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Opportunities and challenges in utilizing electronic health records for infection surveillance, prevention, and control

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There are unique patient safety challenges in the prevention and control of health care-associated infections (HAI). It is estimated that approximately 2 million HAI occur every year in the United States, and each infection increases the risk of death by as much as 6 times.[1] This amounts to an estimated 90,000 deaths annually and $4.5 billion excess health care costs.[2,3] The emergence of specific multidrug-resistant organisms (MDRO), the growing number of immunocompromised patients, and the increasing number of invasive procedures and medical device implantations are posing new challenges for infection control. How many of these HAI are preventable remains unclear, but payers such as the Centers for Medicare Medicare & Medicaid Services have already enacted rules that preclude reimbursement for certain conditions that are attributed to hospitalization, eg, catheter-associated urinary tract infections.[4] Initiatives such as the Institute for Healthcare Improvement's 100,000 and 5 Millions Lives Campaigns, The Joint Commission's National Patient Safety Goals, and guidelines for public reporting of HAI reflect growing concern over HAI and the need for their prevention.[3,5] Many such initiatives are evidence based and have shown to reduce the rate of HAI. For example, adherence to the ''bundle'' (hand hygiene, full-barrier precautions during insertion of catheter, using chlorhexidine antiseptic to clean the skin, avoiding the femoral site, and removing unnecessary catheters) was recently shown to reduce significantly the rates of catheter-related bloodstream infections among patients receiving care in intensive care units.[5]

However, creating a successful culture of safety requires a significant investment in both education of health care personnel and infrastructure support. Currently, a third of all hospitals have less than 1 recommended ratio of infection control professionals (ICPs) to patient beds (a ratio of 0.8 to 1.0 ICP for every 100 occupied acute care beds).[6] Hence, ICPs struggle to keep up with essential infection control tasks because of other competing responsibilities and lack of adequate resources. Without deploying resources that allow for automation, it may not be possible for ICPs to collect more and richer data (such as catheter-days and details on adherence to the bundle for catheter insertion) and at the same time design specific interventions required for pay-for-performance initiatives.

Emerging information technology such as electronic health records (EHRs) can help meet these challenges. They can facilitate automated collection of surveillance data, provide risk-adjusted patient outcomes, and facilitate infection control interventions at the point of care. In 2004, the US Department of Health and Human Services declared the start of a ''decade of health information technology (Health IT)'' (Appendix) and called for universal EHR adoption by 2014. The increased adoption of EHRs and related Health IT provide a unique opportunity for ICPs and infection diseases specialists to automate manual processes and address the growing challenge of HAI and guidelines for public reporting.

The present paper is an awareness and advocacy paper from the Healthcare Infection Control Practices Advisory Committee (HICPAC), which provides advice to the Department of Health and Human Services and the CDC regarding surveillance, prevention, and control of HAI and related occurrences (http://www.cdc.gov/ncidod/dhqp/hicpac_charter.html). The paper should not be construed as a standard of care or guideline but as a viewpoint document that aims to (1) provide a conceptual overview of opportunities in utilizing EHRs for infectious disease management,

