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Enhancing Patient Care and Care Coordination using Event Notification Systems

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ABSTRACT

Event notification systems (ENS) are being deployed to provide timely alerts to participating providers when their patients are being admitted, discharged or transferred (ADT) from participating hospitals. Hospitals and health information exchanges (HIE) are implementing ENS in an effort to reduce costly hospital readmissions and to improve the overall quality of patient care through improved care coordination. Today, there are numerous ENS actively facilitating care coordination across the country. For those participating providers and hospitals, coordination has been significantly improved and hospital readmissions have been reduced. Furthermore, patients and clinicians report improved patient care and care coordination, and report higher levels of patient satisfaction. Despite reported success, the application and implementation of ENS vary across the country. Some of the variability stems from the challenges that are inherent to the design of the ENS. These challenges, discussed herein, require careful consideration in order to fully realize ENS benefits.

KEYWORDS

ADT Messaging, Cost Containment, DHIN, Electronic Health Records, ENS, Florida HIE, Health Information Exchange, HIE, Hospital Readmissions, MiHIN, Patient Matching, Patient Panel

EXECUTIVE SUMMARY

Event notification systems (ENS) are being deployed to provide timely alerts to participating providers when their patients are being admitted, discharged or transferred (ADT) from participating hospitals. Hospitals and health information exchanges (HIE) are implementing ENS in an effort to reduce costly hospital readmissions and to improve the overall quality of patient care through improved care coordination. Similarly, accountable care organizations (ACO) and health systems are also utilizing private information exchange networks to deploy ENS in pursuit of the same benefits.

Today, there are numerous ENS actively facilitating care coordination across the country. For those participating providers and hospitals, coordination has been significantly improved and hospital readmissions have been reduced. Furthermore, patients and clinicians report improved patient care and care coordination, and report higher levels of patient satisfaction. Despite these pockets of success, the application and implementation of ENS varies widely across the country. Some of the variability stems from the challenges that are inherent to the design of the ENS. These challenges require careful consideration in order to fully realize ENS benefits. Some of these challenges include:

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1. Minimizing the time required to deliver notifications to participating providers
2. Optimizing the patient matching algorithms to ensure accurate patient identification
3. Utilizing the right delivery methodology to trigger timely response from providers
4. Balancing the cost - benefit inequity that drives non-ideal system designs
5. Ensuring all patient populations are included and can benefit from the ENS service

ORGANIZATION BACKGROUND

Reducing unnecessary healthcare utilization and the resulting costs remain a top national priority. CMS studies indicate that the national healthcare expenditure will exceed 2.5 trillion dollars by 2023, representing 19.3% of GDP, up from 17.2 percent in 2012 (CMS, 2013). Since the passage of the Affordable Care Act in 2010, cost containment efforts emphasize improving the coordination of care with the specific goal of reducing hospital readmission rates and improving the overall quality across the continuum of care. Consequently, hospitals and physicians are challenged with keeping patients from being readmitted or face significant financial penalties (Rau, 2014).

Today's fragmented healthcare delivery system produces numerous challenges that obstruct the pursuit of delivering high quality, cost-effective healthcare (Shortell, Gillies, Anderson, Erickson, & Mitchen, 1996). Today it is possible for patients to be treated by different care providers within the same geographic region and for these providers to be completely unaware of the care provided outside of their practice. This regrettable lack of coordination is not limited to smaller facilities such as private practices and small clinics. Care coordination between hospitals and between hospitals and private practices is also lacking. For example, it is not uncommon for primary care providers to be unaware of a patient's hospitalization until the patient reports the event afterwards (Arora, et al., 2010). This report may take place in a week, months or years after discharge. One study revealed that one-third of primary care providers never learn about their patient's hospitalization (Kazzaz, 2014).

