawful and block HHS from enforcing it, allowing states to continue providing health care, education, and other essential services without being forced to discriminate.

Attorney General Neronha co-leads this lawsuit with Attorney General Rob Bonta of California, Attorney General Letitia James of New York, and Attorney General Dan Rayfield of Oregon, and is joined by the attorneys general of Colorado, Delaware, Illinois, Michigan, Minnesota, Nevada, Vermont, and Washington. ❖

Brown University Health Urgent Care and Walk-In Clinic opens in Barrington

BARRINGTON — Brown University Health announced the opening of a Brown University Health Urgent Care and Walk-In Clinic in Barrington. **JOHN FERNANDEZ**, President and CEO, Brown University Health, welcomed guests at a ribbon-cutting event recently at the facility, located at 236 County Road.

A ribbon-cutting ceremony was held recently at the new Brown University Health Urgent Care and Walk-In Clinic in Barrington on County Road. [BROWN UNIVERSITY HEALTH]

The new clinic serves patients of all ages, from 18 months old and up. The facility offers plenty of free, convenient parking. Like all Brown Urgent Care locations, it is open Monday through Friday from 8 a.m. to 8 p.m. and Saturday, Sunday, and some holidays from 8 a.m. to 6 p.m. All locations are closed New Year's Day, Thanksgiving, and Christmas.

"We're proud to expand Brown Health Urgent Care to Barrington," said **OLIVIER GHERARDI, DO**, medical director, Brown University Health Urgent Care. "The timing of our new location is excellent given the recent spike in cold and flu cases. Now residents of Barrington and nearby communities with minor illnesses or injuries have the advantage of walk-in care with a Brown Health provider, all year long."

Dr. Gherardi added, "Urgent care delivers quick treatment for unexpected health issues that aren't life-threatening."

In addition to colds and flu, Brown Health Urgent Care offers treatment for a variety of medical needs from animal bites to UTIs. Patients can also obtain X-rays, flu and tetanus shots, COVID testing, and sports physicals. An appointment is not required at any of Brown Health Urgent Care's locations. ❖

Care New England introduces new, shared brand

PROVIDENCE — Care New England recently announced the launch of a new shared brand identity designed to help patients, families, and the community more easily recognize and navigate locations and services. This updated brand reflects a shared system of care while preserving the individual names, identities, and trusted reputations of each operating unit within Care New England.

Women & Infants Hospital, Butler Hospital, Kent Hospital, the VNA Home Health & Hospice, The Providence Center, Anchor Recovery, Integra, and CNE Medical Group will continue to operate independently with their own leadership and workforce. Together, they will share key system resources that improve care delivery and the patient experience, including a single electronic health record, consolidated billing, and coordinated clinical and operational services.

The new logo will serve as a visual cue to patients and the community that Care New England—through all associated entities and operating units—can help them navigate healthcare by making it convenient and seamless to access the exceptional foundational care they need throughout their life's journey.

"Each of our operating units has earned the trust of Rhode Islanders and the greater community," said **DR. MICHAEL WAGNER**, president and CEO, Care New England Health System. "This brand brings that trust together under one shared symbol, showing our shared commitment to our patients."

The new brand will be rolled out across facilities, digital platforms, and patient materials over time. ❖

Bradley Hospital expands access to resources in newly redesigned website

EAST PROVIDENCE — Bradley Hospital announced the official launch of its newly redesigned website, www.bradleyhospital.org, marking an important milestone in the hospital's ongoing commitment to advancing child and adolescent mental health care.

As behavioral health challenges affecting children and adolescents continue to rise nationwide, families, clinicians, and educators can turn to Bradley Hospital for specialized care, expertise, and guidance. The new website is designed to make it easier than ever for those seeking help to connect with Bradley's nationally recognized programs, research, and clinical experts.

The enhanced website features:

- Comprehensive information about Bradley's clinical services, specialty programs, research initiatives, and expert clinicians
- New topic-based "content hubs" focused on key areas such as anxiety, depression, social media addiction, and eating disorders, enabling visitors to quickly find relevant, trusted information
- Expert-written blogs addressing current issues and advances in child and adolescent mental health
- A complete library of Mindcast podcast episodes
- Streamlined access to courses and professional training offered through The Bradley Learning Exchange

More than a digital upgrade, the new website reflects Bradley Hospital's shared commitment to children's mental health and to the families and professionals who rely on the hospital for care, education, and hope.

