

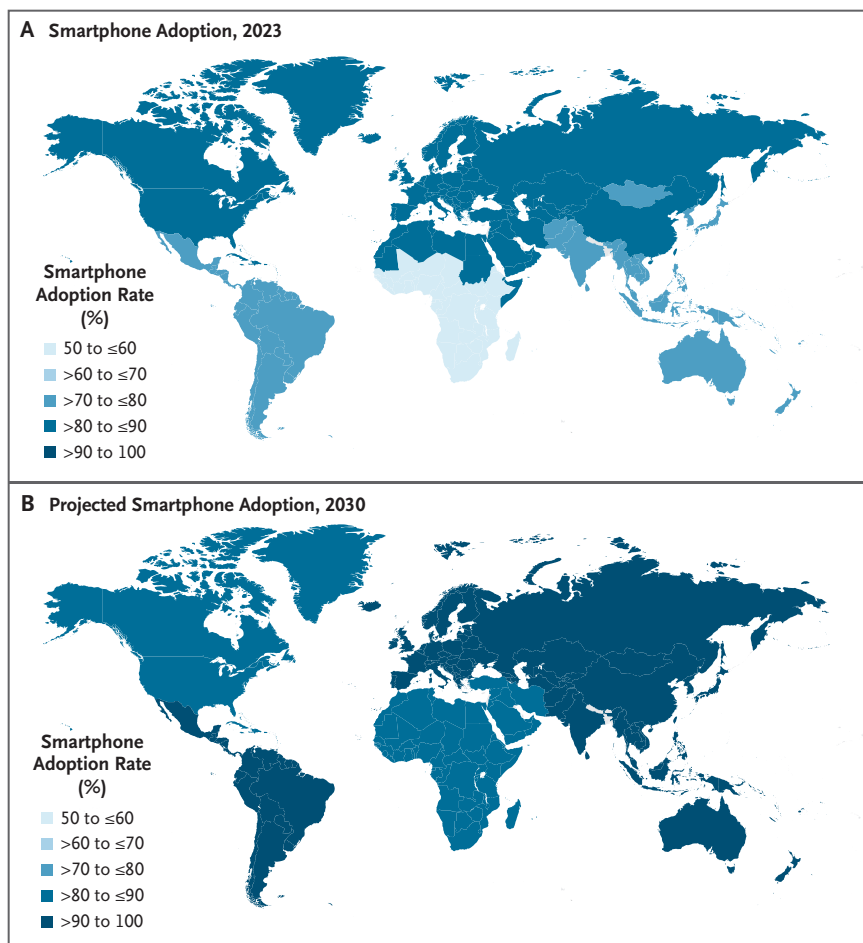


OCTOBER 16, 2025

The Contribution of Digital Treatment to Efforts to Reduce Global Tobacco Use

The first type of intervention can involve digitalization of analogue “stop-smoking” support, such as self-help guides or tobacco-cessation programs that are delivered to people in “bite-sized” pieces and sometimes tailored to individual characteristics. Features that aren’t typically part of traditional tobacco-cessation programs, such as user forums, “money saved” counters, or stress-reduction tools and cravings diaries, are also built into many cessation apps. Some of these tools can provide

Copyright © 2025 Massachusetts Medical Society. All rights reserved, including those for text and data mining, AI training, and similar technologies.



Global Smartphone Adoption and Projected Smartphone Adoption, According to Region.

Data are from the GSM Association.

prescriptions for pharmacotherapy, though prescribing is typically done by a human. Recently, chatbots and “virtual advisors” have been used to imitate human-delivered support. Although most of these systems are relatively primitive, generative artificial intelligence (AI) is enhancing their capabilities. Such tools, with their ability to provide 24/7 support, offer services that are at the limits of what humans could reasonably deliver.

One example of an approach that moves beyond services that humans can realistically provide, on the other hand, is just-in-time

adaptive interventions. These interventions aim to deliver support in real time, typically when users are in a situation that may cause strong cravings or temptation, to prevent lapses (tobacco use during a quit attempt). Such interventions can be driven by sensors that track geolocation, movement (accelerometry), time, or other metrics that can indicate a meaningful vulnerability (a smoking cue) or an opportunity to intervene (the ideal timing for nicotine replacement).¹ Self-adapting systems, including just-in-time interventions, can dynamically adjust support in response to a user’s characteris-

tics, behaviors, quitting progress, and engagement with and reaction to the intervention. Evidence of effectiveness for these tools is lacking, however, particularly for forms of support that humans cannot deliver.¹ Although there is emerging evidence of the acceptability (e.g., in India) and effectiveness of digital tobacco-cessation interventions (e.g., in China and Turkey), scaled-up programs, such as mCessation in India, haven’t been rigorously evaluated.

