Using STD Electronic Medical Record Data to Drive Public Health Program Decisions in New York City

Electronic medical records can house patient information gathered over time and at multiple sites, thus they have the potential to increase continuity of care and improve service delivery in a multiclinic system.

The New York City Department of Health and Mental Hygiene implemented an electronic medical record system in its 10 sexually transmitted disease clinics during 2004 and 2005. We examine the use of real-time electronic medical record data analyses to evaluate clinical services or program activities and present 3 examples of such analyses that have led to program improvements.

Analyses of electronic medical record data have produced changes in clinical practice that in turn have resulted in more effective staff use, increased disease detection, and increased clinic capacity. (*Am J Public Health*. 2010;100:586–590. doi:10.2105/AJPH.2009.175349)

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ADVOCATES OF ELECTRONIC medical records have described the advantages they offer with respect to quality of health care, largely because they can reduce medical recording errors, improve efficiency, and promote patient safety.[1,2] Despite these advantages, however, health care settings have been slow to adopt electronic medical records,[3,4] and estimates of their prevalence vary widely.[5]

Although some authors have described the use of electronic health care quality indicators in other clinical settings, there have been few published descriptions of the use of electronic medical record systems in sexually transmitted disease (STD) clinics.[6–8] Because persistent and untreated sexually transmitted infections can lead to adverse outcomes such as infertility, ectopic pregnancy, and pelvic inflammatory disease,[9,10] timely identification and treatment of STDs is important with respect to interrupting disease transmission and sequelae in a population.

An electronic medical record system was implemented in the 10 New York City Department of Health and Mental Hygiene (DOHMH) public STD clinics between August 2004 and September 2005, replacing all paper charts. We examine an important use of electronic medical records in New York, conducting real-time analyses evaluating the city's clinical services and program activities. In the 4 years since implementation of the STD electronic medical record system in New York City, several such analyses have been performed, leading to programmatic decisions that have saved resources while maintaining or improving standards of patient care. We describe 3 examples of these programmatic analyses.

SETTING

The clinics operated by the DOHMH's Bureau of STD Control (BSTDC) offer free, confidential services including HIV testing, STD testing and treatment, hepatitis vaccinations, Papanicolaou tests, emergency contraception, and counseling, referral, and partner management services. The clinics are designed to provide intermittent walk-in care for episodic infections for those who cannot or do not access STD testing and treatment elsewhere. Patients are required to disclose a name and contact information for all services other than HIV testing; point-of-care HIV testing can be done anonymously, although such anonymous testing is relatively infrequent. To remove obstacles to patients accessing care, the clinics do not charge a fee for the services offered or require patients to provide identification.

Although the clinic system is intended to function as a safety net for those without other options for STD care, it also serves patients who have primary care providers but desire to keep their STD testing and treatment separate from visits to their general physician. In 2008 the clinic system registered 124 131 patient visits, and between 2006 and 2008, 32% of patients made more than 1 clinic visit. The substantial number of repeat visitors indicates an opportunity for improved continuity of care and public health intervention.

FEATURES

The STD electronic medical record system is a Web-based interface accessible from DOHMH network computers to authorized individuals with a unique user login and secure password. Staff can view and edit patient charts from multiple work locations, potentially leading to improved information sharing and continuity of care both across and within clinics.[11,12] Various security features, such as automatic logout of inactive sessions and agency-wide network security systems (firewalls), protect sensitive medical data from access by unauthorized individuals. A search function is used to locate individual charts, allowing for rapid retrieval of medical information.

The STD electronic medical record system improves the legibility of charts, as well as the completeness and uniformity of medical record information, via drop-down options, preformatted fields, logic prompts, and questions that must be answered to move through the chart.[13,14] These highly structured fields and the relative absence of open text fields also serve to provide readily analyzable clinical data. In August 2006, an electronic laboratory interface was added to the system,

enabling paperless ordering of and results for *Neisseria gonorrhoeae* and *Chlamydia trachomatis* nucleic acid amplification tests between the clinics and the city's Public Health Laboratory.