This commitment is also reflected in the hospital's most recent $8 million federal grant from the National Institute of Health (NIH) in September 2025 to construct a new pediatric psychiatric research laboratory on its campus. Bradley Hospital currently hosts over 20 NIH-funded research projects, including the Pediatric Anxiety Research Center (PARC). ❖

Appointments

Carolyn Jackson, MBA, named President and COO of Kent Hospital

WARWICK — Care New England Health System recently announced the appointment of **CAROLYN JACKSON, MBA**, as President and Chief Operating Officer (COO) of Kent Hospital, effective February 2, 2026.

Jackson brings more than two decades of senior healthcare leadership experience, with a strong record of operational excellence, financial turnaround, and quality improvement across complex hospital systems. She will be joining Kent Hospital from Encompass Health Rehabilitation Hospital of Braintree, where she currently serves as Chief Executive Officer. Prior to that role, Jackson spent six years as Chief Executive Officer of Tenet Healthcare's Massachusetts Market and Saint Vincent Hospital in Worcester, and she served as Chief Operating Officer of the Hospital of the University of Pennsylvania in Philadelphia.

"Kent Hospital is a cornerstone community hospital, and an integral part of Care New England's system of hospitals, services, and providers dedicated to delivering foundational care to our community," said **DR. MICHAEL WAGNER**, President and CEO of Care New England. "Carolyn's proven leadership and commitment to quality, and her ability to strengthen organizations clinically and operationally make her exceptionally well-suited to lead Kent Hospital and advance our mission of coordinated, patient-centered care."

During her tenure at Saint Vincent Hospital, Jackson led a dramatic $89 million financial turnaround just three years. Under her leadership, the hospital earned national recognition for clinical excellence, including Healthgrades' designation as one of America's 100 Best Hospitals for Coronary Intervention for two consecutive years. She also spearheaded innovative COVID-19 response efforts, including the establishment of a high-efficiency vaccination clinic that administered more than 85,000 vaccines, while maintaining low employee infection rates through rigorous safety protocols.

Jackson has also demonstrated a strong commitment to expanding access to care, leading the operationalization of eight new behavioral health beds to address critical community needs and securing $2.5 million in funding to operationalize another 17 behavioral health beds.

"I am honored to join Care New England and the exceptional team at Kent Hospital," Jackson said. "I look forward to working collaboratively with physicians, staff, and community partners to build on Kent's strong foundation, deliver high-quality, compassionate care, and advance Care New England's mission to ensure Rhode Islanders have easy, coordinated access to the clinical programs and services that support well-being at every stage of life." ❖

Recognition

Rhode Island Hospital Medical Staff Association: Edward Akelman, MD, Outstanding Physician of the Year

EAST PROVIDENCE — The Rhode Island Hospital Medical Staff Association recently awarded University Orthopedics president, **EDWARD AKELMAN, MD**, with the 2025 Milton W. Hamolsky, MD Outstanding Physician of the Year Award.

Named for a founding figure in the development of Brown University's medical school, the award is the highest honor bestowed by the Rhode Island Hospital medical staff. It recognizes physicians who demonstrate exceptional clinical skill, leadership, professionalism, and dedication to the practice of medicine.

In addition to his duties as president of University Orthopedics, Dr. Akelman serves as chairman of the Orthopaedic Departments at the Warren Alpert Medical School of Brown University, Rhode Island Hospital, and Miriam Hospital. A nationally respected, board-certified expert in his field, Dr. Akelman treats a wide range of upper-extremity conditions and disorders.

Dr. Akelman's longstanding commitment to patient care, medical education, and surgical excellence has had a profound and lasting impact on both his patients and colleagues.

"Dr. Akelman's commitment to teaching and patient care has been inspiring since my first day working with him during my PGY-2 year," said UOI Hand and Upper Extremity Surgeon **JOSEPH GIL, MD**, one of the nominating physicians. "His patience, particularly as he guided me through my first LRTI procedure, left a lasting impression on my development as a physician. He consistently demonstrates the importance of forming meaningful, personal connections with patients—an approach I continue to emphasize with residents and fellows today."

