Refereed paper

Notifications of hospital events to outpatient clinicians using health information exchange: a post-implementation survey

Richard Altman MD
Department of Medical Informatics, Oregon Health & Science University, USA

Jason S Shapiro MD MA
Mount Sinai School of Medicine, New York, USA and New York Clinical Information Exchange, New York, USA

Thomas Moore MPA
New York Clinical Information Exchange, New York, USA

Gilad J Kuperman MD PhD
New York Clinical Information Exchange, New York, USA and Columbia University/New York-Presbyterian Hospital, New York, USA

ABSTRACT

Background The trend towards hospitalist medicine can lead to disjointed patient care. Outpatient clinicians may be unaware of patients' encounters with a disparate healthcare system. Electronic notifications to outpatient clinicians of patients' emergency department (ED) visits and inpatient admissions and discharges using health information exchange can inform outpatient clinicians of patients' hospital-based events.

Objective Assess outpatient clinicians' impressions of a new, secure messaging-based, patient event notification system.

Methods Twenty outpatient clinicians receiving notifications of hospital-based events were recruited and 14 agreed to participate. Using a semi-structured interview, clinicians were asked about their use of notifications and the impact on their practices.

Results Nine of 14 interviewed clinicians (64%) thought that without notifications, they would have heard about fewer than 10% of ED visits before the patient's next visit. Nine clinicians (64%) thought

that without notifications, they would have heard about fewer than 25% of inpatient admissions and discharges before the patient's next visit. Six clinicians (43%) reported that they call the inpatient team more often because of notifications. Eight users (57%) thought that notifications improved patient safety by increasing their awareness of the patients' clinical events and their medication changes. Key themes identified were the importance of workflow integration and a desire for more clinical information in notifications.

Conclusions The notification system is perceived by clinicians to be of value. These findings should instigate further message-oriented use of health information exchange and point to refinements that can lead to even greater benefits.

Keywords: ambulatory care information systems, community medicine, emergency medicine, health-care surveys, interprofessional relations, medical record linkage, programme evaluation, workflow

Introduction

Patient care has become less centralised over the last 20 years.[1,2] Nationally, the number of physicians who take care of patients both in both the inpatient and outpatient settings is growing smaller.[1,2] The current trend of primary care physicians working either as hospitalists or exclusively in an outpatient office has

created a more compartmentalised system in which practitioners are responsible for only a portion of a patient's care. This system can lead to disjointed care for patients, especially during transfers in care.[3,4]

It is within this framework that the idea of health information exchange (HIE) was born.[5] HIE enables digital, clinical information sharing among disparate institutions, which allows for a more seamless transition of care between providers. With HIE, patients can have their existing clinical information viewed by providers across different healthcare organisations, keeping all of their providers informed. Using HIE, community clinicians can also follow their patients' interactions with participating hospitals in real time. Although some studies have documented an association between the use of HIE and decreased costs of care[6–9] and others discuss the way in which HIE is intended to increase continuity of care,[10,11] there are generally few studies which investigate its broad success or impact.

The New York Clinical Information Exchange (NYCLIX) (Box 1) is a health information exchange organisation based in New York City whose HIE system features a notification component. Hourly electronic notifications are sent to outpatient, family practice clinicians at the Institute for Family Health (IFH) (Box 1) when any of three patient events occur at a participating hospital: (1) a new emergency department (ED) visit, (2) a hospital admission, or (3) a hospital discharge. The clinician, after receiving a notification of a hospital-based event, is able to log into the HIE to find out additional clinical information (Box 2).

Our goal was to assess clinicians' impressions of this notification feature with respect to the notifications' effect on the continuity and coordination of patient care. Specifically, we wanted to understand clinicians' perceptions of the impact of the notifications; to discover whether the timing, content and delivery mechanism of the notifications were appropriate; to assess perceived patient safety and the cost implications of the notification system; and to solicit ideas for future functionality from current users.

Methods

Background

The notification system was put into effect in November 2010 with a small pilot of three outpatient family practice physicians at IFH. Gradually, notifications were expanded to a larger community of 20 IFH family practice doctors and nurse practitioners. A sample notification can be seen in Figure 1.

