

REVIEW

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Emergency department-based cancer screening interventions

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Abstract

Background: Emergency department patients are disproportionately non-adherent with the United States Preventive Services Task Force cancer screening recommendations, making the emergency department a target-rich environment for interventions aimed at increasing the uptake of cancer screening. Promotion of cancer screening in the emergency department has the potential to address health disparities and to reach patients that experience significant barriers to accessing preventive care.

Topics of review: This narrative review presents concise summaries of the four types of cancer screenings with grade A or B recommendations from the United States Preventive Services Task Force (breast, cervical, colorectal, and lung) and presents the potential enabling factors and challenges of utilizing the emergency department setting to increase cancer screening uptake. Past and ongoing efforts to promote cancer screening among emergency department patients are discussed, and critical knowledge gaps and research opportunities are highlighted.

Conclusion: Although there has been a paucity of research evaluating interventions that have the potential to increase cancer screening uptake among emergency department patients, the emergency department setting is uniquely positioned to address disparities in cancer screening uptake and contribute to progress towards national cancer screening goals. To be effective, interventions that aim to achieve this purpose must identify patients with screening needs, engage with patients regarding their knowledge and beliefs about screening, and provide an effective method to conduct or connect patients with screening procedures and subsequent follow-up.

Keywords: Emergency department, Breast cancer screening, Cervical cancer screening, Colorectal cancer screening, Lung cancer screening, Health disparities

Background

Recommended cancer screenings aim to identify pre-cancerous lesions that can be removed prior to the development of cancer, and early-stage cancerous lesions that can be effectively treated prior to the development of advanced cancer. There are significant disparities, however, in the uptake of cancer screening based on race, ethnicity, income, level of education, and access to care [1–12].

These risk factors for non-adherence with recommended cancer screenings are disproportionately present among emergency department (ED) patients [11, 13–17]. EDs provide universal access points to the healthcare system where there are 40 visits per year for every 100 people in the USA [18]. Although EDs care for patients from all segments of society, people who experience barriers to accessing healthcare are over-represented in the ED setting where health inequities are pronounced [11, 13–16, 19–21].

The United States Public Health Service recommends that all patient encounters be used to provide preventive healthcare to patients [22]. With approximately 130 million patient visits per year [23], and a patient population

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disproportionately non-adherent with cancer screening, the ED is an environment with significant potential to identify individuals with cancer screening needs, especially those who are hard to reach through other health-care settings, and intervene to catalyze the uptake of cancer screenings. Interventions of this nature should always be designed to minimize burden on clinicians and ED flow, but this restriction does not preclude effectiveness. Numerous other preventive health needs have been successfully addressed in the ED including smoking cessation, alcohol use disorder, substance abuse, HIV testing, and depression screening [24–30].

There are four cancer screenings that have grade A or B recommendations from the United States Preventive Services Task Force (USPSTF): cervical [31], breast [32], colorectal [33], and lung [34]. Each has specific eligibility criteria based on age, sex, and, in the case of lung cancer screening, smoking history. Unfortunately, screening rates for each of these cancers remain below the federal government's *Healthy People 2020* and 2030 targets [10, 35–37]. According to the 2018 National Health Interview Survey (NHIS), rates of breast and cervical cancer screening have not significantly improved since 2005 [10]. Colorectal cancer screening has improved over recent years, although only 66.9% of eligible adults are up-to-date with recommended screening [10]. Lung cancer screening rates are abysmal with only 14.4% of eligible patients found to have been screened in a recent 10 state study [35]. As mentioned above, these general population rates elide significant screening disparities among subgroups.

In a 2020 analysis of NHIS data that sought to estimate the number of patients in need of a cancer screening who also had at least one ED visit in the preceding year, researchers found that more than 14 million, 6 million, and 2 million ED patients were in need of breast, colorectal, or lung cancer screening, respectively [38]. These data underscore the ED's position as a target-rich environment to promote adherence with USPSTF-recommended cancer screenings, especially among hard-to-reach groups, and to advance progress towards *Healthy People 2030* goals.