The Physician of the Year award was virtually presented to Dr. Akelman at the Medical Staff Association's annual meeting on January 21, 2026, with an in-person celebration planned during the Biannual Meeting in September 2026. ❖

Hasbro Children's earns National Beacon Award for Excellence from the American Association of Critical-Care Nurses

PROVIDENCE — Hasbro Children's Pediatric Intensive Care Unit (PICU) has again received The American Association of Critical-Care Nurses (AACN) Silver Beacon Award for Excellence for demonstrating excellence in patient outcomes, nursing workforce engagement, and healthy work environments.

The Beacon Award for Excellence recognizes unit caregivers who successfully improve unit outcomes and align practices with AACN's six Healthy Work Environment Standards. Units that earn this annual award with a gold, silver or bronze designation meet specific criteria established by AACN that represent the characteristics and components of the unit environment that nurses can influence to achieve nursing excellence.

"This marks the second consecutive year Hasbro Children's has earned the Beacon Award under AACN's newer annual designation process," said **SARAH FROST**, Chief of Hospital Operations and President of Rhode Island Hospital and Hasbro Children's. "This designation is acknowledgement of our PICU team's passion for excellence and providing our patients with the best high-quality, patient and family-centered care."

Units earning the Beacon Award demonstrate excellence across three core areas:

- Patient Outcomes
- Nursing Workforce
- Work Environment

The Hasbro Children's PICU submitted extensive quantitative data related to infection prevention, high-risk interventions, staffing, and retention, along with qualitative narratives describing interventions implemented to improve care delivery and workplace culture. The unit also completes an annual survey capturing feedback directly from bedside nurses to guide ongoing improvement efforts.

"We care about every child and family member we treat as though they are our own, providing support and encouragement every step of the way. We care for the sickest children across Rhode Island, Massachusetts and Connecticut. It's a difficult job at times, but one of the most rewarding. We're all so passionate and dedicated as individuals and a team, and that's what makes Hasbro Children's so special," said **MICHAELA VIEIRA, BSN, RN**, Pediatric Intensive Care Unit nurse at Hasbro Children's, who led this year's application effort. ❖

Recognition

Integra earns National Committee for Quality Assurance (NCQA) Case Management Accreditation

PROVIDENCE — Care New England's Integra Community Care Network has received National Committee for Quality Assurance (NCQA) Case Management Accreditation at the highest level for three years. This evidence-based accreditation recognizes organizations that demonstrate excellence in the delivery of high-quality case management programs focused on continuous quality improvement and patient-centered care.

The accreditation reflects Integra's commitment to delivering exceptional performance while meeting the complex needs of the patients and communities it serves.

"This accreditation sets Integra apart and reinforces our mission to put people first," said **ANA TUYA FULTON, MD, MBA**, President and COO, Chief Population Health Officer, Care New England – Integra. "It validates the work our team does every day and demonstrates that our care management programs meet rigorous standards to ensure members receive coordinated, compassionate, and effective support.

Integra's Case Management Accreditation is through 2028. ❖

Brown University Health held a ribbon-cutting ceremony at the opening of its new Cancer Institute at 70 Walnut Street in Foxborough, MA. [BROWN UNIVERSITY HEALTH]

Brown University Health celebrates opening of Cancer Institute in Foxborough

PROVIDENCE — Brown University Health, joined by the Tri-Town Chamber of Commerce and the Neponset River Regional Chamber, recently celebrated the opening of its new Cancer Institute at 70 Walnut Street in Foxborough with a ribbon-cutting ceremony. The event was attended by State Senator **PAUL FEENEY**, Representative **MICHAEL CHAISSON**, Brown University Health leadership, clinicians, staff and community partners.

Medical Oncology, led by **JONATHAN B. CROOPNICK, MD**, specializes in benign and malignant hematology and the treatment of most solid tumors. The onsite infusion center provides advanced chemotherapy, immunotherapy, and targeted therapies guided by tumor sequencing and patient genetics.

Radiation Oncology, led by **JONATHAN M. GLANZMAN, MD**, offers customized radiation therapy plans as part of a multidisciplinary cancer team. The Radiation Therapy Center features a brand new state-of-the-art Linear Accelerator (LINAC) that delivers precise radiation while sparing healthy tissue.