Box 1 NYCLIX and IFH

The New York Clinical Information Exchange (NYCLIX) is a regional health information organisation (RHIO) located in New York City. Now part of a larger regional health information organisation, Healthix, NYCLIX has established an HIE infrastructure that interconnects large medical centres, community health centres, a home health agency, nursing homes and a managed care plan.[12] NYCLIX has created an internet-based portal that enables providers to access patient data from participating locations. The NYCLIX architecture has been previously described.[13]

The IFH is a federally qualified health centre with a total of 26 sites.[14] IFH is staffed by family practice physicians and nurse practitioners at outpatient settings in Manhattan, the Bronx and the mid-Hudson Valley, and serves more than 75 000 patients annually. It is one of the largest community health centres in New York State.[5]

NYCLIX Admission Notification –

PATIENT 1, TEST: Local MRN: 123456 went to the Emergency Room at Beth Israel - Petrie on Sep 7 2011 8:53 PM with MRN: 30000999999, Visit Type: Emergency Visit

Please login to NYCLIX to view the info.

****

Figure 1 Text of a sample notification

Box 2 An example of the ED admission and notification process

- Mrs Jones presents to the ED and is registered.
- After registration is completed, a copy of the registration transaction is sent to the HIE organisation, NYCLIX.
- NYCLIX uses a pre-established database linking patients and clinicians to identify Mrs Jones' healthcare providers.
- Within an hour of her registration, NYCLIX sends a notification message with the relevant information to Mrs Jones' healthcare providers.
- Mrs Jones' healthcare providers receive a message containing information of her ED admission.

Study design and sample

We conducted semi-structured interviews either in person or over the telephone with IFH family practice clinicians from July 2011 to October 2011. Of the 20 clinicians receiving notifications, 14 agreed to be interviewed, three did not return multiple email interview requests, two declined to be interviewed, and one reported that he was not actively seeing patients. The 14 participating clinicians had each been using the notification system for at least three months at the time of their interviews. Our intent was to interview all available clinicians.

Data collection

The interview template was based on tools used in previous studies.[15] An interview guide was created, reviewed and edited by the authors. A single interviewer conducted separate interviews with each respondent, lasting 15–30 minutes. The questions were mostly composed of quantitative questions (i.e. 'What is the estimated percentage of your patients' ED visits that you first find out about from NYCLIX Notify?') and open-ended questions (i.e. 'How do the ED notifications affect your practice?'). Unanswered, open-ended questions prompted the use of fixed suggestions from the interview template with the interviewees, who could agree or disagree. Anecdotal stories were also requested to give a more tangible understanding of how the notifications were affecting patient care. Where relevant, opinions of any cost savings and patient safety effects were elicited. The interviews also asked for demographic information such as age, sex, title and years of practice. In addition, usage logs from the notification system were collected and analysed to identify the number of notifications sent to each clinician over a period of several months.

Data analysis

Quantitative answers were recorded and tallied using Microsoft Excel 2007. Themes were identified by reviewing data collected from the open-ended questions. Recorded usage logs of the corresponding periods were compared with clinician perceptions of received notifications.

Results

Demographics

Of the 14 interviewees, 12 were medical doctors (MDs) and two were nurse practitioners (NPs). The group was comprised of seven men and seven women with an average age of 46 years. All were trained in family practice. The interviewees had an average of 14 years of post-training experience and worked an average of 22 clinical hours a week.
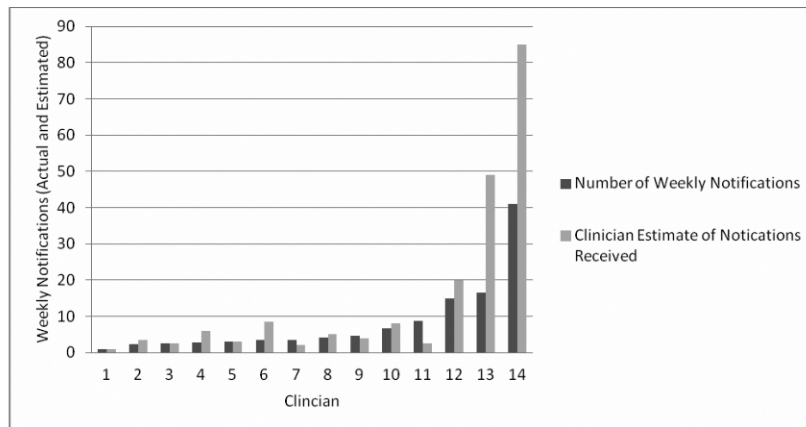
Notification volume

Most clinicians (non-supervisors) only received notifications for their own patients. Based on data from the usage logs, each clinician received, on average, three to four notifications per week. When asked how many notifications they received, seven of 10 (70%) of these clinicians were able to able to approximate, within one, the number of weekly notifications they actually received (Figure 2).