This narrative review presents the potential and challenges of utilizing the ED setting to increase cancer screening uptake. Past and ongoing efforts to promote cancer screening among ED patients are discussed, and critical knowledge gaps and research opportunities are highlighted. Given the emphasis on US-based screening recommendations, surveillance data, and ED operations, applicability to settings outside of the USA may be limited.

USPSTF-recommended cancer screenings

Breast cancer screening

Breast cancer is the most commonly diagnosed cancer among women in the USA (excluding skin cancers) and

is second only to lung cancer in cancer-related attributable deaths among women (estimated 43,600 deaths in 2021) [39, 40]. The USPSTF provides a grade B recommendation for biennial breast cancer screening using mammography for women between the ages of 50 and 74 years [41]. Importantly, there are a variety of patient and family history characteristics that can impact the benefit associated with mammography among women 40 to 49 years of age (e.g., family history of breast cancer, genetic risk associated with breast cancer such as BRCA-1/2 mutations), though the negative effects of testing and false-positive findings tend to offset this benefit. As such, the USPSTF offers a grade C recommendation (“at least fair evidence that [the service] can improve health outcomes but concludes that the balance of benefits and harms is too close to justify a general recommendation”) for regular screening mammography in this age range.

Identification and mortality associated with breast cancer are significantly associated with patient demographic characteristics [39]. Breast cancer among White women is identified when localized 64% of the time and only 54% of the time for Black women. While there is some evidence that this difference is attributable to socioeconomic status [42], other findings implicate lower screening rates [43]. The overall rate of screening adherence in the USA in 2018 was 72.8%, with the *Healthy People 2030* initiative targeting an increase to 77.1%.

Cervical cancer screening

Cervical cancer is among the most preventable forms of cancer. Screening for cervical cancer aims to identify treatable pre-cancerous lesions prior to the development of invasive cancer which is often first detected at a stage when palliation is all that can be offered. The USPSTF recommends cervical cancer screening with a Papanicolaou (Pap) test for women aged 21–65 every 3 years with a possible extension of this screening interval to every 5 years with high-risk human papillomavirus (HPV) DNA testing or co-testing for women aged 30–65 [31]. For women at increased risk of cervical cancer (e.g., women living with HIV), screening recommendations differ from these general guidelines.

It has recently been reported that cervical cancer mortality rates in the USA are higher than previously thought and that there is a significant racial disparity in cervical cancer death rates [5]. The mortality rate for Black women was found to be 10.1/100,000 compared to 4.7/100,000 for White women [5]. The CDC's most recent survey of adherence to USPSTF cervical cancer screening recommendations found that only 80.7% of US women aged 21–65 years reported adherence [13]—considerably below the *Healthy People 2020* target of 93% [36]. The CDC found the very lowest rates of

adherence to cervical cancer screening guidelines among women using the ED as their usual source of care [13].

Colorectal cancer screening

Colorectal cancer (CRC) is diagnosed in nearly 150,000 adults in the USA annually, making it the 3rd most common cancer found in both men (9% of new cases) and women (8% of new cases) [44]. Approximately 53,200 deaths are attributed to colorectal cancer annually, with early detection playing a key role in survival [45–48]. The 5-year survival rate for colorectal cancer is 89% when identified locally and 15% when identified with distal spread.

The USPSTF offers a grade A recommendation for regular CRC screening from age 50 to 75 [49] and a grade B recommendation (i.e., “high certainty that the net benefit is moderate or...moderate certainty that the net benefit is moderate to substantial”) for CRC screening between ages 45 and 49. Colorectal screening adherence involves (a) a colonoscopy every 10 years, (b) flexible sigmoidoscopy every 5 years, (c) CT colonography every 5 years, (d) annual fecal occult blood test (FOBT) or fecal immunochemical test (FIT) [50], or (e) screening of DNA in the stool (e.g., Cologuard) every 1 to 3 years [48, 50, 51]. Unfortunately, only 65.2% of adults were adherent with USPSTF screening recommendations in 2018, with the Healthy People 2030 initiative calling for rates (now on a broader patient population) to reach 74.4%. Furthermore, ethnic and racial disparities in screening adherence similar to those seen for breast and cervical cancer have previously been observed [52, 53], again implying the ED is an ideal setting for intervention.

