Rhode Island Adolescents and Routine Vaccinations: Can We Get Back on Track?

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ABSTRACT

BACKGROUND: Using data from the Rhode Island immunization registry from January 2019 through September 2022, we assessed whether adolescent routine vaccination rates are catching up on losses experienced early in the pandemic.

METHODS: For Q1 2020–Q3 2022, we calculated the number of adolescents ages 11–18 receiving a routine vaccine as a percentage of the same quarter in 2019 along with the cumulative difference through Q3 2022. Human papillomavirus (HPV) vaccine trends were further stratified by racial/ethnic identity and by sex.

RESULTS: Except for Q1 2021, the number of adolescents receiving each vaccine in each calendar quarter since Q1 2020 was below 100% of the same quarter in 2019, resulting in cumulative "losses" or "deficits" relative to pre-pandemic numbers.

CONCLUSIONS: We describe ways Rhode Island can expand on its existing partnerships between primary care providers, public health, and schools to address the decline in adolescent routine vaccination.

KEYWORDS: Immunizations, adolescents, HPV vaccine, adolescent preventive care

INTRODUCTION

The SARS-CoV-2 (COVID-19) pandemic began to unsettle healthcare delivery in the United States early in 2020 as practices pivoted to new infection control procedures and the public drew back from nonessential medical encounters. Multiple publications have described the initial effects of the pandemic on routine childhood and adolescent vaccination in particular: while estimates varied by geography and methodology, there was a widespread and significant decline in the number of routine vaccines administered.[1-9] Two years later, many pediatric providers and parents are understandably focused on addressing escalating pediatric mental health needs,[10-12] while growing instability in health care and public health is also making routine childhood immunization and other tenets of preventive health more important than ever, both to prevent outbreaks and to reduce young people's health risks later in life.

Rhode Island (RI) traditionally performs at or above the national average for routine childhood and adolescent immunizations.[13] The Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP) recommends three routine vaccinations for adolescents: one booster dose of Tdap (to protect against tetanus, diphtheria, and pertussis), Human papillomavirus or HPV (a two-dose or three-dose series depending on age of initiation, to protect against multiple human papilloma virus-associated cancers[14]), and two doses of meningococcal conjugate (MenACWY or MCV4) vaccine, to protect against increased risk of meningococcal diseases in the types of congregate settings that adolescents and young adults may enter (dormitories, military, etc.). In RI, all three of these vaccinations are required for school enrollment. (Of note, ACIP also recommends an annual influenza vaccine, but this was excluded from the current analysis due to its periodicity and because it is not required for school enrollment). We analyzed data from the Rhode Island immunization registry from January 2019 through September 2022 to assess whether adolescent routine vaccination rates in our state are catching up on losses experienced early in the pandemic. Secondarily, we assessed for demographic variations in HPV vaccination trends.

METHODS

The Rhode Island Child and Adult Immunization Registry (RICAIR) is Rhode Island's Immunization Information System (IIS). It maintains records of all vaccinations administered in the state. As of 2022, it also contains past and present records of vaccinations administered in Massachusetts, Connecticut, New Jersey, and New York City to RI residents. RICAIR records are strictly confidential, and access is limited to authorized users such as medical providers and school nurses. The RI Department of Health also accesses RICAIR data to conduct routine public health surveillance and identify potential population-level gaps in coverage; as this study falls under that umbrella, it was deemed exempt from IRB review.

We used 2019 as a baseline, as that was the last full year prior to the pandemic. We calculated the number of adolescents aged 11–18 who received an HPV, MCV4, and/or Tdap vaccine in each calendar quarter between Q1 2019 and Q3

2022 using SAS 9.4. For calendar quarters Q1 2020 and later, we then calculated the number as a percentage of the same quarter in 2019; the difference from the same quarter in 2019; and the cumulative difference through Q3 2022. HPV trends were further stratified by race or ethnicity and by sex. Racial and ethnic identity as well as sex are submitted to RICAIR either through Office of Vital Records birth records, or by providers. Options are Hispanic/Latino ethnicity (Yes, No, or Unknown) and the following identities for race: American Indian/Alaskan Native, Asian, Black, Hawaiian/PI, Multi, Other, Unknown, or White. We created the following categories for analysis: Hispanic/Latinx, Black (non-Hispanic), Asian (non-Hispanic), White (non-Hispanic), and all other identities. Adolescents whose racial or ethnic identity was not known to RICAIR were excluded from the stratification of HPV trends by race or ethnicity, but included in all other analyses. Sex is captured in RICAIR as Male, Female, Other (as of 2022), and Unknown. (There were no individuals with sex reported as "Other" in the study population, and 0.14% were reported as Unknown.) We recognize that the categories of race/ethnicity and sex as captured in RICAIR employed in this analysis do not capture how all adolescents identify themselves.