The 30 days immediately following discharge is a critical time for the patient. If the necessary follow-up is not provided to ensure compliance to the treatment plan, recovering patients can become susceptible to complications and illness, resulting in worse health outcomes and costly hospital readmissions (Kirsch, Kothari, Ausloos, Gundrum, & Kallies, 2015). A recent study showed that when patients are not seen by their primary care providers within 30 days after discharge, they have a ten-fold increased risk of readmission (Moran, Davis, Moran, Newman, & Mauldin, 2012). Additionally, timely notification of emergency room visits can allow primary care providers to share valuable information with the hospital while the patient is still in the ER (Bae, et al., 2012). This timely sharing of information could assist with the hospital's evaluation and treatment of the patient, thereby improving the patient's prognosis and potentially avoiding complications that lead to readmissions (Hernandez, et al., 2010).

Another domain that can be improved by ENS is patient satisfaction. The dimensions of quality from a patient satisfaction perspective can be defined by effective communication, care coordination and transition (Noest, Ludt, & Klingenberg, 2014). Since those specific dimensions are facilitated by ENS, it is anticipated that ENS will increase patient satisfaction by enabling real and perceived improvements in communication and patient care coordination.

SETTING THE STAGE

Improving care coordination and reducing hospital readmission rates is challenging. Fortunately, there are a number of event notification systems actively in use today that are producing measurable benefits. For example, the Delaware Health Information network "DHIN" deployed its event notification system in 2013 and currently has participation from all hospitals in Delaware. Delaware was the first state to establish and operate a state-wide health information exchange (Dullabh, Hovey, & Ubri, 2013).

DHIN has experienced success in reducing hospital readmissions and the improved care coordination has also lead to patients reporting increased satisfaction (Innovations.ahrq.gov, 2013).

When patients are admitted, discharged or transferred from any Delaware hospital, DHIN receives alerts from those hospitals and in turn, notifies the participating physician practices of the events. These physicians are then able to contribute to the care the patient is receiving in the hospital (Moore, et al., 2012). The participating physicians, who are now informed of their patient's status, are better equipped to follow-up to ensure effective continuity of care upon discharge. In this scenario, the ENS resides within DHIN and not at the hospital. Although the hospitals provide the ADT alert to DHIN, it is the DHIN ENS that collects and manages the patient list and notifies the participating providers when a match is detected (DHIN, 2015). Similar event notification systems exist throughout the country, although their design and application vary.

The aim of improving care coordination and cost reduction has led to the creation of accountable care organizations (ACOs); a healthcare network comprised of primary care providers, specialists and hospitals that work together and are collectively responsible for providing high quality care at reduced costs (Fisher & Shortell, 2010). ACOs rely on highly effective care coordination to achieve cost savings. Thus, ENS is central to ACO success. Although notifications are known to produce workflow challenges and disruptions, discussed later in detail, event notification services are in increasingly high demand due to the extensive advantages they produce (Moore, et al., 2012).

Event Notification Systems Vary

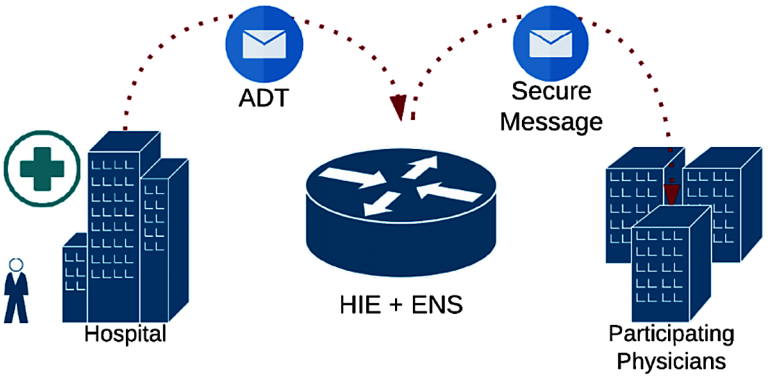
The notification process must complete two (2) distinct events to be successful in improving care coordination and patient care. The first event is the prompt notification to participating providers that their patient has been admitted, discharged or transferred from the hospital. The second event is to trigger timely and effective responses from those care providers to effect positive outcomes for their patient. In other words, event notification alone is not enough (Morris & Bhasker, 2012). It becomes apparent that the critical component of this process is the care providers' ability to timely and effectively respond to the notification. The event notification itself acts as a trigger to initiate responses. Unfortunately, the ENS itself has little control over when the participating provider actually receives the notification and has practically no control over if and how the provider will respond (Morris & Bhasker, 2012).

