

Infect Control Hosp Epidemiol 2010;31:1101–1105

© 2010 by The Society for Healthcare Epidemiology of America. All rights reserved.

0899-823X/2010/3111-0001\$15.00

DOI: 10.1086/656912

White Paper

Moving toward Elimination of Healthcare-Associated Infections: A Call to Action

Denise Cardo, MD;

Penelope H. Dennehy, MD;

Paul Halverson, DrPH, MHSA, FACHE;

Neil Fishman, MD;

Mel Kohn, MD, MPH;

Cathryn L. Murphy, RN, PhD, CIC;

Richard J. Whitley, MD, FIDSA;

HAI Elimination White Paper Writing Group

From the Centers for Disease Control and Prevention (CDC), Division of Healthcare Quality Promotion (DHQP) (D.C.), the Pediatric Infectious Diseases Society (PIDS) (P.H.D.), the Association of State and Territorial Health Officials (ASTHO) (P.H.), the Society of Healthcare Epidemiology of America (SHEA) (N.F.), the Council of State and Territorial Epidemiologists (CSTE) (M.K.), the Association for Professionals in Infection Control and Epidemiology (APIC) (C.L.M.), Infectious Diseases Society of America (IDSA) (R.J.W.). Members of the HAI Elimination White Paper Writing Group are Patrick J. Brennan, MD (IDSA); Jennifer Bright (SHEA); Cecilia Curry, PhD (CDC); Denise Graham (APIC); Belinda Haerum, MPH (ASTHO); Marion Kainer, MD, MPH (CSTE); Keith Kaye, MD, MPH (SHEA); Tammy Lundstrom, MD, JD (SHEA); Chesley Richards, MD (CDC); Lisa Tomlinson (APIC); Elizabeth L. Skillen, PhD (CDC); Stephen Streed, MS, CIC (APIC); Melanie Young (SHEA); and Edward Septimus, MD, FIDSA, FACP, FSHEA (APIC).

Received August 24, 2010; accepted August 24, 2010; electronically published October 7, 2010.

Address reprint requests to Elizabeth L. Skillen, PhD, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA 30039 (eskillen@cdc.gov).

Introduction

Jointly, the Association for Professionals in Infection Control and Epidemiology (APIC), the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), the Association of State and Territorial Health Officials (ASTHO), the Council of State and Territorial Epidemiologists (CSTE), Pediatric Infectious Diseases Society (PIDS), and the Centers for Disease Control and Prevention (CDC) propose a call to action to move toward the elimination of healthcare-associated infections (HAIs) by adapting the concept and plans used for the elimination of other diseases, including infections. Elimination, as defined for other infectious diseases, is the maximal reduction of “the incidence of infection caused by a specific agent in a defined geographical area as a result of deliberate efforts; continued measures to prevent reestablishment of transmission are required.”^{1(p24)} This definition has been useful for elimination efforts directed toward polio, tuberculosis,² and syphilis³ and can be readily adapted to HAIs. Sustained elimination of HAIs can be based on this public health model of constant action and vigilance. Elimination will require the implementation of evidence-based practices, the alignment of financial incentives, the closing of knowledge gaps, and the acquisition of information to assess progress and to enable response to emerging threats. These efforts must be underpinned by substantial research investments, the development of novel prevention tools, improved organizational and personal accountabilities, strong collaboration among a broad coalition of public and private stakeholders, and a clear national will to succeed in this arena.

The clear consensus among healthcare epidemiologists, infection preventionists, infectious disease physicians, and other clinicians attending the Fifth Decennial International Conference on Healthcare-Associated Infections 2010 is that now is the time to advance the cause of HAI elimination.⁴ In this white paper, we embrace the goal of HAI elimination and we identify steps to achieve this goal. We are committed to working together to eliminate HAIs, recognizing that further work is needed to implement the steps identified in this call to action.