STD electronic medical record data allow for regular monitoring of clinical quality outcomes such as hepatitis vaccine coverage among eligible patients, appropriate treatments for syphilis, and compliance with screening and treatment guidelines[15,16]; these outcomes are reported back to the clinicians. Computerized clinical decision support systems, designed to use health information to assist health professionals with decision-making tasks, have been shown to improve provider practice and, to some degree, clinical outcomes,[17,18] and the STD electronic medical records include alerts and reminders to users about individual patients.

Information about alcohol and drug use, allergies, and pregnancy risk, filled out on medical history pages, is highlighted on diagnosis and treatment pages to alert the diagnosing physician of contraindications. Historical views condense patient information into an easily reviewed form; HIV testing history is displayed above each patient's HIV risk assessment page, and syphilis testing history can be displayed or hidden on each patient's treatment–follow-up review page. STD electronic medical record data have also been used to identify the clinical decision support tools that would be of most use to clinicians (e.g., oral or anal gonorrhea testing reminder messages for patients whose sexual history indicates risk factors for gonorrhea at those anatomical sites).

Basic clinical support tools are available as well. Recommended and alternate treatments appear when a physician selects a given diagnosis from a menu on the screen, and these treatments can be selected with appropriate dosage and frequency. Resource links within each chart, to the Centers for Disease Control and Prevention's STD treatment guidelines and to a list of referral services in New York City, provide easily locatable references for busy clinic staff.

USING DATA TO DRIVE PROGRAMMATIC DECISIONS

We describe 3 analyses involving the use of STD electronic medical record data: (1) assessing the utility of an on-site clinical test, (2) identifying the need for combined services, and, (3) evaluating a new clinic visit option. Because these data can be analyzed almost immediately, they can be used to closely monitor the current patient population and disease trends as well as current clinical practices. In each of these analyses, no more than 6 months elapsed between the final patient visit examined and the performance of the data analysis.

Utility of the Urethral Gram Stain at STD Clinics

The urethral gram stain (UGS) is a point-of-care laboratory test, classified as moderate in complexity under federal laboratory regulations, in which a swab is used to collect a urethral specimen that is transferred to a glass slide, stained, and examined under a microscope for indicators of infection. Because this test can be conducted relatively quickly on-site, it can be used to determine which patients to treat presumptively for chlamydia or gonorrhea infection while awaiting the results of tests sent to referral laboratories.

A diagnosis of gonococcal urethritis (i.e., gram-negative intracellular diplococci are present on gram staining) leads to presumptive treatment of gonorrhea, whereas a diagnosis of nongonococcal urethritis (i.e., a specific number of white blood cells are present with no gram-negative intracellular diplococci on gram staining) leads to presumptive treatment of chlamydia only. Regardless of UGS outcome, specimens are sent to a referral laboratory for more sensitive chlamydia or gonorrhea tests.

In 2006, the BSTDC sought to evaluate the utility of clinics' practice of performing UGS on men examined by a physician. Clinical decision making at the time of the patient visit generally leads to presumptive treatment of sexual contacts of individuals with chlamydia or gonorrhea diagnoses and of symptomatic men; thus, UGS is most informative for evaluating men with no symptoms and no sexual contact with individuals known to be infected with chlamydia or gonorrhea.

Laboratory test results were analyzed for nearly 18 000 male STD clinic visits during an 18-month period. We examined the sensitivity, specificity, and positive predictive value of UGS relative to a urethral gonorrhea or chlamydia nucleic acid amplification test (a highly sensitive and specific referral test) in 4 mutually exclusive groups of male patients: sexual contacts of individuals known to be infected with gonorrhea, sexual contacts of individuals known to be infected with chlamydia, men with symptoms (dysuria or discharge reported or noted on physical examination), and men without symptoms who were not sexual contacts of individuals known to be infected with chlamydia or gonorrhea. At the time of this analysis, approximately 32 000 gram stains were performed yearly in BSTDC clinics.

