Clinical Outcomes of Free, Public Skin Cancer Screening Events, Rhode Island, 2015–2019

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ABSTRACT

BACKGROUND: In Rhode Island, malignant melanoma of skin causes about 30 deaths a year. Early detection has been shown to reduce mortality risk.

METHODS: Dermatology volunteers and public health professionals convened 27 free skin cancer screenings at public beaches in 2015–2019 to raise skin cancer awareness and screen patients for malignancy. Participants with suspicious lesions were referred for follow-up and later telephoned to ascertain outcomes.

RESULTS: Of 2354 people screened, 597 (25%) were referred. 319 of 597 (53%) were later reached by telephone. 196 of 319 (61%) who had kept appointments by the time of the telephone call reported the following diagnoses: 7 malignant melanomas, 32 keratinocyte carcinomas, and 34 actinic keratoses, yielding 3.0 as number needed to biopsy (NNB), and 18.3 as number needed to screen (NNS).

CONCLUSIONS: Our results demonstrate the value of convenient skin cancer screening events, suggesting the desirability of additional interventions of this type.

KEYWORDS: skin cancer screening, melanoma, squamous cell carcinoma, basal cell carcinoma, skin cancer, NNB, NNS

BACKGROUND

The reduction of skin cancer morbidity and mortality has been a nationally recognized objective in the United States (U.S.) since at least 1991, with the publication of *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*.[1] Since then, the federal government has consistently promoted skin cancer prevention efforts,[2,3] bolstered by support from other national organizations,[4,5] state and local departments of public health,[6] and ongoing expert reviews of the scientific literature.[7]

Despite these efforts, morbidity from skin cancer has been difficult to control in the U.S. For example, even though the age-adjusted death rate from cutaneous malignant melanoma (MM) fell about 20% among white U.S. residents between 1990 and 2017 (inclusive), the age-adjusted incidence rate of MM for the same group approximately doubled in the same period.[8] Furthermore, MM diagnosis and treatment is costly: about $3.3 billion annually.[9]

Additionally, MM is not the only potentially lethal skin cancer, even though it is the only form of skin cancer tracked by the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute and most state cancer registries in the U.S. Squamous cell carcinoma, a type of keratinocyte carcinoma (KC), has been estimated to cause a majority of skin cancer deaths in the U.S.,[10] and has been shown to cause a majority of skin cancer deaths globally.[11]

Skin cancers of all varieties, including MM, are more successfully treated when detected early, before the opportunity for regional spread or metastases, but *mass* screening is not recommended by national authorities in the United States, for lack of sufficient evidence to justify its cost.[12]

Nevertheless, the promotion of skin cancer risk *awareness* is strongly endorsed by all,[13] and the benefits of *selective vigilance* for MM on the part of primary care physicians, e.g., among high-risk individuals, have been suggested in the literature.[14]

THE SITUATION IN RI, 'THE OCEAN STATE'

The Rhode Island Cancer Registry, like the vast majority of state cancer registries in the U.S., collects reports of MM while excluding other forms of skin cancer. The completeness of MM reporting was problematic until about 2000, when direct reporting from pathology labs became common. Since that time, Rhode Island's age-adjusted MM incidence rates have declined only slightly from about 23.2 per 100,000 in 2002 to about 22.3 per 100,000 in 2017.[15] Annually at present, the state records about 230 new MM cases and 30 MM deaths,[16] and spends about $10 million on MM healthcare.[17] Rhode Island, "The Ocean State," has many occupational and recreational opportunities for ultraviolet light (UV) exposure. Thus MM has been a focus of the state's cancer control efforts since the late 1980s.

OBJECTIVE

To raise awareness of risks and symptoms of skin cancer and to facilitate early detection and treatment of concerning skin lesions, a partnership of volunteers, including dermatologists,

dermatology residents, medical students, cancer control advocates, a media partner, and other supporters organized free skin cancer screenings at Rhode Island beaches.

METHODS

Twenty-seven skin cancer screening events were held at Rhode Island beaches from 2015 through 2019 during peak UV flux hours (12:30 p.m. to 2:30 p.m.) in July or August. Screenings were publicized via earned (unpaid) broadcast media (WJAR Channel 10) and social media to assure capacity attendance. Promotional signage was also used at events. Screenings were performed in cabanas by dermatologists and dermatology residents, assisted by medical students, and supported by other volunteers. All screenings performed by residents and medical students were supervised by a board-certified dermatologist. Non-medical volunteers took responsibility for set-up and break-down, participant flow, and record keeping.