With respect to originating the notification, the ENS is responsible for collecting and managing a list of patients for whom participating providers are interested in receiving ADT notifications. This list is often referred to as simply a "patient-roster" or "patient-list" or "patient-panel" and often includes the details of who to notify in the event a match is detected, the most up to date information regarding the patient and details regarding the event that triggered the notification (Harris, 2015). When the hospital processes an ADT event, the ENS will check the patient against the patient panel and if a match is detected, a notification is sent to the designated party, often the physician practice (Morris, et al., 2014).

For some implementations, ENS may be operated entirely by the hospital. This means that the hospital is responsible for maintaining the roster and for generating the event notification. In other scenarios, as previously described with the Delaware Health Information network and with the Florida Health Information Exchange "FLHIE," the ENS is operated by and on the HIE infrastructure and not that of the hospital (Harris, 2015). This still requires ADT messages to be sent from the source hospital to the HIE. An illustration of this type of configuration is displayed in Figure 1.

When discussing ENS, we typically refer only to the portion which operates to produce the first event, which is the production and delivery of an appropriate notification. However, to effect positive change with regards to producing benefit to patient care and care coordination, we must also consider the second event, which is the effective and timely actions taken by the participating provider after receiving the notification (ONCHIT, 2013). Since delivery method impacts how

Figure 1. Example of HIE operated ENS



providers may respond, it is imperative to consider the delivery methodology that is used to notify participating providers.

Delivery Methods

How providers receive their notifications will impact their ability to effectively respond. For example, one method of notification is to send the provider an email or text message notifying them that an ADT has occurred for one of their patients. Due to HIPAA regulations, this message cannot contain any protected health information (PHI) and can only inform the provider that an event has occurred. The providers then must access their secure mail server to retrieve the details of the notification (Morris & Bhasker, 2012). In other words, the provider has received a notification of a secure message (ONCHIT, 2013). This provider must then log into their secure mail server using their credentials to read the secure message. To be able to respond effectively, this provider would likely need to log into their EHR and access the patient's chart or pull the patient's paper-based records to review. This particular notification scenario illustrates a less efficient workflow as it requires numerous attention disrupting and time consuming activities (Weigl M., Muller, Vincent, Angerer, & Sevdalis, 2012). Providers who are busy with patient care cannot afford this type of workflow interruption (Weigl M., Muller, Zupanc, Glaser, & Angerer, 2015). In combination with other notifications and distractions already present in a busy practice, e.g., refill requests, incoming lab results, telephone calls, and internal office communications, care providers can quickly become inundated with notifications and may start to selectively respond or choose to ignore notifications altogether.

A better, more effective outcome can be achieved using notifications between integrated or interfaced systems. Providers who have electronic health record systems that are configured to fully accept and process ENS messages, or in scenarios where sender and receiver have both adopted messaging standards such as those established for continuity of care documents (CCD), can avoid many of the workflow and attention disruptions previously mentioned (Kazzaz, 2014). In this scenario, a secure channel is established between the ENS and the EHR via a virtual private network or other means of secure communication (ONCHIT, 2013). The secure message is received by the EHR, which processes the message to identify structured data, e.g., patient's name, DOB, address, source facility, destination facility, event time and date and the reason for ADT, and then routes the message through the EHR to the appropriate care provider or case manager (AHCA, 2013). Some systems will indicate a message exists for the providers review using visual cues. In this case, the provider simply needs to read the secure message. Since they are already securely logged into their EHR, they need only open the notification and the patient's medical history is automatically accessed, eliminating the need to jump between secure message systems and EHR systems (ONCHIT, 2013). This method is more streamlined and makes use of EHR automation, minimizing provider fatigue and frustration.