UGS exhibited poor sensitivity (40%) in identifying gonorrhea among contacts of gonorrhea patients and moderate sensitivity (70%) in identifying chlamydia among contacts of chlamydia patients. The only group for which UGS had high sensitivity, specificity, positive predictive value, and negative predictive value in diagnosing gonorrhea was symptomatic men. However, individuals in all 3 of these groups would be presumptively treated at the time of testing according to clinic protocol, so there is no clear added value of UGS to managing these patients. UGS showed the lowest positive predictive value (19%) with respect to diagnosing gonorrhea in asymptomatic men who were not contacts of individuals with either infection; the positive predictive value for chlamydia in this group was higher (82%). Sensitivity for gonorrhea was low (39%), and there was a very low gonorrhea infection rate in this group (1%).[19]

On the basis of the number of tests performed annually, discontinuing the use of UGS could eliminate 6000 tests per year among asymptomatic men with only a limited impact on patient care. In addition, it could benefit technicians considering the estimated time and effort required to call back for treatment untreated asymptomatic individuals who may have been identified by UGS (approximately 650 men each year, an average of 5.5 per clinic per month). These data, combined with the need to reduce patient cycle times, led the BSTDC to eliminate UGS in all clinics in early 2008 while continuing to offer the usual presumptive treatment of sexual contacts of individuals with known infections and symptomatic men.

Emergency Contraception Visits and STD Testing

Since 2003, all BSTDC clinics have provided emergency contraception to women at risk of preventable unintended pregnancy free of charge on a walk-in basis. The emergency contraception regimen consists of 2 hormonal contraceptive pills that can prevent pregnancy up to 5 days after unprotected sex. To receive emergency contraception in BSTDC clinics, female patients must be 12 years or older, report unprotected sex within the preceding 72 hours, and see a physician.

To expedite access, emergency contraception was initially provided on request as a single service (i.e., without other routine STD services). However, because unprotected sex places women at risk for STDs as well as unintended pregnancies, a visit at which only emergency contraception is provided could be a missed opportunity for STD diagnosis and treatment. We undertook an analysis to characterize emergency contraception visits to BSTDC clinics in terms of accompanying STD screening and positivity rates (we refer to visits at which emergency contraception was requested by the patient as emergency contraception–request visits and visits for which emergency contraception was the only reason the patient reported for visiting the clinic as emergency contraception–only visits).

Between October 2005 and April 2007, 3758 women made 4657 emergency contraception–request visits, 66% of which were emergency contraception–only visits. Among women making emergency contraception–request visits, 27% were tested for chlamydia or gonorrhea, and 12% of these women were positive for 1 or both infections. Among women making emergency contraception–only visits, 4% were tested for chlamydia or gonorrhea, of whom 7% were positive for 1 or both infections. Among women making emergency contraception–request visits, the positivity rate was higher among those aged 25 years or younger (14%) than among those older than 25 years (7%).[20] These high chlamydia–gonorrhea positivity rates among emergency contraception requesters, especially young women, indicate that emergency contraception–request visits represent an important opportunity for chlamydia and gonorrhea testing.

These findings led the BSTDC to institute a clinic policy to include STD screening for all emergency contraception requestors as of November 2007. This policy change resulted in chlamydia or gonorrhea testing at 61% of emergency contraception-request visits between November 2007 and May 2008, with a positivity rate of 11%.

The Impact of ''Express Visits'' at STD Clinics

In January 2006, with limited physician resources and an increasing challenge to serve all patients seeking care each day, the BSTDC implemented an "express visit" option in its 10-clinic system. Eligibility for these visits, which involved STD screening (urine chlamydia and gonorrhea nucleic acid amplification tests, syphilis blood tests, and oral swab rapid HIV tests) without a physician examination, was limited to patients who reported no genitourinary symptoms or receptive anal sex, indicated that they were not sexual contacts of individuals known to be infected with an STD, and did not request an examination. We evaluated the express visit option by comparing, before and after implementation, the percentage of visits to a clinician at which the patient reported symptoms, the number of chlamydia or gonorrhea cases detected at each type of visit, and the timeliness of chlamydia or gonorrhea treatment (within 30 days of testing).

In the 4 months before express visits were routinely offered (September to December 2005), there were 18 449 clinic visits and an additional 1476 visits in which only urine chlamydia or gonorrhea nucleic acid amplification tests and syphilis blood tests were conducted. In the 4-month interval between September and December 2006, after express visits had been implemented, there were 18 421 clinic visits and 6064 express visits.