HAIs are an increasingly recognized problem. The number of people who are sickened or die and the financial impact from HAIs are unacceptably high.⁵ Intrinsic to the problem is the inconsistent implementation of proven preventive measures. Furthermore, we know little about the burden of infections outside hospitals, particularly in long-term care facilities, ambulatory surgical centers, and

other outpatient settings, and the burden of infections outside the United States. The World Health Organization has reported that, at any given time, approximately 1.4 million people have an HAI; in developing countries, the risk can be up to 20 times greater than in developed countries.⁶ In addition, the emergence of HAIs caused by multidrug-resistant microorganisms is an increasing concern.⁷ We recognize the diversity of political, economic, educational, and clinical capacity throughout the world, as well as the success of various HAI prevention efforts. The framework we describe is based primarily on the US experience, but we are optimistic that these principles can be applied to the elimination of HAIs around the globe.

Recently, efforts in several countries have shown remarkable success in preventing some HAIs,^{8,11} and there is a growing body of knowledge defining a full range of prevention interventions that can address specific HAIs when consistently applied across settings.¹² As the US population ages and healthcare costs rise, HAI elimination becomes a “best buy” for patient health and healthcare savings. We are now facing a unique and timely opportunity to move toward the elimination of these infections. Political will and investments at the federal, state, and local levels in the prevention of HAIs—such as the Health and Human Services Action Plan to Prevent HAIs, the American Recovery and Reinvestment Act funding,¹³ individual state mandates for public reporting,¹⁴ the Deficit Reduction Act,¹⁵ the Patient Protection and Affordable Care Act,^{16,17} and consumer expectations for transparency and accountability—provide momentum for success.

Learning from Local Successes

Currently, there exists a real opportunity to eliminate specific HAIs, including central line-associated bloodstream infections (CLABSIs). Recent local and regional initiatives have shown 60%–70% overall decreases in the rate of CLABSIs in intensive care units (ICUs), with no CLABSIs for many consecutive months in some ICUs.^{18,19} Moreover, these reductions have been sustained for up to 4 years following implementation of CLABSI prevention interventions.²⁰ The interventions associated with dramatic reductions in the rate of CLABSIs included strategies to increase adherence to existing evidence-based guidelines. Specific strategies to increase adherence to evidence-based guidelines included (1) leadership support at the highest levels of the facility, (2) leadership and guidance from healthcare epidemiologists and experts in infection prevention and control, (3) education and engagement of clinicians, (4) packaging of recommendations in patient-centered “bundles,” (5) improvement of the safety culture in healthcare units and facilities, (6) data-driven tools and initiatives to assess impact and to provide feedback to clinicians about progress and challenges, and (7) local

and statewide collaborative efforts to broadly share best practices.^{18,19,21} These efforts included effective, evidence-based practices, such as immediate and detailed analysis of opportunities to improve the prevention of additional infections after a CLABSI has been detected. An important component of these interventions has been leadership endorsement and support of a culture of safety in the healthcare facility, which has allowed front-line staff to feel empowered to intercede on behalf of patient safety when clinical activities deviated from expected pathways and has likely contributed to improved clinical outcomes.^{18,19}

In moving toward sustained improvements in safety culture and HAI elimination, progress has been incremental, following the quality cycle of “plan-do-check-act-repeat.”²² Successful projects have focused on consistent and reliable implementation of practices shown to reduce HAIs. Further progress toward elimination will require continued research that identifies additional effective practices and strategies to prevent HAIs.

Imperatives for the Elimination of HAIs

On the basis of lessons from recent successes, we propose that the elimination of HAIs will require constant action and vigilance (1) to promote adherence to evidence-based practices through partnering, educating, implementing, and investing; (2) to increase sustainability through the alignment of financial incentives and reinvestment in successful strategies; (3) to fill knowledge gaps to respond to emerging threats through basic, translational, and epidemiological research; and (4) to collect data to target prevention efforts and to measure progress. These efforts must be underpinned by sufficient investment (Figure 1). For example, despite HAIs being among the leading causes of death in the United States, only recently have HAIs been recognized as an important target for prevention. To accelerate progress from recent successes, more support for prevention innovations and training will be needed to accomplish the desired impact in HAI prevention. Important steps for the elimination of HAIs will be characterized by the following imperatives.