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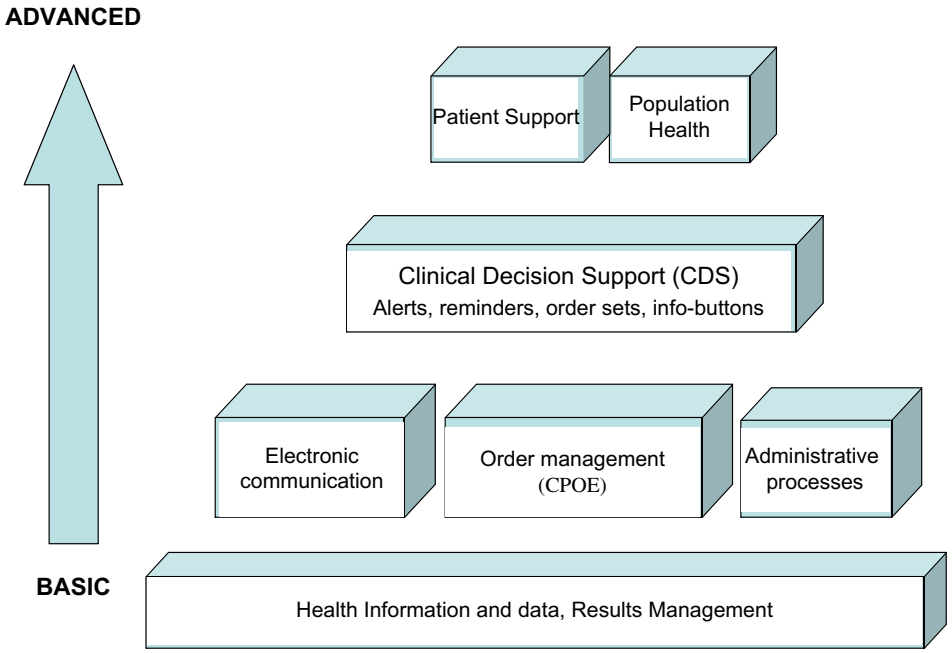

Fig 1. Core functional blocks of an electronic health record (EHR) in the order of increasing complexity.[7] Image reproduced from Atreja et al, courtesy of Blackwell Publishing.[8]

surveillance, prevention, and control; and (2) outline the barriers and the possible strategies to overcome them.

CONCEPTUAL OVERVIEW OF EHR

In its most simple form, EHR can be defined as computerization of health record content and associated processes. The term *EHR* has often been used interchangeably with EMR (electronic medical records) even though there are minor but significant differences between the 2 terms. *EMR* is the older term in use and is often associated with electronic patient record systems within an institution. *EHR* is usually considered the term most reflective of the actual patient experience of receiving health care across institutions. We chose to use the term *EHR* instead of *EMR* to reflect the growing consensus toward a need for interoperable electronic records.

As part of a national effort to encourage the adoption of EHRs, an Institute of Medicine panel has identified a set of 8 core functions that EHRs should perform to promote greater safety, quality, and efficiency in health care delivery (Fig 1).[7,8] Health information and data, results management, electronic communication, and administrative processes are either built-in or readily supported by the majority of the existing EHRs. Health information and data and results management allow for an efficient view of patients' past records including medications, allergies, past admissions, and laboratory and microbiology results. Electronic communication enables better coordination of care plan among multiple providers and ancillary services as well as timely notification of critical patient data. Administrative processes such as scheduling and billing increase the efficiency of heath care organizations, provide timely service to patients, and decrease the paperwork.[7]

Order management, clinical decision support, patient support, and population health functions have the potential for a more direct impact on infectious disease management, surveillance, prevention, and control but are not generally essential components of all present day EHRs. Order management includes functions such as computerized physician order entry (CPOE), which allows electronic entry of laboratory, medications, and radiology orders instead of orders being recorded on paper sheets or prescription pads. The electronic entry allows clinical decision support (CDS) functions to compare the order against standards for dosing, allergies, and others and warn the physician about potential problems. Patient support means providing tools such as patient portals or personalized health records (PHRs), which give patients access to their health records, provide patient education, and help patients carry out home monitoring and self-testing. This can empower patients and help improve control of chronic conditions, such as diabetes and