Lung cancer screening

Lung cancer is the number one cancer cause of death in the USA [54], accounting for a quarter of all cancer deaths [55]. Five-year survival for lung cancer is just 19% [6]. However, early detection of lung cancer increases 5-year survival threefold [6], and lung cancer screening among high-risk patients, using a low-dose CT scan, is cost-effective [56] and has been proven to reduce lung cancer mortality by approximately 20% [57, 58]. In March 2021, the USPSTF expanded eligibility for lung cancer screening to patients aged 50–80 with ≥ 20 pack-year smoking history [34]. Objective C-03 of the Healthy People 2030 initiative is to “increase the proportion of adults who get screened for lung cancer” [37].

Disparities in lung cancer and lung cancer screening are marked in the USA with less economically advantaged and less educated populations at higher risk of disease but with less access to screening services [6]. Racial disparities are particularly prominent: the burden of lung cancer falls disproportionately on black individuals—

especially black males, who have the highest rate of age-adjusted lung cancer incidence of all groups, are more likely to present at an advanced stage of disease, and are more likely to die [6, 59, 60]. Unfortunately, uptake of lung cancer screening has been poor [35]. In July 2020, USPSTF listed “research addressing how to best increase uptake of lung cancer screening ... particularly among minority and vulnerable populations” as a top priority [61].

Enabling factors of the ED setting

Although EDs are designed to treat acute illnesses and injuries, certain characteristics of the ED setting have the potential to facilitate cancer screening interventions. While in a healthcare setting, patients may have a heightened awareness of health risks and health-related behaviors. This may allow for increased receptivity to a preventive health intervention. The “teachable moment” that may occur in the ED is an opportunity to increase the impact of such interventions [62]. Indeed, a number of investigations support the notion that ED patients are receptive to preventive health measures. A survey of over 1200 consecutive ED patients found that 96% reported interest in receiving information on one or more preventive health issues [63]. Similarly, in a pilot study evaluating the feasibility of promoting mammography among ED patients, 75% of women reported receptivity to the proposed intervention [64]. ED patients have also been found to readily engage with computerized preventive health education resources while waiting for care [65].

Wait time is another potentially enabling factor of the ED setting. Patients not only wait in the waiting room prior to full evaluation by a provider, they also spend a significant amount of time waiting in treatment areas for radiologic studies to be completed, test results to become available, and evaluations by specialists. This “down time” provides an opportunity to identify cancer screening needs and intervene to address them without impacting the length of stay. High acuity ED patients, patients in significant distress, and patients with an altered level of consciousness are poor candidates for preventive health interventions. However, many ED patients are low to moderate in acuity, and lower acuity ED visits are common among patients with barriers to care and those at increased risk for non-adherence with cancer screening recommendations [66].

ED directors are also in favor of ED-based preventive health services that do not increase the patient length of stay or take clinician time away from other patients [67]. Still, in a field with a seemingly never-ending expansion of responsibilities, concern about mission creep is very real [68]. Ideally, cancer screening needs are identified by primary care providers and then scheduled as needed. However, among patients that lack ready access to

primary care due to under-insurance or other barriers, the ED remains the safety net for healthcare system failures. Patients subjected to these system failures are from the precise hard-to-reach groups that are most in need of cancer screening. The provision of preventive care in the ED can be viewed as a diversion of resources that should rightfully be directed towards those with acute illness and injury. However, a significant amount of the acute illness cared for in the ED could have been prevented had access to primary care and preventive health services been sufficient. Thoughtful interventions designed with provider input have the potential to achieve meaningful preventive outcomes while minimizing the impact on clinical operations.