As is common in the context of innovation driven by technological advancement, there has been an evaluation lag for such tools. Messaging- and website-based interventions have been the focus of most randomized, controlled trials in this area, but the number of evaluations of smartphone apps is increasing. The evaluation lag is longer in LMICs than in high-income countries; a recent review that we conducted found no LMIC-based trials evaluating cessation apps.² The World Health Organization’s 2024 tobacco clinical treatment guideline lists conducting research on cessation apps and on AI-based interventions as a priority.

The most robust evidence generated on digital cessation interventions has pertained to text- or instant-messaging-based interventions. Although effectiveness varies among these interventions, according to a Cochrane review, there is moderate-certainty evidence that as compared with minimal support, messaging interventions increase people’s chances of quitting by between 3 and 4 percentage points, from 6% to approximately 9%.³ Such interventions typically resemble bite-sized tobacco-cessation programs, delivering tips, encouragement, and

support, generally once or twice a day for 4 to 12 weeks. Effect sizes have generally been similar for messaging interventions evaluated exclusively in LMICs and those evaluated in high-income countries, although some studies in LMICs have shown larger between-group differences in cessation rates,² potentially because of the limited existing access to cessation treatment in these regions.

Evaluating effectiveness is more complex for apps than for messaging interventions because of the wide variation in app designs. Ideally, apps would be considered a delivery method, rather than a type of intervention. Various digital cessation-support interventions — including “serious games,” “third-wave” cognitive behavioral therapy, and just-in-time adaptive interventions — could be delivered through apps. Some evidence suggests that digital interventions, including apps, that provide personalized or interactive support may be more effective than those without this feature, potentially because such support helps promote engagement. Additional evaluations, particularly evaluations conducted in LMICs, are needed for each broad app-based approach to cessation support, with characterization of the intervention and targeted populations and settings to enable clear contextualization of evidence.

To maximize the population-level benefits of digital support, opportunity costs and preferences should be considered. Many digital treatments are less effective than interpersonal approaches, in part because of low levels of engagement with digital tools. In regions where access to interpersonal treatment is inadequate, as it is in many LMICs, the decision to

broadly deploy digital support — even tools with low-to-moderate effectiveness — would be straightforward, as long as costs are modest: something is better than nothing. In regions where both digital and interpersonal interventions are available and have appeal, people might choose easier-to-access digital options, which could reduce their chances of quitting relative to interpersonal support. Alternatively, for some people, using digital support tools could facilitate the adoption of interpersonal support, particularly if digital tools prompted them to seek additional assistance. In areas where multiple treatment options are available, people would ideally be triaged by health professionals or digital systems to the most promising option on the basis of their preferences and potential treatment benefits.

A key but often neglected factor influencing the effectiveness of digital cessation treatment is adoption. Very few studies have quantified the adoption of these tools, and we aren’t aware of any such studies conducted in LMICs. One large study from the United Kingdom showed that, at most, 10% of people making a quit attempt used digital support.⁴ Most people find apps through app stores. Selection depends heavily on app-store rankings, which are driven primarily by popularity metrics. For example, one of us recently found that a 4.8-star app-store rating was twice as important as a 4.0-star rating or having a credible developer for influencing smoking-cessation-app choice.⁵ As a result, popular apps dominate. But research has suggested that popular tobacco-cessation apps are seldom evidence based and typically don’t align with clinical

guidance. This evidence was reinforced by the United Kingdom study, which showed that “real-world” cessation-app use isn’t associated with abstinence.⁴ Factors such as data-privacy concerns, lack of smartphone compatibility with some apps, and insufficient phone memory can also limit adoption.

Dedicated efforts will therefore be required to promote access to and use of effective cessation apps. One option is for clinicians and public health bodies to ensure that people wanting to use digital tobacco-cessation treatment are directed to evidence-based interventions. Health care programs, including maternity, tuberculosis, and HIV programs, could integrate these interventions into their care models. Digital portals can also provide access to high-quality, evidence-based tools. But experience with the U.K. National Health Service’s apps library, which was rebooted multiple times before being decommissioned, highlights the challenges associated with maintaining a digital intervention library that requires entries to adhere to evidence standards.

Another approach is to allow clinicians to prescribe digital interventions, as Germany has done by creating a digital health applications directory. But the lack of evidence-based apps — this directory currently has only two smoking-cessation apps available to be prescribed — restricts people’s choices for digital support. Variation in digital data-security standards among countries, particularly LMICs, is another challenge.