RESULTS

In 2019, on average 6555 RI adolescents aged 11–18 received an HPV vaccine each calendar quarter, 6203 received an MCV4 vaccine, and 3472 received a Tdap. For the first three quarters of 2022, the average number of adolescents receiving those vaccines each quarter were 5526, 5594, and 3047 respectively. With the exception of Q1 2021, the number of adolescents receiving each vaccine in each calendar quarter since Q1 2020 was below 100% of the same quarter in 2019. After the first full-quarter impact of the pandemic in Q2 2020, when routine vaccinations were about half of their normal volume (47.7% for HPV, 52.8% for MCV4, and 49.2% for Tdap; see **Figure 1**), the proportions ranged from 80.2% (HPV in Q4 2021) to 106.8% (MCV4, Q1 2021). Although the Q-to-2019 Q ratios stabilized after Q2 2020, Q1 2021 was the only quarter in which change from the same quarter in 2019 was positive, with 106.8% of Q1 2019 receiving MCV4 and 101.9% receiving Tdap. (Even in this quarter, however, only 97.1% of Q1 2019 received an HPV vaccine). For every quarter from Q4 2020 on, the Q-to-2019-Q ratio was lower for HPV than for MCV4 and Tdap. As a result, the cumulative effect of below-2019 numbers vaccinated in each quarter was greater for HPV than for MCV4 or Tdap. By the end of Q3

Figure 1. Number of Rhode Island adolescents aged 11–18 who received vaccines in each calendar quarter Q1 2020-Q3 2022 as a percentage of the same quarter in 2019

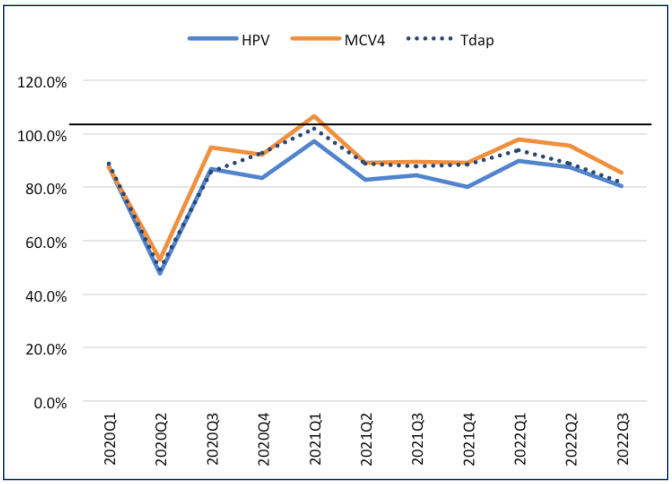


Figure 2. Tdap vaccination trends in Rhode Island by calendar quarter, Q1 2020–Q3 2022

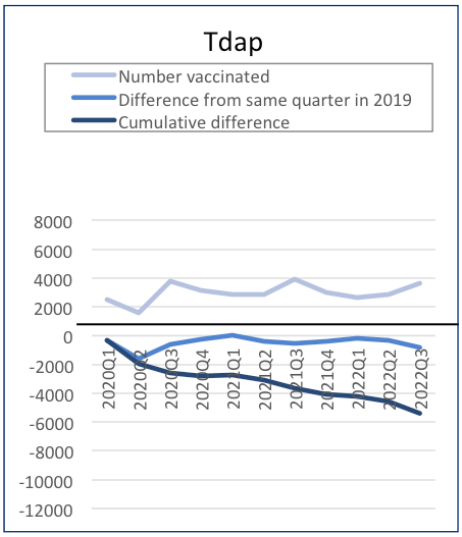


Figure 3. MCV4 vaccination trends in Rhode Island by calendar quarter, Q1 2020–Q3 2022