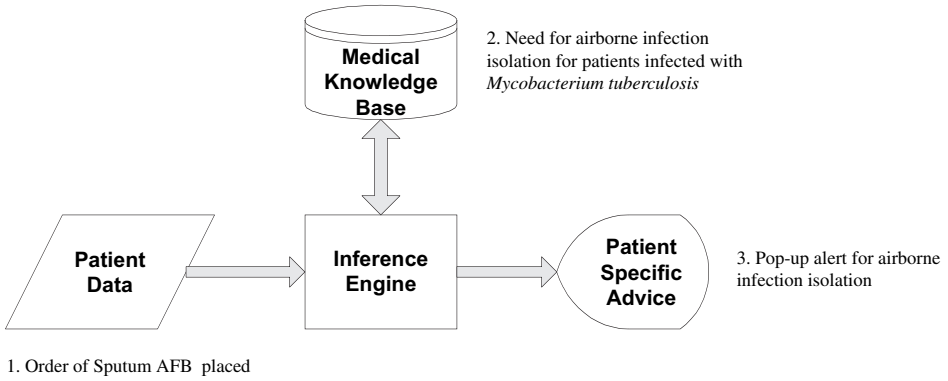

Fig 2. Schematic representation of a clinical decision support (CDS) demonstrating generation of alert suggesting airborne infection isolation and a negative-air room when an order is entered for sputum acid fast bacilli (AFB) collection.

congestive heart failure. Reporting and population health management support the use of already collected electronic data in EHR for uses other than clinical care. Quality management, outcomes reporting, and infectious disease surveillance are included in this category.

LEVERAGING EHR TO ENHANCE PATIENT CARE AND INFECTION DISEASE MANAGEMENT

Although the benefits of health information, result management, electronic connectivity, and administrative support activities in terms of 24/7 chart access and better availability of the data are apparent and well understood, CPOE and CDS when customized and utilized appropriately can also have a direct and significant impact on patient care. CPOE can support process improvement, increase accuracy and legibility of the order, and integrate CDS into the order-entry process.[9,10] CDS can provide alerts for drug-drug, drug-allergy, and drug-food interactions based on routinely updated drug formularies. In addition, CDS also includes reminders, prompts, and alerts to improve compliance with best clinical practices and hyperlinks that can provide context-specific drug or disease information to the provider at the point of care. Studies have shown that properly designed CPOE and CDS can lead to as much as 85% reduction in serious medication errors.[10] Other system-wide benefits from fully functional EHRs include increased compliance with preventive care guidelines, better coordination and management of chronic conditions, improvement in quality indicators for pay-for-performance initiatives, reduced staff time spent on paperwork, reduced number of duplicate or unnecessary laboratory and imaging orders, and increased accuracy and timeliness of billing.[11]

To support infectious disease (ID) management, CDS can be customized to incorporate patient-specific clinical information such as laboratory or microbiology information along with diagnostic, demographic, and clinical guidelines. This allows for several modes of decision support including alerts for critical laboratory values and recommendations for best antibiotic practices. Figure 2 shows a CDS where information from patient and a knowledge base feed into an inference engine (a software that uses different rules to draw conclusions) to generate a computerized alert that specifies the need for isolation and a negative-air room for a patient that is suspected to be infected with *Mycobacterium tuberculosis*. CDS can also be customized to generate reminders to enhance vaccination rates and preventive screening that have shown to be more effective and less expensive than the paper-based reminders.[11,12] It is estimated that such computerized reminders to providers at the point of care can lead to a 6.1% to 28.4% increase in preventive health activities such as pneumococcal and influenza vaccinations.[12]

CDS can also help address the persistent problem of inappropriate antimicrobial prescribing that can promote antimicrobial resistance. For example, Evans et al reported the use of an antiinfective-management program that recommended antimicrobials for patients admitted in intensive care unit and provided warnings and immediate feedback.[13] The use of the program led to significant reductions in orders for antibiotic-susceptibility mismatches (12 vs 206, respectively, $P < .01$) and in adverse events caused by antiinfective agents (4 vs 28, respectively, $P < .02$). In addition, patients who always received the regimens recommended by the computer program had reduced length of the stay (adjusted mean, 10.0 vs 12.9 days, respectively;

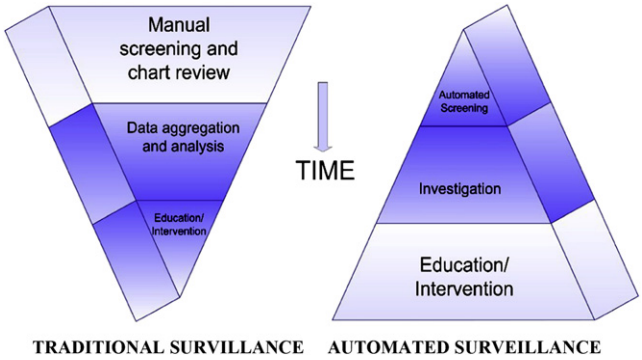

Fig 3. The shifting paradigm from current manual surveillance strategies to automated surveillance strategies with a focus on education and interventions. Image adapted with courtesy of Healthcare Purchasing News and Cardinal Health.[20]