Despite the predicted rise in the use of digital tobacco-cessation treatments, the extent to which these tools will help reduce global tobacco use is unclear. Such

interventions hold great promise, particularly amid conceptual and technological advances. Digital interventions will undoubtedly evolve and incorporate enhanced use of AI, though not without prompting complex ethical questions. Additional components, such as medication prescribing that doesn't require direct human contact, will also probably be incorporated into these tools, where local funding permits access to cessation medication. While clinicians, public health practitioners, and policy-makers await the results of additional research to help identify the most effective digital cessation treatments, we can work to ensure

that the environment will facilitate the adoption and use of evidence-based approaches, once this information is available.

The series editors are Nancy A. Rigotti, M.D., Kamran Siddiqi, M.B., B.S., M.P.H., Ph.D., Debra Malina, Ph.D., Geneva Pittman, M.P.H., and Stephen Morrissey, Ph.D.

Disclosure forms provided by the authors are available at NEJM.org.

¹Addiction Research Group, Faculty of Medicine and Health Sciences, University of East Anglia, Norwich, United Kingdom; ²Centre for Global Mental Health, Department of Population Health, London School of Hygiene and Tropical Medicine, London; ³Addictions and Related Research Group, San-gath, India.

This article was published on October 11, 2025, at NEJM.org.

1. Perski O, Hébert ET, Naughton F, Hekler EB, Brown J, Businelle MS. Technology-mediated just-in-time adaptive interventions (JITAIs) to reduce harmful substance use: a systematic review. *Addiction* 2022;117:1220-41.
2. Nadkarni A, Gaikwad L, Sequeira M, et al. Behavioral interventions for tobacco cessation in low- and middle-income countries: a systematic review and meta-analysis. *Nicotine Tob Res* 2025;27:575-85.
3. Whittaker R, McRobbie H, Bullen C, Rodgers A, Gu Y, Dobson R. Mobile phone text messaging and app-based interventions for smoking cessation. *Cochrane Database Syst Rev* 2019;10:CD006611.
4. Jackson SE, Brown J, Buss V, Shahab L. Prevalence of popular smoking cessation aids in England and associations with quit success. *JAMA Netw Open* 2025;8:e2454962.
5. Szinay D, Cameron RA, Jones A, et al. Eliciting preferences for the uptake of smoking cessation apps: discrete choice experiment. *J Med Internet Res* 2025;27:e37083.

DOI: 10.1056/NEJMp2500683

Copyright © 2025 Massachusetts Medical Society.

Advancing Surveillance of Health Care–Associated Infections — Targeting Hospital-Onset Sepsis

Fizza Manzoor, M.D.,^{1,2} Chanu Rhee, M.D., M.P.H.,^{1,2} and Michael Klompas, M.D., M.P.H.^{1,2}

In the United States, health care–associated infections are detected in 1 in 31 hospitalized patients, cause about 72,000 deaths each year, and cost the health care system billions of dollars each year.¹ Despite these substantial clinical and economic effects, surveillance of health care–associated infections in U.S. hospitals is limited. Federal reporting requirements focus on just six health care–associated infections: hospital-onset *Clostridioides difficile*, central venous catheter–associated bloodstream infections, catheter-associated urinary tract infections (UTIs), methicillin-resistant *Staphylococcus aureus* (MRSA) bacteremia, surgical-site infections occurring after abdominal hysterectomy, and surgical-site infections occurring after colorectal surgery.¹ This approach results in many serious infections going

unmonitored, which undermines efforts to understand and prevent the full breadth of nosocomial infections.

The current focus on just these six infections may trace back to the landmark Study on the Efficacy of Nosocomial Infection Control (SENIC), conducted in the 1970s by the Centers for Disease Control and Prevention (CDC).² SENIC investigators analyzed the charts of thousands of patients treated at hundreds of U.S. hospitals to assess the incidence of nosocomial infections and the effects of infection-control programs. The study revealed the vital link between infection-control programs and reduced rates of infection. It also established two principles that continue to govern infection-control practice: a small number of infections, typically device-associated

infections that are concentrated in critical care units, account for most health care–associated infections, and infection-control programs can therefore focus primarily on these infections in these units; and infection surveillance requires detailed chart review conducted by highly trained professionals applying the CDC's complex, clinically detailed surveillance definitions.

On its face, this approach to infection control has been very successful: incidence rates for most of the targeted infections are now very low.¹ Nonetheless, the SENIC approach has several important limitations in the current era. First, manual chart review is complicated and time consuming. This process limits the number of infections that hospitals can monitor. In addition, despite the use of