Identifying eligibility and need

The first step to increasing uptake of cancer screening among ED patients is to identify those patients who are eligible for screening. Each of the four USPSTF grade A/B screenings has different but potentially overlapping eligibility criteria (Table 1). In addition, just because someone is eligible does not mean they are in need of screening—some patients will be up-to-date with cancer screening recommendations. Over-referral or over-screening would be an unintended negative consequence of a cancer screening intervention that failed to accurately assess screening needs.

Determination of screening adherence, therefore, is a necessary second step to identify candidates for an ED-based cancer screening intervention (Fig. 1). While the process of determining screening eligibility and adherence seems straightforward, it is potentially labor intensive. The ED triage process is already burdened with extensive screening questions including topics such as fall risk, intimate partner violence, elder abuse, and risks associated with international travel. Adding a series of surveys to evaluate cancer screening needs is not likely feasible. A number of studies have succeeded in using

non-physician staff to survey patients and determine their screening needs [2, 11, 15, 69]. While some EDs may have research associates, volunteers, patient care technicians, or other staff available to do this work, many will not.

An ongoing study funded by the National Cancer Institute is evaluating an adaptive self-administered process using a tablet computer to determine cancer screening needs in order to relieve staff of this burden [70]. A more generalized health risk computerized survey, evaluating issues such as substance abuse and immunizations, was successfully deployed in an ED nearly 20 years ago [71]. A “smart” electronic health record (EHR) could potentially flag patients with screening needs although confirmation by staff would likely still be necessary.

ED-based screening interventions

Despite the potential of the ED setting to catalyze the uptake of cancer screening, few interventions attempting to do so have been evaluated.