The percentage of clinic visits by symptomatic patients was 86% after implementation of express visits (versus 74% before express visits were introduced; $P < .001$), and the percentage of patients testing positive for gonorrhea at these visits was 13.8% (versus 13.2% before express visit implementation). After express visit implementation, an additional 38 chlamydia or gonorrhea infections were detected as a result of clinic visits, and an additional 536 cases were detected as a result of express visits. The percentage of chlamydia or gonorrhea patients treated within 30 days of their clinic visit increased from 92.1% to 95.9%, and median time to treatment decreased from 14 days to 10 days without a reduction in the overall percentage of patients treated within 30 days of testing (92.1% in 2005 versus 93% in 2006).[21]

This analysis demonstrates that clinics can implement a nonclinician visit option while maintaining the volume of clinician visits, increasing chlamydia and gonorrhea detection, and even decreasing time to treatment. The only additional costs incurred are those related to increased testing and treatment. Express visits enabled the DOHMH STD clinic system to handle larger patient volumes by directing physician resources toward symptomatic patients while offering screening to increasing numbers of asymptomatic patients.

DISCUSSION

The New York City DOHMH implemented an electronic medical record system in the city's STD clinics to facilitate access to medical records across and within clinics and to allow assessments of patient characteristics and service provision. The electronic medical record system has fulfilled these expectations and, moreover, has provided readily analyzable data that have led to changes in clinical practices, including more effective staff use, increased disease detection, and increased clinic capacity. The 3 analyses described here were all performed within months of data collection, allowing for immediate application of their results. Aggregation of clinical data sets of this size and scope extracted from a paper medical record system would be at best cumbersome and time consuming and at worst impossible.

It is perhaps surprising that electronic medical records, which early proponents valued for their potential to maintain an electronic record of the longitudinal course of patient visits over extended periods of time, would prove so beneficial in a clinic system designed to provide episodic care. However, by standardizing and streamlining medical recording and eliminating the need for paper chart storage, New York City's electronic medical record system

provides unique advantages to the city's STD clinic system, which delivers care to an extremely high volume of patients in relatively little physical space. Furthermore, because electronic medical records can house medical record information gathered over time at multiple clinical sites, they have the potential to increase continuity of care and improve service delivery in an environment where this may be otherwise difficult to achieve.

New York City's STD electronic medical record system was built in-house by the DOHMH Bureau of Informatics and Information Technology, offering a degree of flexibility of design and control over enhancements that may not be available with commercial health information technology systems. However, other public health jurisdictions that are considering shifting to an electronic system or are in the early stages of electronic medical record implementation may benefit from the lessons learned in New York.

First, it is important to plan for system flexibility by ensuring that an electronic medical record system can accommodate an increased volume of records and changes to the system resulting from alterations in testing, treatment, or other services and user-driven requests for modifications. In 2004, before full implementation of the electronic medical record system, BSTDC clinics served 109 175 patient visits. Since that time, patient volumes have increased substantially, and in 2008 124 131 visits were registered. Second, conducting a clinic flow analysis before electronic medical record implementation can help identify how flows may change. Because multiple clinic staff can access an electronic medical record simultaneously, patients' paths through the clinic are no longer dependent on the location of their medical records. With an electronic medical record, staff no longer pass paper charts back and forth, which may alter preexisting systems of clinic communication and patient management and follow-up.

Third, the value of on-site hardware and software support during clinic hours cannot be underestimated, and it is important to establish a protocol detailing a backup mechanism for times of system or network interruption, along with a contingency plan for entering any handwritten charts into the system. Finally, staffing needs may grow or change as a result of electronic medical record implementation. In New York City, continuing resource needs include 2 to 3 full-time project management and computer programming staff, full-time on-site hardware and software support, a readily accessible inventory of replacement hardware, and continuing supplies of printer labels and toner. Similarly, increasing analytic demands may require additional analytic staff.

One reason New York's STD electronic medical record system has been such a powerful program improvement tool is that it contains relatively few open text fields, relying mainly on strictly formatted or categorical fields (e.g., drop-down menu options, check boxes, and logic prompts) that promote uniformity. This reflects a medical history collection system that was already present in the clinics' paper records, which included many questions with structured answer options. The inherently limited scope of diagnostic options and services offered in STD clinics may be distinct from that of a more general medical setting. New York City's public STD clinic system is designed to provide uniform care and services across 10 clinic sites, and electronic medical records substantially increased the system's ability to ensure completeness, consistency, and legibility of medical records.