Figure 1 (135 KB)

Figure 1. Pillars of HAI elimination. The elimination of HAIs will require (1) adherence to evidence-based practices; (2) alignment of incentives; (3) innovation through basic, translational, and epidemiological research; and (4) data to target prevention efforts and measure progress. These efforts must be underpinned by sufficient investments and resources.

1. Implement Evidence-Based Practices

The cornerstone of HAI elimination is to increase adherence to what we already know can be effectively implemented, on the basis of scientific evidence. These recommendations are based on research conducted by experts in prevention and are included in several clinical guidelines (eg, CDC's Healthcare Infection Control Practices Advisory Committee [HICPAC] infection control guidelines,¹² SHEA and IDSA's Compendium of Practical Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals,²³ and APIC's Elimination Guides²⁴). Adherence to evidence-based practices will require flexibility to respond to the changing healthcare environment and emerging pathogens. Furthermore, the barriers to adherence are multiple and complex. Although most of the reportedly successful HAI prevention strategies have targeted infections in ICUs, such interventions must move increasingly into non-critical care hospital settings and nonhospital healthcare settings to achieve the best possible outcomes. To identify best implementation strategies, partnerships and collaboration with specific clinical groups (eg, hospitalists, critical care specialists, surgeons, and infectious disease physicians), as well as with healthcare epidemiologists, infection preventionists, patient safety and quality officers, and health service researchers, are needed. In addition, all groups (eg, physicians, nurses, allied health professionals, dietitians, housekeepers, and clerical staff) who impact the daily care of a patient must work as a team to prevent HAIs. As part of the team, each person should understand his or her role in prevention and should be empowered to do the right thing for patients. "Collaboration rather than competition should be the hallmark of elimination efforts."²⁵

Successful collaboratives have focused on the development of partnerships outside of single facilities. Partnerships among competing facilities and hospitals, as well as health departments and hospital associations, have allowed sharing of best practices and strategies to overcome barriers to implementation and progress in a nonthreatening manner. Partnering with payers can also create an incentive for facilities to prevent HAIs by rewarding progress toward elimination.

Finally, healthcare epidemiologists, infectious disease physicians, infection preventionists, and public health professionals need to expand and to improve upon current collaborations and

partnerships with consumers and legislators to provide the most current science and evidence-based practices on improving HAI prevention. Such efforts can increase the likelihood of legislative mandates that truly support, rather than hinder, progress toward HAI elimination. Public health departments, working with HAI prevention experts, need to establish and to maintain strong programs in HAI elimination.

2. Align Incentives

A thoughtful integration of payment incentives that focuses on prevention is critical in moving toward elimination of HAIs. The combined tools of healthcare payment, oversight and accreditation, and public reporting are emerging ways to increase adherence to HAI prevention practices. Currently, there is political will to identify cost-saving strategies, and HAI prevention strategies provide many opportunities to achieve that goal. Refining and strengthening these tools on the basis of both experience and data must be priorities to achieve elimination goals and to prevent potential unintended consequences. For example, in the United States, experts in healthcare epidemiology and infection prevention join infectious diseases physicians to collaborate with the Joint Commission, the Centers for Medicare and Medicaid Services (CMS), and other certification and accreditation groups to improve evidence-based oversight of infection prevention practices. These collaborations can greatly increase opportunities to improve adherence and to prevent infections. Ideally, payment policies should provide sufficiently broad incentives to catalyze the development of systems of care that are prevention oriented. In such systems, prevention of HAIs would not be an added requirement but would be completely embedded in the processes of care. Ultimately, working with key payment stakeholders—including payers (health plans, insurance companies, and CMS) and providers (hospitals, physicians, vendors of information technology, medical products, and laboratory systems)—to create appropriate incentives to promote system-wide strategies for HAI prevention will be critical to creating sustainable elimination. High standards of accountability also will be needed to make sustained elimination a reality.