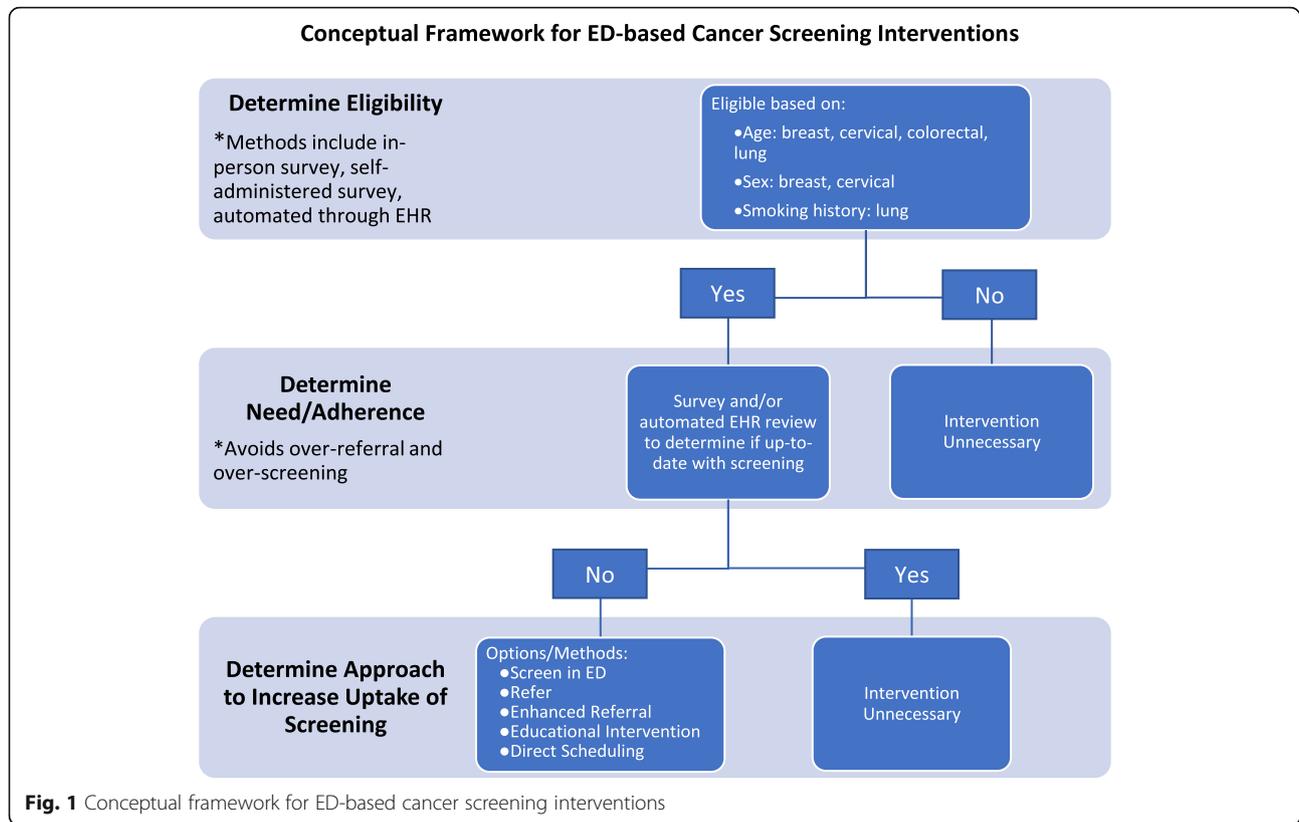
In-ED cancer screening

While some cancer screening procedures could conceivably be done in the ED (e.g., Pap tests for cervical cancer, low-dose CT scan for lung cancer, FIT and/or stool DNA testing for colorectal cancer), others are plainly not feasible (e.g., colonoscopy). Precious little work has been done in this area, all of it related to Pap tests, and much of it more than two decades ago. In all cases, these studies only conducted Pap tests on women already undergoing pelvic exams to evaluate the complaint that brought them to the ED [72–76]. This convenience-based approach would not address the cervical cancer screening needs of most ED patients. Still, the investigators behind some of this work did specifically report that high-quality Pap specimens were successfully obtained in the ED, supporting at least one aspect of feasibility

Table 1 USPSTF cancer screening eligibility criteria and intervals

Cancer	Patient population ^a	Screening test(s)	Recommended screening interval(s)
Breast	Women age 50–74 years	Screening mammogram	Every 2 years
Cervical	Women age 21–65 years	Papanicolaou (Pap) test High-risk human papillomavirus (hrHPV) test Pap and hrHPV tests (co-testing)	Every 3 years Every 5 years (age 30–65 only) Every 5 years (age 30–65 only)
Colorectal	Age 45–75 years	Colonoscopy Sigmoidoscopy Fecal occult blood tests Fecal immunochemical tests CT colonography Stool DNA tests (e.g., Cologuard)	Every 10 years Every 5 years Annually Annually Every 5 years Every 1 to 3 years
Lung	Age 50–80 years with a 20 pack-year smoking history and have smoked within the past 15 years	Low-dose computed tomography (CT) of the chest	Annually (until the individual has not smoked within 15 years)

^aPatient population refers to those individuals for whom the USPSTF has provided an A- or B-level recommendation for screening. Other patient sub-populations, based on personal and family history, can also benefit from screenings



[72, 75]. Many of these investigations, however, reported significant challenges to patient follow-up after Pap testing. Self-sampling to obtain cervico-vaginal specimens for high-risk HPV testing has been demonstrated to be acceptable among ED patients [77], but result notification and arranging subsequent care remain a challenge. Cancer screening of all types is more than just a testing procedure—it is a process that requires follow-up and, when needed, subsequent testing or treatment to address abnormal findings. Any in-ED approach to cancer screening would need to be linked with a follow-up process in order to be successful.