Using the American Academy of Dermatology "SPOTme" screening registration and report form[18] [**See Appendix**], an encounter record was created for each participant, noting demographic information (gender, age, race, ethnicity), risk factors (sunscreen use, history of tanning and sunburns), examination findings, and referrals for dermatology appointments.

Participants who were referred were asked to volunteer contact information so that we might ascertain definitive diagnoses. Virtually all consented to follow-up telephone calls, though some could not be reached. (Up to three calls were attempted.) Most calls were made 1–2 months post screening, and a few up to 6 months post screening.

Recording, management, and analysis of screening data were done in Microsoft Excel. Confidential information was managed in a secure, hospital-based data system. Only authorized personnel had access to confidential information. A fully de-identified dataset was prepared for data analysis.

RESULTS

Demographics and History of Subjects

2354 members of the general public were screened. The number of subjects screened at events ranged from 41 to 127. More subjects presented for screening on "good beach days" and when screenings were better publicized. Almost two-thirds of the subjects (63%) had reached age 40. One-third (33%) had reached age 60. Only 8% were younger than 19. (Minors were screened in the company of parents.) Slightly more than half of the subjects (56%) were female. Most self-reported as white/non-Hispanics. (**Table 1**) Almost a tenth of the subjects (9%) reported personal history of skin cancer, and about one-fourth (23%) reported family history of skin cancer. About one-third (31%) reported indoor tanning, and slightly more than one-third (35 percent) reported four or more episodes of blistering sunburn. (**Table 1**) In short, subjects were predominantly fair-skinned adults who had reached middle age, many of whom reported personal or family histories of skin cancer or high-risk exposures to UV.

Table 1. Demographics of those screened, by year of screening

Year of Screening	5 Years	2015	2016	2017	2018	2019
Number screened	**2,354**	432	515	379	513	515
Age						
<19 years	**8%**	13%	7%	4%	6%	11%
20–39 years	**18%**	29%	16%	12%	15%	18%
40–59 years	**30%**	29%	30%	23%	30%	34%
60–79 years	**31%**	22%	39%	20%	39%	31%
80+ years	**2%**	2%	3%	1%	3%	0%
Unknown	**11%**	5%	7%	40%	6%	5%
Gender						
Female	**56%**	59%	57%	54%	57%	54%
Male	**37%**	38%	40%	34%	39%	35%
Unknown	**6%**	3%	3%	12%	4%	11%
Race/Ethnicity						
White/Non-Hispanic	**92%**	90%	94%	92%	92%	89%
Hispanic/Latino	**3%**	4%	1%	4%	3%	4%
African-American/Black	**1%**	1%	1%	1%	1%	1%
Asian	**1%**	0%	2%	1%	1%	2%
Mixed Race/Ethnicity	**2%**	3%	1%	1%	2%	2%
Other/Unknown	**2%**	2%	1%	1%	1%	2%
Family history of skin cancer	**23%**	41%	38%	27%	19%*	18%*
Personal History of skin cancer	**9%**	9%	11%	8%	8%	8%
Ever engaged in indoor tanning	**31%**	36%	27%	37%	24%	31%
Sunscreen use						
Always	**39%**	47%	37%	36%	40%	36%
Sometimes	**42%**	43%	45%	45%	38%	40%
Rarely	**8%**	6%	10%	9%	7%	8%
Never	**4%**	2%	4%	5%	3%	4%
Unknown	**7%**	2%	4%	5%	12%	13%
Estimated number of previous blistering sunburns						
0–3	**57%**	62%	61%	52%	51%	58%
4–6	**19%**	19%	18%	20%	22%	17%
7–10	**7%**	8%	7%	10%	7%	6%
10+	**9%**	8%	7%	10%	9%	9%
Unknown	**8%**	3%	7%	8%	11%	10%

* In some 2018 screenings and in all 2019 screenings, a direct question about family history was not asked, but participants could indicate family history as one of the reasons for attending the screening.