$P < .001$) and total hospital costs (adjusted mean, $26,315 vs $35,283, respectively; $P < .001$). In a separate study, the authors reported that the percentage of patients having surgery who received appropriately timed preoperative antimicrobial prophylaxis increased from 40% to 99.1%, and the antibiotic-associated adverse drug events decreased by 30%. During the study, antimicrobial resistance patterns were stable, and mortality rates decreased from 3.65% in 1988 to 2.65% in 1994 ($P < .001$). The authors concluded that computer-assisted decision support programs can improve antibiotic use, reduce associated costs, and stabilize the emergence of MDRO.[14]

In summary, CPOE and CDS can decrease medication errors by increasing accuracy and legibility of the physician orders and providing alerts for drug-drug, drug-allergy, and drug-food interactions. In addition, they can help reduce inappropriate antimicrobial prescribing, which is one of the leading causes of adverse drug events and antimicrobial resistance. These tools can be also customized specifically to improve isolation practices for those infected with MDRO or active contagious diseases.

FROM TRADITIONAL SURVEILLANCE TO EHR-SUPPORTED AUTOMATED SURVEILLANCE

Surveillance is defined as a comprehensive method of measuring outcomes and related processes of care, analyzing the data, and providing information to members of the health care team to assist in improving those outcomes.[15,16] Manual methods to identify potential HAI cases by chart reviews, entering data, and looking for associations can be inefficient, labor intensive, and error prone.[17] EHRs can automate many of these processes. If properly designed, EHRs and related Health IT can also help in data analysis by identifying abnormal distributions of variables from large interrelated databases.[18] This has shown to be more efficient (requiring one third to one sixth the amount of time required by standard surveillance methods) and effective in screening potential outbreaks as well as finding and reporting endemic HAI.[18,19] With current emphasis on mandatory reporting of HAI and requirement by some states to perform house-wide surveillance, EHRs and related information technologies provide a unique opportunity to support the paradigm shift to automated surveillance strategies, which allow ICPs to minimize time spent *finding* HAI and to maximize time spent *preventing* them (Fig 3).[20]

EHR-supported surveillance has the potential for being a more proactive approach compared with traditional techniques for case finding by which data are collected post hoc after the infection or outbreak has happened. For example, Pittet et al used their hospital information system to generate a ''readmission alert'' to ICPs that informed them about a readmission to the hospital of any patient previously colonized or infected with MRSA.[21] During the first 12 months of application, delayed recognition of readmitted MRSA carriers decreased significantly, and the proportion of MRSA patients recognized at the time of admission to the hospital increased from 13% to 40% ($P < .001$). The effectiveness of this approach has also been reported by Gransden et al, who found that two thirds of patients readmitted to the hospital were not known to be previously infected by the admitting staff and were instead alerted by the computerized system.[22] Early identification of patients at risk, such as at the time of hospital admission, allows ICPs to conduct active surveillance and take prompt contact precautions if needed to prevent nosocomial spread.[23] This strategy has been found to be cost-effective and supported by

the Society for Healthcare Epidemiology of America (SHEA).[23,24]

USE OF WEB AND OTHER HEALTH INFORMATION TECHNOLOGIES

Institutions that do not have comprehensive EHRs can benefit from utilizing Web-based systems and other health information technologies for HAI prevention, control, and surveillance. For example, the Chicago Antimicrobial Resistance Project (CARP) reported a successful use of the clinical data warehouse to automate measurement of performance indicators and surveillance for infection control.[25] The clinical data warehouse was designed to store data collected from both nonelectronic sources (eg, manually abstracted data from patient medical records and scanned surveys) and electronic data from many different hospital information systems: pharmacy, laboratory, radiology, medical records, and emergency department. The CARP data warehouse has been used in regular surveillance activities such as determining rates of HAI, central venous catheter use, and antimicrobial resistance as well as for quality improvement activities. These investigations as well as others highlight potential applications that utilize increased convergence between EHRs and laboratory and pharmacy information systems for electronic reporting of endemic and syndromic conditions in the population.[26,27]