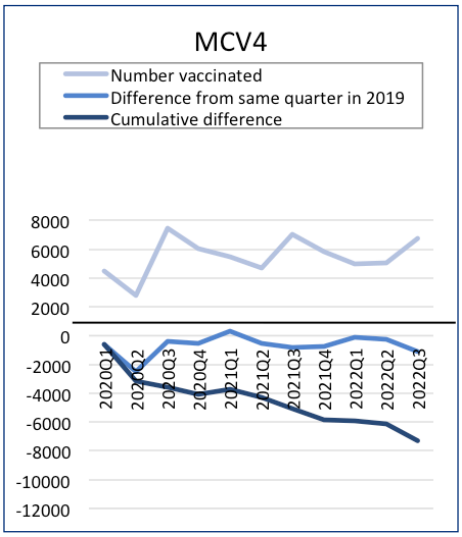
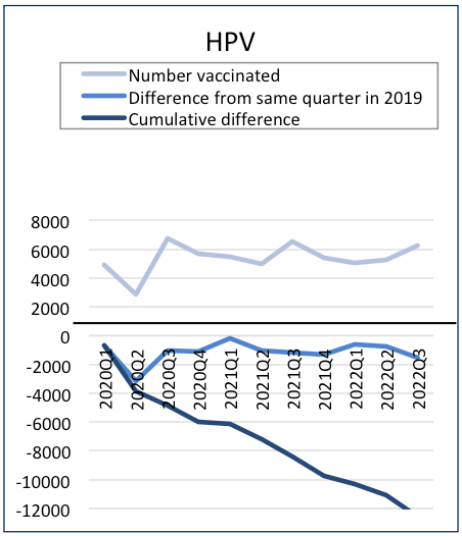


Figure 4. HPV vaccination trends in Rhode Island by calendar quarter, Q1 2020–Q3 2022



2022, 12,594 fewer HPV, 7266 fewer MCV4, and 5396 fewer Tdap vaccinations were administered overall than would be expected based on 2019 numbers (**Figures 2–4**).

It is perhaps easier to think of these cumulative negative differences (the darkest lines in Figures 2-4) as HPV, MCV4, and Tdap vaccine "deficits" relative to pre-pandemic numbers. Since over 90% of adolescents initiated the HPV series before age 15 (mean age 12.5 years, median age 11.9 years) and thus qualified for a 2-dose rather than 3-dose series, we would expect any Tdap: MCV4: HPV ratio to be about 1: 2: 2.1 (that is, for every 1 Tdap dose we would expect 2 MCV4 doses and 2.1 HPV doses). The ratio of the cumulative "deficit" in Figures 2-4 was instead 1: 1.35: 2.33 – that is, for every 1 Tdap "deficit" compared to 2019, there were 1.35 MCV4 doses not administered and 2.33 HPV doses not administered. HPV vaccines, that is, lost more ground than Tdap and MCV. To investigate further the disproportionate decline in the number of adolescents receiving HPV compared to MCV4 or Tdap, we assessed HPV trends by sex and racial or ethnic identity. After initially similar trends, males dropped behind females Q3 2020-Q4 2021, and by Q3 2022 had a cumulative decline of 6914 compared to 5691 for females (**Figure 5**). There was also variability among racial and ethnic identities over time. Black and Hispanic/Latinx adolescents were largely in tandem until Q1 2021, when the trend for Black adolescents began to fall several points below that of Hispanic/Latinx peers. There was more fluctuation among non-Hispanic White adolescents, although they too reached parity with a 2019 quarter only in Q1 2021 (**Figure 6**). Asian adolescents, although a much smaller population, were the only group with multiple quarters at or above 100% of the 2019 quarter and a cumulative effect just above zero by Q3 2022).