Table 2. Results of screenings, by year of screening

Year of Screening	5 Years	2015	2016	2017	2018	2019
Number screened and referred to dermatologist						
Number Screened	**2,354**	432	515	379	513	515
Number referred to dermatologist	**597**	73	134	126	118	146
% referred to dermatologist	**25%**	17%	26%	33%	23%	28%
Follow-up by persons screened						
Number of those referred reached by follow-up interview	**319**	45	75	67	47	85
% of those referred reached by follow-up interview	**53%**	62%	56%	53%	40%	58%
Number with a **completed** visit to a dermatologist confirmed	**196**	29	53	44	26	44
Number with a **scheduled** visit to a dermatologist confirmed	**24**	2	3	1	2	16
% with a completed visit, confirmed (of 597)	**33%**	40%	40%	35%	22%	30%
% with a **completed or scheduled** visit, confirmed (of 597)	**37%**	42%	42%	36%	24%	41%
Initial observations at screening of all screened						
Observation: Actinic keratosis AK	**248**	22	67	50	57	52
Observation: Keratinocyte carcinoma KC	**126**	16	38	21	24	27
Observation: Melanoma MM	**8**	1	0	2	1	4
TOTAL of AK + KC + MM observations	**382**	39	105	73	82	83
TOTAL of KC + MM observations	**134**	17	38	23	25	31
Observation: Other	**762**	89	183	105	204	181
Initial observations at screening of those with confirmed visits						
Observation: Actinic keratosis AK	**99**	8	20	24	21	26
Observation: Keratinocyte carcinoma KC	**89**	10	14	11	12	42
Observation: Melanoma MM	**9**	1	0	1	0	1
TOTAL of AK + KC + MM observations	**197**	19	34	36	33	75
TOTAL of KC + MM observations	**98**	11	14	12	12	49
Observation: Other	**98**	8	20	11	11	48
Reported diagnoses						
Diagnosis: Actinic keratosis AK	**34**	0	3	19	3	9
Diagnosis: Keratinocyte carcinoma KC	**32**	6	6	4	5	11
Diagnosis: Melanoma MM	**7**	3	3	1	0	0
TOTAL of AK + KC + MM diagnoses	**73**	9	12	24	8	20
TOTAL of KC and MM diagnoses	**39**	9	9	5	5	11

Initial Observations and Referrals

Of 2354 subjects screened, 597 (25%) were referred for dermatology appointments, 248 (42%) for suspicion of actinic keratosis (AK), 126 (21%) for suspicion of keratinocyte carcinoma (KC), nine (1%) for suspicion of melanoma of skin (MM), and 215 (36%) for suspicion of other conditions. (**Table 2**)

Follow-up Interviews

Of 597 subjects referred, 319 (53%) were subsequently reached by telephone and asked: "Did you make a dermatology appointment?" [If yes:] "Did you keep it?" [If yes:] "What was your diagnosis?"

Appointments Made and Kept

Of the 319 subjects reached by telephone, 196 had completed appointments, 24 had scheduled appointments, and 99 had not yet scheduled appointments. Thus, at least 37% of the 597 subjects referred had scheduled an appointment, and at least 33% of the 597 had kept an appointment.

Reported Diagnoses

The 196 subjects who had completed appointments reported 73 diagnoses of special note: 34 AK, 32 KC, and seven MM (**Table 2**), yielding (minimum) prevalence estimates among 2354 subjects of: 1444/100,000 (AK), 1359/100,000 (KC), and 297/100,000 (MM). These prevalence minima may be compared *very roughly* with analogous estimates of prevalence (PRV as available, or incidence INC in the absence of prevalence estimates) for the United States as a whole: 11,000–25,000/100,000 (AK PRV),[19] 1,056/100,000 (KC INC),[20] 41/100,000 (MM INC).[21] Reported diagnoses may also be compared with the conditions suspected at the time of referral, e.g., AK: 34/99 (34 diagnoses from 99 referrals), KC: 32/89, and MM: 7/9. (There were also a few "crossover" cases, e.g., suspected to be AK, found to be KC.)

Screening Efficiency

Maximum and best estimates of two measures of screening efficiency, "number needed to screen" (NNS) and "number needed to biopsy" (NNB) were calculated for cancerous lesions (KC + MM) and for precancerous and cancerous lesions combined (AC + KC + MM). NNS and NNB were defined as follows: NNS = number screened ÷ number diagnosed; NNB = number referred ÷ number diagnosed.

Maximum estimates were calculated from raw numbers of subjects screened, subjects referred, and confirmed diagnoses. Best estimates were calculated from raw numbers of subjects screened, subjects referred, and *estimated* numbers of confirmed diagnoses. The latter were constructed by assuming that the number and types of diagnoses were *proportionately* the same among referred subjects who had been seen by a dermatologist and those who had not been seen or could not be recontacted.

The resulting estimates provide a range between which "true" measures of NNS and NNB *probably* reside.