A recent report described a stand-alone electronic anesthesia record system and 6 sigma methodology to improve successfully the timing of perioperative antibiotic prophylaxis before surgical incision.[28] The time interval for antibiotic administration before surgical incision decreased from a preintervention mean of 88 minutes (95% CI: 56-119 minutes) to 38 minutes (95% CI: 25-51 minutes) ($P < .01$). A recently published study reported using an intranet-based tool for improvement and documentation of influenza vaccination and declination rates of 20,170 health care personnel in an 1100-bed hospital. With an estimated direct cost of $4800, the intranet-based tool was associated with a significant increase in documented vaccination rates from 38% to 55% in 1 year.[29]

There are commercial surveillance technology software that can work with EHRs or other health information systems to help automate identification of HAI using algorithms that analyze laboratory results, admission records, and possible pathogens. The majority of these can be readily implemented within a few months. Some of these products can simultaneously track infection data and combine it with pharmacy data such as antibiotic use to generate antibiotic utilization and resistance reports and recommend targeted and cost-effective antibiotic selections at the point of care. A few can even provide real-time infection risk profiles via an electronic clinical dashboard that helps alert clinicians to specific patients who may be at high risk for infection.[18,20] In addition, some may facilitate efficient and timely reporting of notifiable conditions to public health agencies.[30] More detail on commercial surveillance technology solutions is reported elsewhere (www.manageinfection.com/10-06/mic1006w26.pdf). Because these solutions may require significant capital investment and customization, a thorough analysis is recommended to find the best fit for an organization.

There are also CDC-led initiatives for endemic HAI and outbreak surveillance. For example, the National Healthcare Safety Network (NHSN) is a Web-enabled surveillance system designed for surveillance of HAI in health care facilities.[31,32] Enrollment in the NHSN is free and currently open for hospitals and outpatient hemodialysis centers. The NHSN allows entry of event and denominator data for both device- and procedure-associated events as well as data entry for microbiology susceptibility and antimicrobial use that can be risk adjusted and used for interfacility comparisons and quality improvement activities (Fig 4). In addition, the NHSN plans to implement modules that will focus on MDROs, central line insertion practices, and high-risk patient influenza vaccination. There are an increasing number of states that are adopting NHSN participation as a platform for responding to legislative mandates for public reporting.

During the global epidemic of severe acute respiratory syndrome (SARS), the CDC successfully utilized Web-based tools to rapidly establish multiregion syndromic surveillance. A total of 27 emergency departments reported syndrome frequencies from more than 146,000 patient encounters, confirming the usefulness of Web-based systems for triage and outbreak surveillance.[33] Currently, the CDC's BioSense application is aimed at detecting early signs of disease outbreaks by gathering real-time data related to illness syndromes and clinical severity and confirmed clinical findings from hospitals to CDC.[34] The application provides electronic ''views,'' analytics, and reports to inform outbreak surveillance at national, state, and local public health levels and aims to reduce burden of clinical data collection during the early outbreak investigation.

Because each health care organization must tailor its surveillance according to its population characteristics and outcome priorities, it helps to list clearly the purpose and objectives of the surveillance system and indicate its level of usefulness to the organization. The CDC has published guidelines for evaluating public health surveillance systems that can also be applied