Administrators received notifications for their patients as well as for all patients who attended clinics that they supervised. Two of four administrators (50%) interviewed thought that they received twice as many notifications as they actually received (Figure 2). Ten users (71%) checked their electronic medical record (EMR) inbox for notifications four or fewer times daily, while four users (29%) reported checking six or more times daily.

ED notifications

More than half of all users felt that they first found out about 50% or more of their patients' ED visits from a

Figure 2 Number of weekly notifications actually received per clinician versus clinician self-estimate of notifications received

notification. Nine of 14 (64%) thought that without notifications, they would have heard about fewer than 10% of ED visits before the patient's next visit. All providers reported that they infrequently or never called the ED to discuss patient care, independent of notifications.

When asked about how ED notifications affect medical care, six (43%) independently noted the ED notifications were able to help them schedule follow-up appointments sooner, three (21%) felt it saved them time catching up during the next visit, and two (14%) thought that improvements in patient care were seen by the ability to get more clinical information through the portal. One mentioned that although the notifications do not currently affect her practice, she thought that it would if she could make time for available on-line training on portal use.

Inpatient notifications

Five of 14 users (36%) felt that they initially found out about the majority of their patients' admissions and discharges from a notification. Nine (64%) thought that without notifications, they would have heard about fewer than 25% of these admissions and discharges before the patients' next visit. Six clinicians (43%) reported that they call the inpatient team more often because of notifications.

When asked about how these notifications affect medical care, eight (57%) felt that the inpatient notifications were able to help them schedule follow-up appointments sooner, three (21%) mentioned that it facilitated appropriate hand-off, and three (21%) noted that notifications enabled follow-up after discharge. Users also spoke about the benefit of confirming that patients sent to the ED were admitted, the

ability to alert specialists of their patient's admission, and the ability after discharge to acquire the discharge summary before the patient's next visit.

Comments about timeliness, safety and cost

Six users (43%) wanted to receive notifications more quickly than the current 1-hour cycle. They remarked that 'sooner is always better' and 'real time would be best' but 'currently [it] is fast enough'. Nine users (64%) wanted more clinical information in the notification itself such as chief complaint, visit diagnosis or a discharge summary.

Eight users (57%) thought that notifications improved patient safety by giving them information that allowed them to reach out to patients and providers about medications and by increasing their awareness of the patient's clinical events. Four others (29%) thought that the system would increase patient safety in the future but was not affecting it at present.

Six users (43%) perceived current cost savings by either reduced readmissions or avoidance of tests discovered to have already been performed. Five (36%) thought that cost was not currently affected but they saw the potential for it. One provider said that with notifications, his team could figure out whether a patient was following up at the wrong clinic, thereby avoiding inappropriate appointments.

Clinical anecdotes

During the interviews, clinicians were asked to share stories about specific patient encounters that were affected by the notification system.

One clinician told about an alert for an ED visit of a known bipolar patient with drug-seeking tendencies. As a result of the notification, he was able to call her at home and reconnect her with her psychiatric doctor. The outpatient physician felt that this opportunity to intervene potentially avoided a crisis, further drug-seeking behaviour and ED visits.

Three clinicians related stories of patients with drug-seeking behaviour. One discharged a patient from the practice after finding out about multiple ED visits with drug seeking. Another described a patient who had already lost his opiate privileges and was noted to have multiple ED visits. This alerted the team to possible drug-seeking behaviours which they were then able to address with the patient.

Another heard about a patient with back pain who developed sepsis after epidural catheter placement. Knowing about his recent clinical history allowed the provider to schedule enough time for a thorough visit.

Themes

One consistently mentioned theme was workflow. Seven providers (50%) independently mentioned that although the information received was excellent and potentially useful, there was no time in their schedule to react to the information. Half of the clinicians explicitly stated that although they felt the system had merit, they did not think that it was fully beneficial yet, with most citing workflow issues.

Where one clinician felt 'overwhelmed with information', another said that the notifications were 'tremendously beneficial' and that 'there is no question that NYCLIX has made it 100% better than what I knew before'. Other clinicians thought the notifications were a 'fantastic first step' which improved transition of care episodes and allowed them to 're-engage the patient' after hospitalisation.

Discussion

These interviews provide an interesting look at the experiences of busy family practice clinicians using a new notification system. A notable finding is that clinicians felt strongly that the notification system increased their awareness of their patients' interactions with the medical system. The majority of clinicians responded that they would not have known about most of their patients' ED or hospital admissions before their next visit without the notification system. This resulted in perceived increases in communication with inpatient providers and improved follow-up scheduling. Clinicians felt they could use the notification information in a variety of ways to care for their patients more appropriately.