Educational interventions

Patient knowledge and beliefs about cancer screening have a significant impact on screening behavior. Surveys of ED patients have identified poor overall knowledge regarding cancer screening tests [66, 78, 79]. Not surprisingly, decreased knowledge is associated with lower levels of education and under-insurance [79–81]—some of the same risk factors for non-adherence with cancer screening recommendations. One study found that 74% of women undergoing pelvic examination in the ED believed that they had had a Pap test [82]. Another found that poor knowledge about cancer screening was a stronger predictor of screening adherence than race [3].

Despite the importance of knowledge and beliefs on screening uptake, a paucity of work has been done to investigate the impact of ED-based educational interventions. In one study, health promotion nurses discussed cervical cancer screening with ED patients who self-identified as requiring screening, resulting in nearly half obtaining Pap testing during the study follow-up period after ED discharge [71]. Another study, comparing the impact of a simple brochure versus in-person education and motivational interviewing among ED waiting room patients, found no difference in mammography uptake at 3 months [64].

Simple referral

Given the challenges to conducting cancer screening procedures in the ED itself, a number of interventions have aimed to facilitate cancer screening after ED discharge for those patients who have been identified as both eligible and in need of screening. Interventions consisting of simple referral (i.e., without extended contact aimed at reinforcing the encouragement to get screened) have had modest results. A breast cancer screening referral program that identified over 2500 ED patients in need of screening found that only 159 (6%) had completed the exam upon follow-up [76]. In an Urgent Care-based study of referral for cervical cancer screening, 29% of women had obtained the test at study

follow-up [72]. One-month screening uptake rates for an ED-based study using a simple referral for patients in need of breast or cervical cancer screening were 8.3% and 10.2%, respectively [83]. In a study that evaluated the efficacy of making a next-day mammogram appointment for eligible ED patients, 38% of enrolled patients completed the screening [84]. It is notable that even with next-day appointments, a feat not likely feasible in many healthcare systems, most patients did not obtain screening. Although there is meager literature describing ED-based referral interventions for cancer screening, these results suggest that there is likely room to improve upon the results of simple referral.

Enhanced referral

A specific challenge of ED-based interventions is that longitudinal relationships are not built between ED providers and patients. Interventions are generally limited to the single ED index visit. The limited success of interventions based on a simple referral to promote uptake of cancer screening underscores this challenge. In an effort to extend an ED-based intervention beyond the index visit with the purpose of reinforcing and augmenting a referral, a text-message-based intervention was evaluated in a randomized controlled pilot study [15]. A series of text messages that included referral links as well as content grounded in behavioral change theory were sent to enrolled patients in an effort to increase uptake of cervical cancer screening. Uptake at follow-up was increased among those receiving text messages 19% relative to the control group (simple referral). This approach is currently being evaluated in a larger NIH-funded trial [70]. Texting or other mobile health (“mHealth”) approaches have the potential to reinforce and enhance the efficacy of interventions initiated in the ED.

Other approaches

A number of potential approaches to increasing uptake of cancer screening among ED patients have yet to be explored. System-based interventions such as linkage of ED patients with patient navigator programs, “smart” electronic health records that flag patients in need of screening and automate referral, and integration of the ED as an intentional portal of entry into a system integrated model of care, all have some potential to improve screening rates among ED patients. For any approach to succeed, it must first effectively identify eligible patients who are in need of screening, address their knowledge and beliefs regarding screening, and connect them with screening services through which subsequent follow-up and care pathways are established.

Additional considerations regarding ED-based cancer screening

Interventions to promote cancer screenings that are not recommended by the USPSTF, including skin, ovarian, prostate, thyroid, pancreatic, testicular, bladder, and oral cancer, have not been evaluated in the emergency medicine setting. However, substantial literature exists on hepatitis screening in the ED—especially hepatitis C [85]. While USPSTF does have a set of grade A and B screening recommendations related to viral hepatitis, these recommendations are not specifically designated as cancer screenings. Although most people infected with hepatitis B or C do not develop hepatic cancer, 65% of hepatic cancer in the USA is related to these infections [86]. Given the recent treatment advances for hepatitis C, and the associated risk factors that are disproportionately represented among ED patients (e.g., older age, dialysis, injection drug use), hepatitis C screening has demonstrated promise with both targeted and untargeted screening interventions among ED patients [87–89].