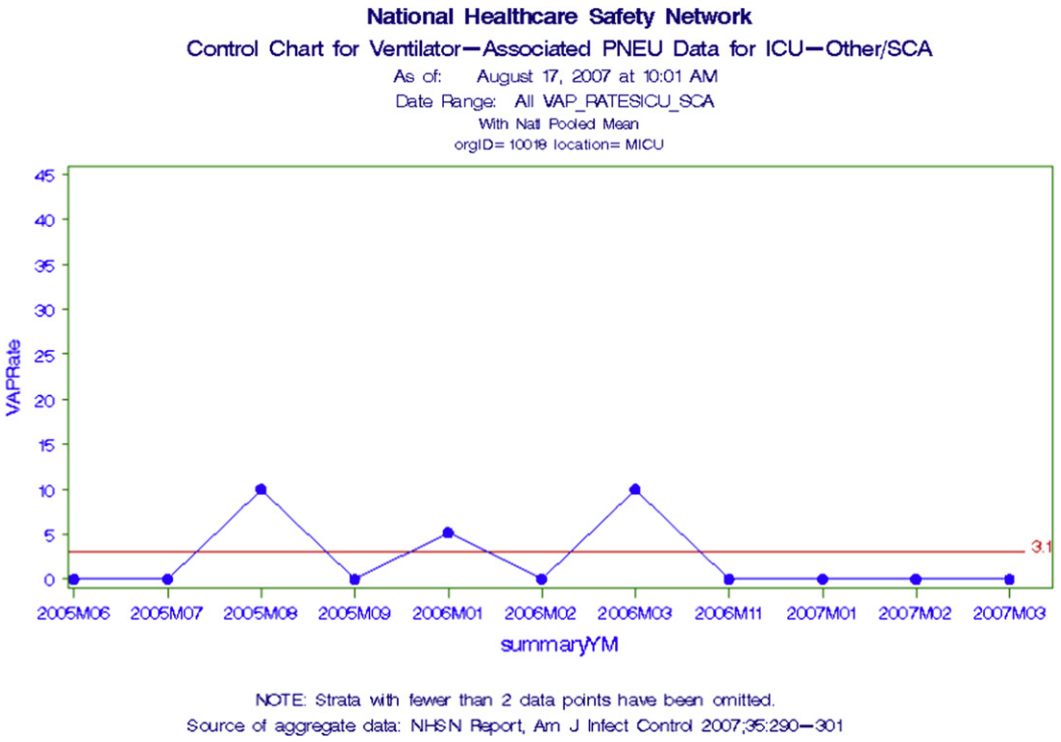

Fig 4. Screenshot of National Healthcare Safety Network (NHSN) comparing ventilator-associated pneumonia rates of an organization (blue line) to national aggregate (red line).

to commercial surveillance software and information systems at individual health care facilities.[15] After determining the objectives of the surveillance systems, evaluation should assess system attributes, including simplicity, flexibility, data quality, acceptability, sensitivity, predictive value positive, representativeness, timeliness, and stability. It is also useful to assess whether the system uses data exchange and messaging standards that can automate data collection from EHRs and existing Health IT and facilitate reporting to public agencies. Although automation enhances efficiency, it does not by itself lead to more accurate data. Overt reliance on administrative or billing databases can lead to inaccurate and misleading reporting.[35,36] Hence, due diligence should be exercised to confirm the accuracy of data and associated processes so as to meet the requirements of an epidemiologically sound surveillance system.[15,16]

ROLE OF ID SPECIALISTS AND ICP

Transformation in current practice of ID management, surveillance, prevention, and control will not occur without proactive involvement of ID specialists and ICPs in Health IT initiatives at the local, regional, or national level. Awareness about Health IT and its adoption and advocacy is key to successfully leveraging EHRs and related information technologies.

Awareness

The ICPs and ID specialists need to first become aware of the changing landscape in the field of infection control; the opportunities created by modern Health IT to realize the new paradigm; and the evolving role of Health IT in surveillance, prevention, and control of HAI. It is necessary to become familiar with current and planned IT initiatives in ones own health care institution and at regional, state, and national levels to promote synergy and prevent duplication of efforts. Regular communication and dialogue with health care institutions' chief informatics officer or chief technology officer could be the initial step in starting to know more about an institution's short- and long-term Health IT strategies.