A broad, strategic approach toward prevention-oriented healthcare payment is likely to shift the focus from strategies based on individual healthcare encounters (ie, reduced payment for individual HAIs) to performance-modeled payment to providers or groups of providers based on the population-based results (ie, numbers or rates of HAIs among all hospital admissions, all providers' patients, or particular groups of patients).

3. Address Gaps in Knowledge

To develop and to test credible prevention strategies for HAIs, we need to better understand how and why these infections occur. Although there are successful prevention initiatives for some device-associated infections in ICUs,^{18,20} research is still needed to develop evidence-based prevention recommendations for many other HAIs. In some cases, additional research is needed to augment a limited understanding of the basic epidemiology of healthcare-associated pathogens (eg, colonization and transmission dynamics), to inform development of rational prevention strategies.

Research is also needed to assess the impact of existing prevention recommendations and policies. Experts in the field propose 5 phases of translational research to address gaps in knowledge: (1) epidemiologic studies, (2) discovery of potential interventions, (3) evaluating promising interventions leading to the development of evidence-based guidelines, (4) moving evidence-based guidelines into health practice, and (5) evaluating the “real world” health outcomes of population health practice.²⁶ The current level of evidence for HAI prevention varies for each type of infection and also by type of healthcare setting. For example, knowledge of the prevention of CLABSI in ICUs^{18,19} is well understood and more adequate to move toward elimination. To expand prevention efforts to other HAIs in all healthcare settings and to move closer to elimination, knowledge gaps need to be addressed. Experts in healthcare epidemiology, in collaboration with stakeholders in prevention, must develop science-based, systematic approaches to the design of studies that will provide definitive answers to the critical questions of HAI prevention.²⁷

4. Data for Action and Responding to Emerging Threats

Timely and accurate data on HAI occurrence are necessary to define the scope of the problem (and its variability across locations) and to assess progress toward elimination. Incidence data allow healthcare epidemiologists and infection preventionists to detect HAIs, to inform clinicians about how best to prioritize prevention interventions, and to assess the impact of those interventions. Data also allow public health officials to identify local and regional facilities requiring improvement. Measurement can also provide institutions and the public with information for comparisons across facilities and regions to better understand current risks for HAIs as well as risks over time. With accurate data, both providers and patients can make informed decisions about risks and prevention strategies for HAIs. Investments for timely and high-quality data should be focused on (1) reshaping standard definitions and surveillance methods to fit the new, emerging information system paradigms

(eg, electronic health information records and data mining); (2) creating national and global data standards for key HAI prevention metrics; and (3) creating or refining the data analysis and presentation tools available to prevention experts, clinicians, and policy makers at the local, state, national, and international levels.

Healthcare delivery is complex and dynamic. New devices and invasive procedures are developed and introduced at an extraordinary rate, creating the need for prospective assessment of hazards associated with new technology. Experts in healthcare epidemiology, infectious diseases, and infection prevention should identify and should address potential infections associated with these newer technologies and procedures through collaboration with developers and those who test new devices. In addition, new and emerging pathogens and resistance remain an ongoing threat in all healthcare settings. Public health agencies have a unique role to play in HAI prevention. Federal, state, and local public health agencies investigate outbreaks of emerging infections or adverse events, such as inappropriate medical device use, medical product contamination, or unsafe clinical practices. By discovering new or previously unrecognized problems, we gain information on what needs to be measured, and we identify research gaps and educational needs. Through the investigation of these outbreaks, preventable causes of emerging infections can be identified and incorporated into practice guidelines. State and local health departments are in a unique and important position to assess emerging trends or gaps in prevention, particularly given shifts in healthcare delivery from acute care settings to ambulatory and long-term care settings. The public health model's population-based perspective in state and local health departments and its collaboration with other experts in infection prevention and with professional associations will provide increased national capacity to assess emerging risks from HAIs.