In addition to the benefits of legible and uniform information, improved organization, retention of records, and space conservation, an STD electronic medical record system provides the opportunity to evaluate medical record data in real time to inform clinical program and policy decisions. Our 3 case studies provide a snapshot of the evaluations regularly conducted in New York in which STD electronic medical record data are used. Although these analyses identified opportunities for clinical policy changes with respect to point-of-care laboratory tests, missed opportunities for STD testing, and expanding access to services, many such evaluations do not alter clinic policies or practices but may identify needed data fields, resources, or opportunities for improved care. Regardless of their immediate practical application, analyses of New York's STD electronic medical record data are valuable for guiding future policies or interventions by providing an improved understanding of the city's public STD services and patients. ■

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Contributors

R. Paneth-Pollak originated and wrote the majority of the article. J. A. Schillinger and S. Blank helped to conceptualize ideas and reviewed drafts of the article. J. M. Borrelli, S. Handel, and P. Pathela performed and described the 3 electronic medical record analyses.

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Human Participation Protection

Because these analyses were performed as part of the New York City Health Department's clinical program evaluation activities, no protocol approval was needed.

References

1. Shekelle PG, Morton SC, Keeler EB. Costs and benefits of health information technology. *Evid Rep Technol Assess (Full Rep)*. 2006;132:1–71.

2. Chaudhry B, Wang J, Wu S, et al. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Ann Intern Med*. 2006;144(10):742–752.

3. Jha AK, DesRoches CM, Campbell EG, et al. Use of electronic health records in U.S. hospitals. *N Engl J Med*. 2009; 360(16):1628–1638.

4. DesRoches CM, Campbell EG, Rao SR, et al. Electronic health records in ambulatory care—a national survey of physicians. *N Engl J Med*. 2008;359(1):50–60.

5. Goldzweig CL, Towfigh A, Maglione M, et al. Costs and benefits of health information technology: new trends from the literature. *Health Aff (Millwood)*. 2009;28(2):w282–w293.

6. Shojania KG, Grimshaw JM. Evidence-based quality improvement: the state of the science. *Health Aff (Millwood)*. 2005;24(1):138–150.

7. Kaelber DC, Jha AK, Johnston D, et al. A research agenda for personal health records (PHRs). *J Am Med Inform Assoc.* 2008;15(6):729–736.

8. Chan KS, Weiner JP. Electronic health record-based quality indicators for ambulatory care: findings from a review of the literature. Available at: http://healthit.ahrq.gov/portal/server.pt/gateway/PTARGS_0_3882_217665_0_0_18/e-indicator-lit-review.pdf. Accessed January 5, 2010.

9. Hillis SD, Owens LM, Marchbanks PA, et al. Recurrent chlamydial infections increase the risks of hospitalization for ectopic pregnancy and pelvic inflammatory disease. *Am J Obstet Gynecol.* 1997; 176(1):103–107.

10. Brunham RC, Maclean IW, Binns B, et al. *Chlamydia trachomatis*: its role in tubal infertility. *J Infect Dis.* 1985;152(6): 1275–1282.

11. Varon J, Marik PE. Clinical information systems and the electronic medical record in the intensive care unit. *Curr Opin Crit Care.* 2002;8(6):616–624.

12. Shapiro JS, Kannry J, Lipton M, et al. Approaches to patient health information exchange and their impact on emergency medicine. *Ann Emerg Med.* 2006;48(4): 426–432.

13. Menke JA, Broner CW, Campbell DY, et al. Computerized clinical documentation system in the pediatric intensive care unit. *BMC Med Inform Decis Mak.* 2001;1:3. Available at: http://www.biomedcentral.com/1472-6947/1/3. Accessed January 5, 2010.

14. Evans KD, Benham SW, Garrard CS. A comparison of handwritten and computer-assisted prescriptions in an intensive care unit. *Crit Care.* 1998;2(2): 73–78.

15. Centers for Disease Control and Prevention. Sexually transmitted diseases treatment guidelines, 2006. *MMWR Recomm Rep.* 2006;55(RR-11):1–94.