Adoption

At present, only 1 in 4 physicians use some type of EHRs, and fewer than 1 in 10 use a comprehensive EHR system. The return on investment and incremental benefit of EHRs increase when they can also be utilized for ID management, surveillance, prevention, and control. Because EHRs differ with respect to their features, it is important for ICPs and ID specialists to know which EHR has functionalities that can support their practices (see Table 1). ICPs in institutions that

Table 1. Some of the EHR functionalities that can support infectious disease management, surveillance, prevention, and control

Functionality	Examples
Capturing and reporting of structured data of interest to the facility	Patients with possible contagious diseases requiring isolation Compliance with the central line bundle
Decision support at the point of care	Pneumovax and influenza vaccine reminders Alerts to restrict use of broad-spectrum antibiotics or provide alternatives to an indwelling urinary catheter
Supporting surveillance functions	Alerts to ICPs about MDRO or epidemiologically significant new isolates of interest Regular reports on trend in HAI, MDRO, reportable diseases, and antimicrobial use patterns
Standards that allow for interoperability	Use of HL7 messages to exchange data with surveillance software Use of data vocabularies such as LOINC/SNOMED for microbiology data

ICP, Infection control professional; *MDRO*, multidrug-resistant organism; *HAI*, health care-associated infection; *HL7*, Health Level 7; *LOINC*, Logical Observation Identifiers Names and Codes; *SNOMED*, Systematized Nomenclature of Medicine[37]

have already adopted EHRs or made the decision to do so should, as subject experts, help with the customization of the EHRs to support best practices for ID management and surveillance.

Advocacy

There needs to be advocacy to decision makers at the federal, state, and local levels for the promotion of a synergistic strategy to leverage IT for ID management and surveillance. Currently, many of the EHRs are not prepackaged with decision support capabilities and the surveillance solutions required for ID management and control. This requires many institutions to either customize the EHRs or resort to stand-alone commercial surveillance systems to meet their requirements. HICPAC plans to work closely with standard developing organizations such as Health Level 7 (HL7) to drive standards and support for features and functions that enable ID management and surveillance.

CHALLENGES AND FUTURE DIRECTION

It is important to realize that EHR is not a panacea but an important and critical tool in patient-centered health care. There are many significant barriers to widespread use of EHRs that could limit its potential to transform our practices in the 21st century. Most notable are the cost of technology, the lack of standards to support data exchange, and the potential for adverse consequences if not implemented correctly.

Cost is the cited as the biggest impediment to the widespread implementation of Health IT. It has been estimated that universal EHR adoption and interoperability will cost $156 billion in capital investment over 5 years and $48 billion in annual operating costs.[38] In addition, there needs to be continued investment in human capital that has a diverse skill set (programming, database administration, network support, project management, data mining, statistics, clinical informatics, and others) if full benefits of EHR are to be realized.

Another impediment to widespread Health IT adoption is the lack of standards that allow for nationwide interoperability. Hence, the fact that a patient has had MRSA in one institution can be completely missed by another institution even if both institutions have EHRs. Furthermore, many EHRs lack functions that support CDS customization or allow for reporting, population health, or surveillance. In 2004, the Certification Commission for Healthcare Information Technology (CCHIT) was formed to create certification criteria for health care IT products, including EHRs (www.cchit.org). CCHIT provides a list of EHRs that are certified to have these functions so that end users can expect to leverage them for their clinical, research, and surveillance needs.

There is also growing concern that technology, if not properly utilized, can lead to unintended consequences such as more/new work for clinicians, untoward changes in communication patterns, generation of new kinds of errors, and overdependence on the technology.[39] Any new implementation of Health IT needs to be rigorously tested and regularly evaluated to prevent such unintended consequences of technology.

CONCLUSION

Each health care infection control program is distinctive, but the expectation is that each is based on sound epidemiologic principles and meets the standards required to address the growing problem of

HAI. It is essential that informatics principles be widely understood if ICPs are to develop the capacity to manage and utilize information systems to address HAI and other adverse events associated with the delivery of health care. EHR-based automated surveillance, reporting, and HAI epidemiology can allow ICPs to focus their efforts toward education and interventions rather than manual data gathering. At the same time, EHRs can promote better antimicrobial prescribing, enhance immunization practices, and help in prompt identification and isolation of patients with MDRO. ID specialists and ICPs need to become aware of emerging technologies and get involved in advocacy and adoption efforts at local, regional, and national levels to leverage the opportunities created by current Health IT initiatives.