Call to Action

Progress toward the elimination of HAIs is real. The opportunities to build on successes described here and at the recent Fifth Decennial International Conference on Healthcare-Associated Infections 2010 provide momentum to achieve aggressive goals for the elimination of HAIs. The expertise and resourcefulness of healthcare epidemiologists, infection preventionists, infectious disease physicians, and other clinicians together with public health professionals can build on and can accelerate recent progress. We must continue to work together to increase adherence to practices supported by the body of knowledge on existing prevention interventions and toward the alignment of incentives such as institutional and personal accountability to accelerate the elimination of HAIs. We must invest in

research to find innovative solutions to combat challenges, such as antimicrobial resistance, the increasing burden of HAIs outside of traditional hospital settings, and the refinement of existing intervention bundles to be the safest and most cost-effective. We must be flexible and responsive to emerging challenges and the changing healthcare environment. Most of all, we must focus on the patient and must challenge ourselves to no longer accept the unacceptable. HAIs are preventable. We must work together to eliminate HAIs for the generations to come.

Acknowledgments

We thank the boards of APIC, SHEA, CSTE, IDSA, ASTHO, and PIDS as well as CDC leadership for review and contribution to the manuscript.

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article.

References

- 1. Centers for Disease Control and Prevention (CDC). Global disease elimination and eradication as public health strategies. Proceedings of a conference. Atlanta, Georgia, USA. 23-25 February 1998. *MMWR Morb Mortal Wkly Rep* 1999;48(suppl):1-208.
<http://www.cdc.gov/mmwr/pdf/other/mm48su01.pdf>. Accessed 26 August 2010.
First citation in article, PubMed
- 2. Dowdle WR. A strategic plan for the elimination of tuberculosis in the United States. *MMWR Morb Mortal Wkly Rep* 1989;38(suppl S-3):1-25.
First citation in article, PubMed
- 3. Centers for Disease Control and Prevention. The national plan to eliminate syphilis from the United States. Atlanta, GA: US Department of Health and Human Services; 2006.
First citation in article
- 4. Notes from the decennial [commentary]. *Am J Infect Control* 2010;38(5):337-340.
First citation in article, CrossRef, PubMed
- 5. Klevens R, Edwards JR, Richards CL, et al. Estimating healthcare-associated infections and deaths in US hospitals, 2002. *Public Health Rep* 2007;122:160-166.
First citation in article, PubMed
- 6. World Health Organization. WHO guidelines on hand hygiene in health care. The first global patient safety challenge: clean care is safer care. Geneva: World Health Organization; 2009.
First citation in article
- 7. Hidron AI, Edwards JR, Patel J, et al. NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections: annual summary of data reported to the

National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006–2007. *Infect Control Hosp Epidemiol* 2008;29:996–1011.

First citation in article, Abstract, PubMed

- 8. Perman JW. 2004 Lowbury Lecture: the Western Australian experience with vancomycin-resistant enterococci—from disaster to ongoing control. *J Hosp Infect* 2006;63(1):14–26.

First citation in article, CrossRef, PubMed

- 9. Pearson A, Chronias A, Murray M. Voluntary and mandatory surveillance for methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-susceptible *S. aureus* (MSSA) bacteraemia in England. *J Antimicrob Chemother* 2009;64(suppl 1):i11–i17.

First citation in article, CrossRef, PubMed

- 10. Carlet J, Astagneau P, Brun-Buisson C, et al. French national program for prevention of healthcare-associated infections and antimicrobial resistance, 1992–2008: positive trends, but perseverance needed. *Infect Control Hosp Epidemiol* 2009;30:737–745.