Figure 5. Number of Rhode Island adolescents aged 11–18 who received the HPV vaccine in each calendar quarter as a percentage of the same quarter in 2019 and cumulative change since Q1 2020, by sex

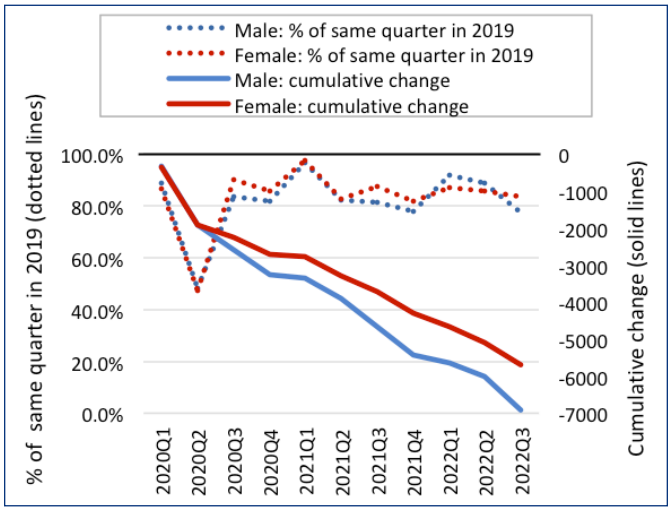
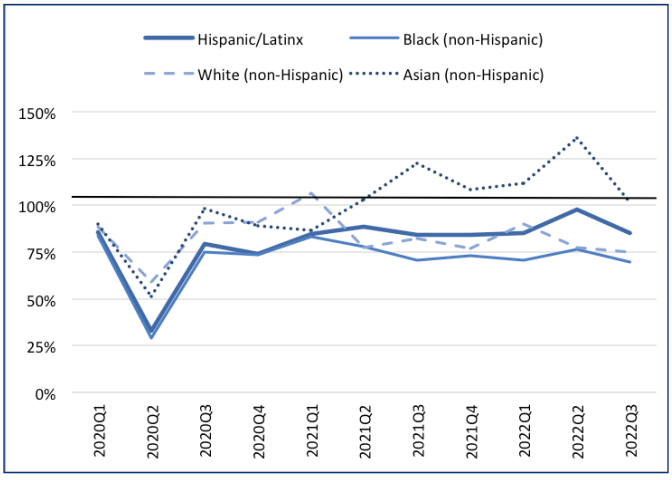


Figure 6. Number of Rhode Island adolescents aged 11–18 who received the HPV vaccine in each calendar quarter as a percentage of the same quarter in 2019, by racial or ethnic identity



DISCUSSION

The number of RI adolescents receiving HPV, MCV4, and/or Tdap vaccines quarterly stabilized after Q2 2020, but has remained overall lower than during pre-pandemic baseline quarters. As a result, relatively small "deficits" each quarter have accumulated steadily since 2020. The decline in adolescents receiving vaccines is relative to a very strong pre-pandemic track record, given RI's traditionally high coverage rates, but it is still cause for concern. National and global declines in routine vaccinations since the beginning of the COVID-19 pandemic have brought renewed attention to the tremendous public health accomplishment in reducing childhood vaccine-preventable diseases – but also to how vulnerable that accomplishment is.[15,16] Progress in reducing global and local disparities appears similarly tenuous.

This may especially be the case for HPV, which is marked by both very high lifetime probability of infection[17] and dramatic reductions with the introduction of the vaccine.[18,19] In Rhode Island, the Q-to-2019-Q ratio for the HPV vaccine fell behind those for MCV4 and Tdap in late 2020 and has remained lower since. The divergence is all the more discouraging in light of the great progress made in RI since HPV vaccination became a school requirement in 2015. Vaccinations surged in that year as families complied with the new requirement, dropped somewhat in 2016 as catch-up vaccination occurred, and then remained consistent through 2019 (detailed data available upon request). It is not altogether clear why HPV vaccinations declined more than MCV4 and Tdap and among some demographic groups more than others, but the consequences – including the possible resurgence of HPV-related cancers – may be severe and not realized for some years unless adolescents are brought up to date.[14,20]

It may not be easy to encourage these adolescents and their families to reengage with vaccination as an important

part of preventive care. As the last 2.5 years made clear, the pandemic has exacerbated pre-existing limitations and inequities of the US healthcare system. At the same time, the crisis has created a rare opportunity for us to step back and envision fresh approaches to the partnership between primary care, public health, and schools that has been the foundation of RI's success in childhood vaccination. Pooling the knowledge of these partners may help us determine the real drivers behind the trends we present here, and thus potential solutions. It may make a big difference if we can identify whether declines stem from parents struggling to keep up with preventive care despite Rhode Island's high rate of insurance coverage and provider efforts to expand availability, or if the declines are manifestations of vaccine hesitancy or opposition, potentially spilling over from politicized misinformation about the COVID-19 vaccine into renewed opposition to routine childhood vaccines.