One of the challenges of cancer screening in any setting is following up with patients that have abnormal results in order to conduct additional diagnostic or treatment procedures. The precise barriers to care that are disproportionately experienced by ED patients also put them at risk for being lost to follow-up for cancer screenings conducted in other healthcare settings. Some of the interventions described above that are aimed at initiating cancer screening with ED patients could conceivably be adapted to identify ED patients with extant abnormal screening exam results and intervene to re-establish their care in order to take the next steps in their evaluation or treatment.

Finally, incidental identification of cancer or suspected cancer is a routine occurrence in the ED setting. ED care involves extensive use of advanced imaging that generates findings suspicious for malignancy that are often unrelated to the test indications [90]. While the approach to follow up for these incidental findings is an important and challenging issue in emergency medicine, it is distinct from cancer screening which is an intentional evidenced-based approach to detect cancer or pre-cancerous lesions before they become symptomatic.

Knowledge gaps and research opportunities

Despite its potential, relatively little work has been done exploring the use of the ED environment to promote the uptake of cancer screening. Knowledge gaps and research opportunities are wide ranging and all of the methods described above merit further investigation. Refined approaches to in-ED screening might still find success relative to prior work. The use of mHealth methods to sustain contact with ED patients is only now being explored in depth. ED-adjacent care settings, such as

urgent care centers and observation units, may hold promise in promoting cancer screening. Given the essential first step of systematically identifying patients with screening needs, EHR-automated or self-administered survey methods require further exploration. Importantly, the validity of survey measures for self-report of screening is important and refinement of these measures may be needed.

While development of health system models of care is a task that extends far beyond the ED, intentional integration of the ED into the cancer screening programs of over-arching models of care has the potential to engage hard-to-reach groups into these programs. Effective approaches to linking ED patients to local screening resources, including cancer screening navigation programs, are also needed. There may be opportunities to link more established ED-based interventions (e.g., smoking cessation) with cancer screening (e.g., lung cancer screening). In all cases, cost-effectiveness of proposed interventions would need to be explored.

Another important knowledge gap is how to best engage sexual and gender minorities in ED-based cancer screening. Sexual and gender minority persons, including non-binary and transgender persons, experience significant healthcare disparities [91] and are at increased risk for some cancers [92]. Cancer screening may pose a particular challenge among these groups as identifying individual screening needs relies in part on data sources that may fail to identify them accurately [93]. Cancer screening (e.g., cervical cancer) should be based on anatomy; however, healthcare providers often lack knowledge and effective communication skills related to transgender and other sexual and gender minority patients' health [94]. Engaging these groups in cancer screening research is essential to addressing disparities and improving their care.

Conclusion

Millions of patients in need of recommended cancer screenings are cared for in emergency departments every year in the USA, many of whom experience barriers to care and are difficult to reach through other healthcare settings. This makes the ED setting uniquely positioned to address disparities in cancer screening uptake and contribute to progress towards national cancer screening goals. To be effective, interventions that aim to achieve this purpose must identify patients with screening needs, engage with patients regarding their knowledge and beliefs about screening, and provide an effective method to conduct or connect patients with screening procedures and subsequent follow-up. Overall, there has been a paucity of research on interventions to improve cancer screening uptake among ED patients. However, a number of approaches have been explored in early stages and some promising avenues are actively under investigation.

Abbreviations

CRC: Colorectal cancer; ED: Emergency department; EHR: Electronic health record; FIT: Fecal immunochemical test; FOBT: Fecal occult blood test; HPV: Human papillomavirus; NHIS: National Health Interview Survey; Pap: Papanicolaou; USPSTF: United States Preventive Services Task Force

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Authors' contributions

DA conceived of the overall purpose and structure of the manuscript. BA and EC contributed to the manuscript writing and critical editing. All authors read and approved the final manuscript.

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