16. Centers for Disease Control and Prevention. Update to CDC's sexually transmitted diseases treatment guidelines, 2006: fluoroquinolones no longer recommended for treatment of gonococcal infections. *MMWR Morb Mortal Wkly Rep.* 2007;56(14):332–336.

17. Kuperman GJ, Bobb A, Payne TH, et al. Medication-related clinical decision support in computerized provider order entry systems: a review. *J Am Med Inform Assoc.* 2007;14(1):29–40.

18. Hunt DL, Haynes RB, Hanna SE, et al. Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. *JAMA.* 1998;280(15): 1339–1346.

19. Pathela P, Harvey K, Blank S, et al. The utility of male urethral gram stain for informing treatment decisions on the day of clinic visit. Paper presented at: 17th Meeting of the International Society for Sexually Transmitted Disease Research/10th International Union against Sexually Transmitted Infections World Congress; July 29–August 1, 2007; Seattle, WA.

20. Handel S, Schillinger JA, Borrelli J, et al. STD testing at emergency contraception visits to local STD clinics. Paper presented at: 2008 National STD Prevention Conference; March 10–13, 2008; Chicago, IL.

21. Borrelli J, Paneth-Pollak R, Wright S, et al. The impact of introducing "express visits" for asymptomatic persons seeking STD services in a busy urban STD clinic system, 2005–2006. Paper presented at: 2008 National STD Prevention Conference; March 10–13, 2008; Chicago, IL.

A Framework for Public Health Action: The Health Impact Pyramid

A 5-tier pyramid best describes the impact of different types of public health interventions and provides a framework to improve health. At the base of this pyramid, indicating interventions with the greatest potential impact, are efforts to address socioeconomic determinants of health. In ascending order are interventions that change the context to make individuals' default decisions healthy, clinical interventions that require limited contact but confer long-term protection, ongoing direct clinical care, and health education and counseling.

Interventions focusing on lower levels of the pyramid tend to be more effective because they reach broader segments of society and require less individual effort. Implementing interventions at each of the levels can achieve the maximum possible sustained public health benefit. (*Am J Public Health.* 2010;100:590–595. doi:10.2105/AJPH.2009.185652)

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LIFE EXPECTANCY IN DEVELOPED countries has increased from less than 50 years in 1900 to nearly 80 years today.[1] The greatest improvement occurred in the first half of the 20th century, when life expectancy in the United States and many parts of Europe increased by an average of 20 years,[2] largely because of universal availability of clean water and rapid declines in infectious disease,[3] as well as broad economic growth, rising living standards, and improved nutritional status.[4] Smaller gains in the latter half of the 20th century resulted primarily from advances in treatment of cardiovascular disease and control of its risk factors (i.e., smoking, high blood pressure, and high cholesterol).[5]

The traditional depiction of the potential impact of health care interventions is a four-tier pyramid, with the bottom level representing population-wide interventions that have the greatest impact and ascending levels with decreasing impact that represent primary, secondary, and tertiary care.[6] Other frameworks more specific to public health have been proposed. Grizzell's 6-tier intervention pyramid emphasizes policy change, environmental enhancement, and community and neighborhood collaboration.[7] Hamilton and Bhatti's 3-dimensional population health and health promotion cube incorporates 9 health determinants (e.g., healthy child development, biology and genetics, physical environments, working conditions, and social support networks) and evidence-based actions to address them (e.g., reorienting health services, creating supportive environments, enacting healthy public policy, and strengthening community action).[8] The maternal and child health pyramid of health services, developed by the US Health Resources and Services Administration, consists of 4 levels of services used by states to allocate resources for mothers and children.[6] Infrastructure building (e.g., monitoring, training, systems of care, and information systems) is at the bottom of the pyramid, followed by population-based services (e.g., newborn screening, immunization, and lead screening) and enabling services (e.g., transportation, translation, case management, and coordination with Medicaid), with direct health care services at the top.

All of these models, however, focus most of their attention on various aspects of clinical health services and their delivery and, to a lesser extent, health system infrastructure. Although these are of critical importance, public health involves far more than health care. The fundamental composition, organization, and operation of society form the underpinnings of the determinants of health, yet they are often overlooked in the development frameworks to