A significant finding of this survey was the consistent request for better workflow integration for these notifications. This consistency is especially notable given the relatively few notifications (three or four) that most clinicians received weekly. Providers felt that the workflow changes needed to appropriately respond to these alerts were not taken into account when the system was implemented; it was seen as additional work. Many thought the tasks would be handled more efficiently if routed to a dedicated physician enabler such as a nurse or care manager. As a group, they appreciated the value of the information, but did not feel that processing the alerts themselves was the best use of their time.

Notably, the more notifications a clinician received, the easier it was to overestimate their number. This was especially true for clinician administrators whose estimates doubled the actual number received in half of the cases. This may signify a point of information overload where even a small increment in the number of messages is experienced as larger quantity. It may be useful to keep this trend in mind when deciding an optimum number of clinician notifications or alerts.

This change in workflow was perceived by one clinician as a change in responsibility. This clinician noted that previously, if a patient was admitted to the hospital it was the responsibility of the ED or inpatient clinician to contact the outpatient doctor. However, with the notifications, the onus was placed on the outpatient physician to reach out to the hospital. They felt that this change in workflow was not represented in their schedule or support system.

Another finding in this survey was the way in which clinicians responded to ED notification messages. None of the clinicians surveyed called the ED to discuss their patients. Instead, they viewed the notifications as a marker for future action such as follow-up appointments or as clinical information. However, despite the lack of communication with the ED, requests were made for ED clinician contact information. This seems to imply that outpatient clinicians would like to discuss their patients with ED clinicians but may not because they perceive the process of reaching the appropriate clinician too difficult or time-consuming.

A majority of clinicians in our study perceived current or potential cost savings with the notification system. Previous studies have detected savings from HIE systems implementation,[7,8,16] although others have had mixed results.[9] There have been few studies of the financial impact of HIE-based notifications. One study examined the impact of electronic ED reports sent to outpatient family physicians ED within 24 hours of an ED visit. These reports did not reduce ED return visits at 14 or 28 days, decrease outpatient

> **Box 3** Lessons learned
>
> - Notifications from an HIE system can enhance clinicians' awareness of their patients' interactions in the medical system.
> - Clinicians perceived improvements in communication and follow-up scheduling as a result of notifications.
> - Increase in clinician workload and change in responsibility may be unintended effects of notifications. These workflow issues should be carefully considered.
> - Timely notifications may further improve clinician-to-clinician communication.

resource utilisation or result in a reduction in the duplication of diagnostic tests.[17] A major difference between these reports and our study is the ability of the NYCLIX system to notify outpatient clinicians within an hour of a patient's presentation at the ED.

Cost is often discussed as a factor in HIE adoption. Some suppose that a lack of financial incentives is a large barrier to adoption,[18] whereas others counter that improvements in the quality of care may outweigh economic concerns.[19] In the USA, direct financial incentives for HIE can come from government-funded initiatives such as Meaningful Use[20] and qualification for a patient-centred medical home.[18] However, it remains to be seen if notification systems will have an effect on hospital or population-based savings.

It is possible that if ED notifications are timely and ED contact information is readily available, more interclinician communication would be initiated. This could result in patient safety improvements (i.e. increased transfer of important clinical information) and potential cost savings (i.e. fewer redundant tests, avoidance of unnecessary admissions).

This survey was limited by several factors. The number of clinicians who use the system was limited as was the number of possible respondents. There may have been a sample bias of clinicians who were willing to engage in the notifications project as well as participate in the survey. Each clinician had varying exposures and training levels within the system. In addition, the clinicians were using the notifications in different settings (purely outpatient, a mix of inpatient and outpatient) and environments (mostly admissions within their own hospital system versus admissions to an external hospital system).

This real-world study highlights the possible benefits of implementing HIE and the importance of understanding the effects of implementation of a new system in any setting (Box 3). Although the information provided was clearly valued by clinicians, they felt overwhelmed by a relatively small amount of information. A different workflow may need to be implemented to maximise the benefit of this new information. This could range from daily protected

time to handle messages to having non-physician staff dedicated to processing each notification for an organisation. Regardless of which option is chosen, workflow considerations must be accounted for when instituting system changes. More work can also be done to modify the content where possible to improve its immediate usefulness to receiving clinicians.

Future investigations might include a series of data-driven studies to quantify changes in interclinician communication, scheduling changes and resource usage (including cost differences) with notifications. In addition, these interviews could be replicated after workflow and content issues have been addressed to measure changes in attitude and overall effect.