Case Description

One successful deployment of ENS was designed by Baltimore-based Audacious Inquiry to augment Maryland's HIE, the Chesapeake Regional Information System for our Patients (CRISP), and Delaware's DHIN. This ENS was not part of the original health information exchange design. According to CRISP CEO David Horrocks, the organization began considering how to control admission-discharge-transfer (ADT) notifications in 2011, and by August of 2012, the ADT information was being collected from all 46 Maryland hospitals. The service is paid through fees from hospitals and payers, which are collected through a state assessment. (Health Data Management, 2014).

One challenge is getting the patient list up front from the primary care physician, rather than relying on the data collected at the hospital. The service is used mostly by primary care providers (PCPs) and care coordinators at health plans, with 5,000 alerts per day and approximately 3 million people in the patient roster (Health Data Management, 2014). In addition, care coordinators are employed at hospitals to scrutinize ED visits of recently discharged patients. The Johns Hopkins Community Physicians in Maryland have succeeded in integrating ENS into their patient workflow. Utilizing CRISP, Johns Hopkins Community Physicians have integrated the notifications across their five hospitals, community based health centers, and specialty and primary care offices in the Baltimore/DC area. The service currently sends over 330,000 notifications per month to PCPs, care coordinators and other players responsible for patient care and has succeeded in decreasing readmission rates for patient seen by a PCP within seven days compared to patients not being seen by a PCP within seven days (HI Stalk Webinars, 2014). Interestingly, CRISP has found that physicians prefer not to be notified via mobile phone throughout the day, but prefer instead to receive batch notification at specific times during the day for optimal care coordination (Health Data Management, 2014).

To entice PCPs to participate in ENS, the CRISP website offers the following benefits (CRISPhealth.org, 2015):

- Real-time notification of your patients' hospital visits (admit, discharges, or ER) for active patients in your practice
- Free to any provider affiliated with a participating hospital
- Proactively coordinate your patients care and schedule any necessary follow-up treatment or visits
- In conjunction with the CRISP query portal, review medical records from your patient's hospital stay

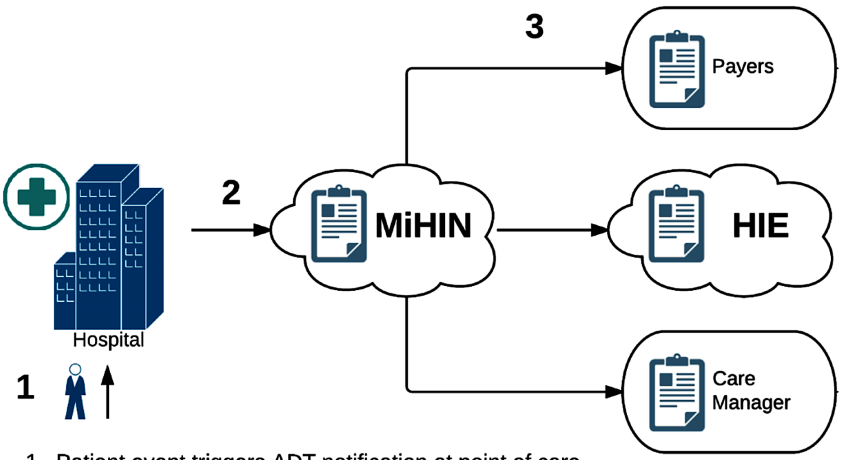
Another successful deployment of ENS is the Michigan Health Information Network (MiHIN), which provides ENS in the form of (ADT) notifications. The system notifies those involved in an "active care relationship," usually the primary care physician or specialist familiar with the patient's case. This service uses a "push exchange" meaning that the information is sent through the HIE's secure messaging system to the patient authorized provider(s). As noted previously, improved coordination of treatment and patient outcomes, along with cost savings are the anticipated benefits of this information sharing system (MiHIM, 2015) (see Figure 2).