Additional services at the Foxborough location include advanced imaging, CT scanning, ultrasound, bone density testing, and new diagnostic 3D mammography, along with walk-in lab services, therapeutic phlebotomy, and non-cancer-related infusions and injections.

During the ceremony, State Senator Paul Feeney and Representative Michael Chaisson presented official citations recognizing the opening of the Foxborough Cancer Institute and commending Brown University Health for its continued commitment to expanding access to high-quality, patient-centered cancer care in the region.

"This new location represents a meaningful step forward in how we deliver cancer care, bringing expert, highly coordinated services into the communities where our patients live," said **CYNTHIA PETERSON**, executive vice president, Ambulatory and Clinical Services, Brown University Health. "By co-locating medical and radiation oncology in a single, modern setting, we're improving access, strengthening collaboration, and enhancing the overall patient experience. We are truly grateful for the wonderful community partners in Foxborough and the strong collaboration between Brown University Health and the Tri-Town and Neponset River Chambers." ❖

Obituaries

JOSEPH D. DIZOGLIO, MD, FACOG, 87, passed away on Dec. 29th, 2025.

After graduating from Classical High School in Providence, Class of 1955; College of the Holy Cross in Worcester, Massachusetts, Class of 1959; and Tufts Medical School, Class of 1963, he became a board-certified obstetrician and gynecologist, co-founded Broadway Ob/Gyn, and served on the staff of Women & Infants Hospital for over 50 years.

He was a proud veteran of the United States Air Force Medical Corps, serving as a Captain in the Department of Ob/Gyn, in Homestead, Florida, during the Vietnam War.

He leaves behind his wife and soulmate of 34 years, Dr. Beata DiZoglio née Zakowicz, FACOG. He is also survived by his younger brother, Gregory J. DiZoglio and his wife Robin A. DiZoglio of Cranston; six children: Thomas DiZoglio of Brattleboro, Vermont; James DiZoglio (wife, Lee) of Los Gatos, California; Sarah Macrina (husband, Eric) of Marblehead, Massachusetts; Rebecca DiZoglio of Marin County, California; Dr. Joseph DiZoglio Jr., (wife, Dr. Kate Telma) of Verona, Wisconsin, and Jan Benjamin DiZoglio of Three Forks, Montana, and five grandchildren.

In his memory, the family would greatly appreciate donations to his favorite charity, Pawtucket Soup Kitchen, PO Box 3102 Pawtucket, RI, 02861 or donations online at pawtucketsoupkitchen.org.

Visit NardolilloFH.com for online condolences. ❖

EDGARDO RODRIGUEZ, MD, 81, passed away peacefully on Dec. 20th, 2025. He was surrounded by his family including his wife of 45 years, Suzanne Cruanes-Rodriguez, and their two sons, Forest and Hunter. He leaves behind family members including a brother-in-law and two sisters-in-law, and beloved nieces, nephews, cousins, and many friends and colleagues.

He served in the United States Navy from 1963 to 1969, and lived a life shaped by world travel and service. This included work at the Prithipura Infant Home in Ceylon (now Sri Lanka), where he cared for sick and impoverished children.

In 1974, he graduated from Fordham University with a degree in English and later completed his medical training at Columbia Presbyterian/St. Luke's-Roosevelt Hospitals in Manhattan.

Dr. Rodriguez worked as an anesthesiologist in Rhode Island for 37 years, including time at Roger Williams Hospital, St. Joseph's Hospital, and Our Lady of Fatima Hospital in Providence, and his "second home," Memorial Hospital of Rhode Island in Pawtucket. He was the consecutive two-term president of the Pawtucket Medical Society in 2001 and 2002 and served as a faculty member of Brown University.

He was proud to have inspired many nurse anesthetist students through his teaching at The Memorial Hospital School of Nurse Anesthesia. Dr. Rodriguez was an earnest healer who treated his patients as if they were his own kin. His authenticity and compassion deeply touched the lives of all he served and worked with.

He was a member of the American Society of Anesthesiologists, the RI Society of Anesthesiologists, the RI Medical Society, the American Association of Physician Specialists, the Preservation Society of Newport County, and the Friends of Mount Hope Farm.

Memorial contributions can be made to the Our Lady of Mount Carmel School. To order memorial trees in memory of Dr. Rodriguez, visit Sansone Funeral Home flower store. ❖