Conclusion

Although there is opportunity for improvement, the notification system that has been developed as part of the NYCLIX HIE organisation is perceived by clinicians at a federally qualified health centre to be of value for patient care. These findings should instigate further message-oriented use of HIE and point to refinements that can lead to even greater benefits.

CONFLICTS OF INTEREST

At the time the study was conducted, Dr Kuperman was Board Chair and Executive Director of NYCLIX, Dr Shapiro was a board member of NYCLIX and Mr Moore was technical manager of NYCLIX. Dr Altman had no potential conflicts of interest.

REFERENCES

1 Wachter RM and Goldman L. The hospitalist movement 5 years later. *JAMA* 2002 Jan 23–30;287(4):487–94.

2 Kuo YF, Sharma G, Freeman JL and Goodwin JS. Growth in the care of older patients by hospitalists in the United States. *New England Journal of Medicine* 2009;360:1102–12.

3 Coleman EA and Berenson RA. Lost in transition: challenges and opportunities for improving the quality of transitional care. *Annals of Internal Medicine* 2004; 141:533–6.

4 Moore C, Wisnivesky J, Williams S and McGinn T. Medical errors related to discontinuity of care from an inpatient to an outpatient setting. *Journal of General Internal Medicine* 2003;18:646–51.

5 Kuperman GJ. Health-information exchange: why are we doing it, and what are we doing? *Journal of the American Medical Informatics Association* 2011;18:678–82.

6 Fontaine P, Ross SE, Zink T and Schilling LM. Systematic review of health information exchange in primary care practices. *Journal of the American Board of Family Medicine* 2010;23:655–70.

7 Frisse ME, Johnson KB, Nian H *et al.* The financial impact of health information exchange on emergency department care. *Journal of the American Medical Informatics Association* 2011 Nov 4;19:328–33.

8 Maenpaa T, Asikainen P, Gissler M *et al.* Outcomes assessment of the regional health information exchange: a five-year follow-up study. *Methods of Information in Medicine* 2011;50:308–18.

9 Overhage JM, Dexter PR, Perkins SM *et al.* A randomized, controlled trial of clinical information shared from another institution. *Annals of Emergency Medicine* 2002;39:14–23.

10 Payne TH, Detmer DE, Wyatt JC and Buchan IE. National-scale clinical information exchange in the United Kingdom: lessons for the United States. *Journal of the American Medical Informatics Association* 2011; 18:91–8.

11 Alves B, Muller H, Schumacher M, Godel D and Abu Khaled O. Interoperability prototype between hospitals and general practitioners in Switzerland. *Studies in Health Technology and Informatics* 2010;160(Pt 1):366–70.

12 Appleby C. NYCLIX: New York HIE life. An expansive HIE network has taken shape in the nation's most densely populated urban area. *Healthcare Informatics* 2010;27(10):29–31.

13 Moore T, Shapiro J, Doles L *et al.* Event Detection: a clinical notification service on a health information exchange platform. *AMIA Annual Symposium Proceedings* 2012;2012:635–42.

14 *About Us—Institute for Family Health.* www.institute 2000.org/about-us (accessed 11 February 2012).

15 Genes N, Shapiro J, Vaidya S and Kuperman G. Adoption of health information exchange by emergency physicians at three urban academic medical centers. *Applied Clinical Informatics* 2011;2:263.

16 Bailey JE, Wan JY, Mabry LM *et al.* Does health information exchange reduce unnecessary neuroimaging and improve quality of headache care in the emergency department? *Journal of General Internal Medicine* 2013;28:176–83.

17 Lang E, Afilalo M, Vandal AC *et al.* Impact of an electronic link between the emergency department and family physicians: a randomized controlled trial. *Canadian Medical Association Journal* 2006;174:313–18.

18 Rudin RS. The litmus test for health information exchange success: will small practices participate? Comment on 'health information exchange'. *Archives of Internal Medicine* 2010;170:629–30.

19 Ross SE, Schilling LM, Fernald DH, Davidson AJ and West DR. Health information exchange in small-to-medium sized family medicine practices: motivators, barriers, and potential facilitators of adoption. *International Journal of Medical Informatics* 2010;79:123–9.

20 *Meaningful Use: policymaking, rules, & regulation.* www.healthit.gov/policy-researchers-implementers/meaningful-use (accessed 5 December 2012).

ADDRESS FOR CORRESPONDENCE

Jason S Shapiro
Associate Professor of Emergency Medicine
Department of Emergency Medicine
One Gustave L. Levy Place, Box 1620
New York, NY 10029–6574
USA
Email: jason.shapiro@mssm.edu