Table 3. Estimating number needed to screen (NNS) and number needed to biopsy (NNB), by year of screening

Year of Screening:	5 Years	2015	2016	2017	2018	2019
Number screened, referred, interviewed, diagnosed						
Number screened	**2,354**	432	515	379	513	515
Number referred for AK, KC, or MM	**382**	39	105	73	82	83
Number confirmed as seen for AK, KC, or MM	**116**	14	33	30	17	22
Number diagnosed with AK, KC, or MM	**73**	9	12	24	8	20
Number diagnosed with KC or MM	**39**	9	9	5	5	11
Number needed to screen for cancer						
Maximum: A ÷ E	**60.4**	48.0	57.2	75.8	102.6	46.8
Best Estimate: A ÷ [E x (B ÷ C)]	**18.3**	17.2	18.0	31.2	21.3	12.4
Number needed to screen for cancer or precancer						
Maximum: A ÷ D	**32.2**	48.0	42.9	15.8	64.1	25.8
Best Estimate: A ÷ [D x (B ÷ C)]	**9.8**	17.2	13.5	6.5	13.3	6.8
Number needed to biopsy for cancer						
Maximum: B ÷ E	**9.8**	4.3	11.7	14.6	16.4	7.5
Best Estimate: C ÷ E	**3.0**	1.6	3.7	6.0	3.4	2.0
Number needed to biopsy for cancer or precancer						
Maximum: B ÷ D	**5.2**	4.3	8.8	3.0	10.3	4.2
Best Estimate: C ÷ D	**1.6**	1.6	2.8	1.3	2.1	1.1

(Although it is *possible* that the true measures of NNS and NNB are lower than best estimates, we have no evidence to suggest this.) NNS appears to lie between 18 and 60 for cancerous lesions, and between 10 and 32 for cancerous and precancerous lesions together. NNB appears to lie between 3 and 10 for cancerous lesions, and between 2 and 5 for cancerous and precancerous lesions together. (**Table 3**)

Subjects' Satisfaction

Virtually all participants valued rated the screening experience either "excellent" or "very good."

DISCUSSION

Over five summers, 27 skin cancer-screening events were conducted at Rhode Island beaches at very low cost because of volunteered space, labor, and publicity. Overall, 2354 subjects were screened, 597 of whom (25%) were referred for dermatological follow-up, including 134 for suspicion of KC or MM (cancer), 248 suspicion of AK (precancer), and 215 for other conditions. Of the 597 subjects referred, 319 subjects (53%) could be recontacted, and of these, 196 had kept appointments, allowing us to calculate minima for confirmed diagnoses and related maxima and best estimates for NNS and NNB.

Our best estimate of NNS for KC and MM combined (18.3) compares favorably with a range of NNS estimates observed in office-based practices over the past 29 years: 10.5–122.6.[22,23,24,25,26]

Similarly, our best estimate of NNB for KC and MM combined (3.0) compares favorably with estimates of NNB observed for office-based practices over the past 15 years: 1.5–6.6.[27,28,29,30,31,32]

Several factors may have contributed to the consistently good yield of serious diagnoses and the relative efficiency of our screening efforts over five years of public screenings. Concerning yield, our screenings were highly publicized and conducted at beaches, where sun worshipers congregate. Concerning efficiency, our screenings were overseen by board-certified dermatologists. Indeed, the consistency of our findings suggests that we would continue to achieve strong yield and high efficiency were we to maintain these practices. Our study had two limitations. First, given the effort that went into promoting our screening events, it is quite likely that participants may have self-selected on the basis of existing concerns. Although this possibility is not a problem in itself, our yield of skin cancers should not be considered representative of what is discoverable in the general population or, for that matter, among beach goers. Second, we were able to recontact only 53 percent of the participants referred for dermatological care. Therefore, our yield of confirmed diagnoses almost certainly underestimates the true yield. Even though the latter may have biased our results conservatively, we will attempt to increase our "recontact rate" in future.

CONCLUSIONS

In our study, we conducted a screening program primarily at public beaches in the summer, and thus, our participants were "presumptively-at-high-risk" individuals, most of whom were sunbathing at the beach during peak UV index hours. Our yield of serious lesions was consistently strong.

Our approach has the following advantages: It is simple, it is accessible, it is inexpensive, and it facilitates non-invasive visual inspection, since most participants at the beach are wearing bathing suits when they decide to participate. Furthermore, we believe our approach is highly replicable. We held screenings on 27 separate occasions using different sets of volunteers, and found similar results across five years.

A potential risk of public screening events is low yield, which increases the cost-per-case-detected for staff and participants alike, and may lead to increased health care costs because of unnecessary dermatology appointments and biopsies. However, our "formula" has demonstrated consistent and efficient yields, and therefore, we propose to continue our efforts in Rhode Island.

In the future, we will continue to evaluate our efforts closely, broadening our focus from screening yield and

participant satisfaction to include careful measurement of costs (including the dollar value of the time spent by our unpaid volunteers). We will also attempt to measure changes in the knowledge, attitudes, and practices of the Rhode Island general public in regard to skin cancer prevention and screening which may be attributable to the publicity generated by the public screenings we conduct.

APPENDIX

SPOTme Registration Form

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