Whatever the root causes, we must consider solutions along the lines of the "Swiss cheese model"[21] brought to public awareness early in the COVID-19 pandemic: it is clear that we need multiple approaches to vaccine catch-up, rather than trying to rely on any one-size-fits-all solution. One example involves reinforcing provider recommendations, which are still the most important factor in whether adolescents receive vaccines, and the HPV vaccine in particular.[22-24] *How* providers make recommendations may matter as much as *whether* they do, and this is an area in which public health can provide valuable support to providers. For instance, RICAIR data show that adolescents regularly receive one vaccine with another left overdue. This can happen for a variety of reasons, but clearer messaging to parents may help reduce these "missed opportunities." For example, emphasizing the safety of "bundled" vaccines (administering more than one in the same visit)[24] is all the more important given a growing disconnect between fears regarding HPV vaccine safety and its actual safety.[25] Likewise, there is growing awareness of the positive effects of presenting the HPV vaccine as cancer prevention rather than focusing on prevention of sexually transmitted infections.[22] In partnership and to help support this message, RIDOH can add additional communications support to the technical assistance it already extends to providers.

Another layer of vaccine catch-up strategy is to provide options and access for adolescents who, for whatever reason, are not vaccinated with their primary care providers. RI is exceptional in its Vaccinate Before You Graduate (VBYG) school-based clinics, which were originally designed for 12th-graders but now also provide catch-up vaccines to all public middle schools and all high schools in the state. Although VBYG clinics administer far fewer adolescent vaccines than do primary care providers, a significantly larger proportion of vaccines administered via VBYG go to adolescents of color and those on public insurance (additional data available upon request). VBYG clinics thus play an important role in reducing disparities in preventive care. Expanding this model provides not only an additional setting for normalizing and encouraging vaccination, but an opportunity to encourage adolescents to attend their well-visits for additional important preventive care. As these two examples illustrate, adolescent catch-up will require not only a multi-pronged approach but active collaboration between the public health, school and primary care sectors.

CONCLUSION

Assessing trends in RI adolescent vaccination rates is complicated by the maturing of a slightly smaller birth cohort reflecting a decline in births following the 2008 recession. However, the declines in adolescent vaccines since early 2020 are far more than this birth trend can account for, raising the possibility of setbacks in controlling vaccine-preventable diseases. Reimagining the primary care-public health partnership with a creative, multi-pronged approach will be the best path forward.

References

1. Bramer CA, Kimmins LM, Swanson R, et al. Decline in child vaccination coverage during the COVID-19 pandemic - Michigan Care Improvement Registry, May 2016-May 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69(20):630-631.
2. Ji C, Piche-Renaud PP, Apajee J, et al. Impact of the COVID-19 pandemic on routine immunization coverage in children under 2 years old in Ontario, Canada: A retrospective cohort study. *Vaccine.* 2022;40(12):1790-1798.
3. Kujawski SA, Yao L, Wang HE, Carias C, Chen YT. Impact of the COVID-19 pandemic on pediatric and adolescent vaccinations and well child visits in the United States: A database analysis. *Vaccine.* 2022;40(5):706-713.
4. Ota MOC, Badur S, Romano-Mazzotti L, Friedland LR. Impact of COVID-19 pandemic on routine immunization. *Ann Med.* 2021;53(1):2286-2297.
5. Patel Murthy B, Zell E, Kirtland K, et al. Impact of the COVID-19 pandemic on administration of selected routine childhood and adolescent vaccinations - 10 U.S. jurisdictions, March-September 2020. *MMWR Morb Mortal Wkly Rep.* 2021;70(23):840-845.
6. Saxena K, Marden JR, Carias C, et al. Impact of the COVID-19 pandemic on adolescent vaccinations: projected time to reverse deficits in routine adolescent vaccination in the United States. *Curr Med Res Opin.* 2021;37(12):2077-2087.
7. SeyedAlinaghi S, Karimi A, Mojdeganlou H, et al. Impact of COVID-19 pandemic on routine vaccination coverage of children and adolescents: A systematic review. *Health Sci Rep.* 2022;5(2):e00516.
8. Shet A, Carr K, Danovaro-Holliday MC, et al. Impact of the SARS-CoV-2 pandemic on routine immunisation services: evidence of disruption and recovery from 170 countries and territories. *Lancet Glob Health.* 2022;10(2):e186-e194.
9. Walker B, Anderson A, Stoecker C, Shao Y, LaVeist TA, Callison K. COVID-19 and routine childhood and adolescent immunizations: evidence from Louisiana Medicaid. *Vaccine.* 2022;40(6):837-840.
10. Durante JC, Lau M. Adolescents, suicide, and the COVID-19 pandemic. *Pediatr Ann.* 2022;51(4):e144-e149.
11. Lantos JD, Yeh HW, Raza F, Connelly M, Goggin K, Sullivant SA. Suicide risk in adolescents during the COVID-19 pandemic. *Pediatrics.* 2022;149(2).