First citation in article, Abstract, PubMed

- 11. Burton DC, Edwards JR, Horan TC, Jernigan JA, Fridkin SK. Methicillin-resistant *Staphylococcus aureus* central line-associated bloodstream infections in US intensive care units, 1997–2007. *JAMA* 2009;301(7):727–736.

First citation in article, CrossRef, PubMed

- 12. Centers for Disease Control and Prevention. Healthcare Infection Control Practices Advisory Committee (HICPAC). <http://www.cdc.gov/hicpac/index.html>. Accessed 10 August 2010.

First citation in article

- 13. American Recovery and Reinvestment Act of 2009, Pub L No. 111–115, 111 Stat 1 (2009).

First citation in article

- 14. McKibben L, Horan T, Tokars JI, et al. Guidance on public reporting of healthcare-associated infections: recommendations of the Healthcare Infection Control Practices Advisory Committee. *Am J Infect Control* 2005;33:217–226.

First citation in article, CrossRef, PubMed

- 15. Deficit Reduction Act, Pub L No. 109–171, 109 Stat 1932 (2006).

First citation in article

- 16. Patient Protection and Affordable Care Act, Pub L No. 111–148, 111 Stat 3590 (2010).

First citation in article

- 17. Hospital inpatient prospective payment systems for acute care hospitals and the long-term care hospital prospective payment system changes and FY2011 rates, 75 Federal Register 157 (2010) (codified at 42 CFR §411–§422 and §489).

First citation in article

- 18. Pronovost P, Needham D, Berenholtz S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med* 2006;355:2725–2732.

First citation in article, CrossRef, PubMed

- 19. Centers for Disease Control and Prevention (CDC). Reduction in central line-associated bloodstream infections among patients in intensive care units—Pennsylvania, April 2001–March 2005. *MMWR Morb Mortal Wkly Rep* 2005;54:1013–1016.

First citation in article, PubMed

- 20. Pronovost P. Interventions to decrease catheter-related bloodstream infections in the ICU: the Keystone Intensive Care Unit Project. *Am J Infect Control* 2008;36:S171.e1–S171.e5.

First citation in article, CrossRef, PubMed

- 21. 5 Million Lives Campaign. Getting started kit: prevent central line infections how-to guide. Cambridge, MA: Institute for Healthcare Improvement; 2008. <http://www.ihl.org>. Accessed 6 July 2010.

First citation in article

- 22. Institute for Healthcare Improvement. Plan–Do–Study–Act (PDSA) Worksheet (IHI Tool). <http://www.ihl.org/IHI/Topics/Improvement/ImprovementMethods/Tools/>. Accessed 6 July 2010.

First citation in article

- 23. Yokoe DS, Mermel LA, Anderson DJ, et al. A compendium of strategies to prevent healthcare-associated infections in acute care hospitals. *Infect Control Hosp Epidemiol* 2008; 29:S12–S21.

First citation in article, Abstract, PubMed

- 24. Association for Professionals in Infection Control and Epidemiology. APIC elimination guides. http://www.apic.org/AM/Template.cfm?Section=APIC_Elimination_Guides&Template=/CM/HTMLDisplay.cfm&ContentID=14743. Accessed 10 February 2010.

First citation in article

- 25. Pronovost P. Overview of STOP-BSI program. Oral presentation to Healthcare Infection Control Practices Advisory Committee (HICPAC); November 2009; Washington, DC.

First citation in article

- 26. Khoury MJ, Gwinn M, Yoon PW, Dowling N, Moore CA, Bradley L. The continuum of translation research in genomic medicine: how can we accelerate the appropriate integration of human genome discoveries into health care and disease prevention? *Genet Med* 2007;9:665–674.

First citation in article, CrossRef, PubMed

- 27. The Research Committee of the Society of Healthcare Epidemiology of America. Enhancing patient safety by reducing healthcare-associated infections: the role of discovery and dissemination. *Infect Control Hosp Epidemiol* 2010;31:118–123.

First citation in article, Abstract, PubMed