APPENDIX

Glossary

BIOSENSE: BioSense is the CDC national initiative designed to improve the nation's capabilities for real-time biosurveillance and situational awareness. By providing access to data from hospitals and health care systems in major metropolitan cities across the nation, BioSense is connecting existing health information to public health in a way not previously possible (http://www.cdc.gov/biosense).

CDR, Clinical Data Repository: CDR is a database that consolidates data from a variety of information sources to present a unified view for a clinician or researcher. Typical data types that are often found within a CDR include the following: laboratory test results, patient demographics, pharmacy information, radiology reports and images, pathology reports, hospital admission/discharge/transfer dates, ICD-9 codes, discharge summaries, and progress notes.

CPOE, Computerized Provider Order Entry: A computer application that allows a physician's orders for diagnostic and treatment services (such as medications, laboratory, and other tests) to be entered electronically instead of being recorded on order sheets or prescription pads.

CDS, Clinical Decision Support: Computer tools or applications to assist physicians in clinical decisions by providing evidence-based knowledge in the context of patient-specific data. Examples include drug interaction alerts at the time medication is prescribed and reminders for specific guideline-based interventions during the care of patients with chronic diseases.

eRx, Electronic Prescribing: A type of computer technology whereby physicians use handheld or personal computer devices to review drug and formulary coverage and to transmit prescriptions to a printer or to a local pharmacy. E-prescribing software can be integrated into existing clinical information systems to allow access to patient-specific information to screen for drug interactions and allergies.

Health IT, Health Information Technology: The application of information processing involving both computer hardware and software that deals with the storage; retrieval; sharing; and use of health care information, data, and knowledge for communication and decision making. A central element of Health IT is the patient's electronic health record.

HL7, Health Level Seven: A standard setting organization for Health IT specifically in clinical and administrative data (www.hl7.org).

Interoperability: The ability of a system or a product to work with other systems or products without special effort on the part of the customer.

NHIN, National Health Information Network: Describes the technologies, standards, laws, policies, programs, and practices that enable health information to be shared among health decision makers, including consumers and patients, to promote improvements in health and health care (http://www.hhs.gov/healthit/healthnetwork/background).

NHII, National Health Information Infrastructure: Often used synonymously with NHIN. NHII came before NHIN and is an acronym that encompasses all of the necessary components needed to make EHRs interoperable. NHIN, as the name suggests, refers to both the physical and national network needed for interoperability to occur.

NHSN, National Healthcare Safety Network: A Web-enabled surveillance system designed for use by the CDC and its health care partners for the purpose of improving patient and health care worker safety. NHSN merges 3 predecessor surveillance systems maintained by the Division of Healthcare Quality Promotion (DHQP) in the CDC's National Center for Prevention, Detection, and Control of Infectious Diseases (NCPDCID). These were the National Nosocomial Infections Surveillance (NNIS) System, the National Surveillance System for Healthcare Workers (NaSH), and the Dialysis Surveillance Network (DSN).

ONCHIT, Office of the National Coordinator for Health Information Technology: Provides leadership for the development and nationwide implementation of an interoperable health information technology infrastructure to improve the quality and efficiency of health care and the ability of consumers to manage their care and safety. The National Coordinator for Health Information Technology serves as the Health and Human Services Secretary's principal advisor on the development, application, and use of health information technology (www.hhs.gov/healthit).

PHR, Personal Health Record: An electronic application through which individuals can maintain and

manage their health information (and that of others for whom they are authorized) in a private, secure, and confidential environment.

RHIO, Regional Health Information Organization: A multistakeholder organization that enables the exchange and use of health information, in a secure manner, for the purpose of promoting the improvement of health quality, safety, and efficiency. Officials from the US Department of Health and Human Services (HHS) see RHIOs as the building blocks for the National Health Information Network (NHIN). When complete, the NHIN will provide universal access to electronic health records.

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