12. Theberath M, Bauer D, Chen W, et al. Effects of COVID-19 pandemic on mental health of children and adolescents: A systematic review of survey studies. *SAGE Open Med.* 2022;10:20503121221086712.
13. Centers for Disease Control and Prevention. Vaccination coverage among young children (0 – 35 months). Available at https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/index.html. Vaccine coverage among adolescents (13-17 years old). Available at https://www.cdc.gov/vaccines/imz-managers/coverage/teenvaxview/index.html. Accessed 11/14/22.
14. Senkomago V, Henley SJ, Thomas CC, Mix JM, Markowitz LE, Saraiya M. Human Papillomavirus-attributable cancers - United States, 2012-2016. *MMWR Morb Mortal Wkly Rep.* 2019;68(33):724-728.
15. Warren MD, Hanna MF. Vaccines are profoundly effective, and we can't stop there. *Pediatrics.* 2022;150(3).
16. Talbird SE, Carrico J, La EM, et al. Impact of routine childhood immunization in reducing vaccine-preventable diseases in the United States. *Pediatrics.* 2022;150(3).
17. Chesson HW, Dunne EF, Hariri S, Markowitz LE. The estimated lifetime probability of acquiring human papillomavirus in the United States. *Sex Transm Dis.* 2014;41(11):660-664.
18. Markowitz LE, Liu G, Hariri S, Steinau M, Dunne EF, Unger ER. Prevalence of HPV after introduction of the vaccination program in the United States. *Pediatrics.* 2016;137(3):e20151968.
19. Rosenblum HG, Lewis RM, Gargano JW, Querec TD, Unger ER, Markowitz LE. Declines in prevalence of Human Papillomavirus Vaccine-type infection among females after introduction of vaccine - United States, 2003-2018. *MMWR Morb Mortal Wkly Rep.* 2021;70(12):415-420.
20. Daniels V, Saxena K, Roberts C, et al. Impact of reduced human papillomavirus vaccination coverage rates due to COVID-19 in the United States: A model based analysis. *Vaccine.* 2021;39(20):2731-2735.
21. Roberts S. The Swiss Cheese Model of Pandemic Defense. *The New York Times.* 12/5/2020. Available at https://www.nytimes.com/2020/12/05/health/coronavirus-swiss-cheese-infection-mackay.html?searchResultPosition=1. Accessed 11/14/22.
22. Attia AC, Wolf J, Nunez AE. On surmounting the barriers to HPV vaccination: we can do better. *Ann Med.* 2018;50(3):209-225.
23. Boitano TKL, Daniel C, Kim YI, Straughn JM, Jr., Peral S, Scarinci I. Beyond words: Parental perceptions on human papilloma virus vaccination recommendations and its impact on uptake. *Prev Med Rep.* 2021;24:101596.
24. Landis K, Bednarczyk RA, Gaydos LM. Correlates of HPV vaccine initiation and provider recommendation among male adolescents, 2014 NIS-Teen. *Vaccine.* 2018;36(24):3498-3504.
25. Sonawane K, Lin YY, Damgacioglu H, et al. Trends in Human Papillomavirus vaccine safety concerns and adverse event reporting in the United States. *JAMA Netw Open.* 2021;4(9):e2124502.

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Disclosures

The authors report nothing to disclose.

Disclaimer

The views expressed herein are those of the authors and do not necessarily reflect the views of the Rhode Island Department of Health.

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