Current Challenges

For ENS to enhance patient care and care coordination, timely notification of care providers is required. The value of ENS is the facilitation of improved care coordination, and this is entirely contingent on participating providers receiving the notification as quickly as possible and their ability to respond effectively. There are a number of challenges in achieving quick event notification delivery, discussed below.

1. Minimizing the time required to deliver notifications to participating providers
2. Optimizing the patient matching algorithms to ensure accurate patient identification

Figure 2. Flow of information in the MiHIN



3. Utilizing the right delivery methodology in order to trigger timely response from providers
4. Balancing the cost - benefit inequity that drives non-ideal system designs
5. Ensuring all patient populations are included and can benefit from the ENS service

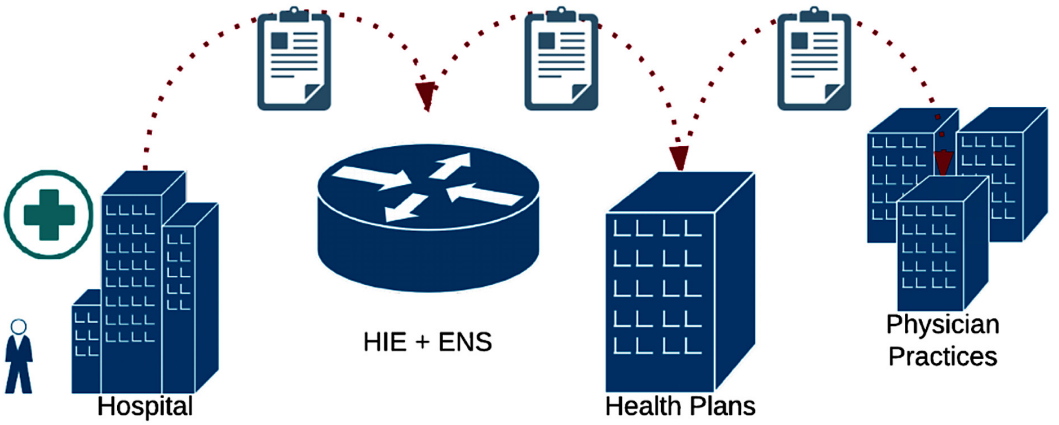
Minimizing Delivery Time

Application of ENS varies across implementations but all have inherent challenges. One of the greatest challenges is to minimize the amount of time required to deliver notifications to participating providers. Although many ENS are designed to push notifications in "real-time," the actual push alert may not occur immediately following an ADT for a number of reasons. For example, if a hospital does not immediately send its ADT to the HIE's ENS, this causes a delay with the event detection and subsequent triggering of a notification (Morris & Bhasker, 2012). This transmission delay could be minutes or hours depending the cause of the source delay. Furthermore, once the transmission has been completed by the ENS, it is still subject to a number of variables that could delay receipt of the message by participating providers. A delay in the network infrastructure, such as congestion, could delay transmission (Welzl, 2005). If notifications are being sent to mobile phones as text messages, then any delays with cellular networks could inhibit timely delivery. Physicians agree that timely notification is critical. In an independent survey, participating providers remarked that "sooner is always better" and that "real-time would be best." (Altman, Shapiro, Moore, & Kuperman, 2012)

A delay can occur if the ENS does not send notifications directly to participating providers but instead sends to a third party. Often, health plans are the third parties involved in ENS and directly receive the messages from the ENS. This is the case with the FLHIE (Florida-HIE, 2015). In this scenario, the health plans act on behalf of the care provider, who in turn notifies its participating providers of the hospital's ADT message. Although this does not automatically result in significant delays in transmission when compared to configurations where the hospitals notify providers directly, it does introduce opportunities for delays and errors as it requires the transmission to pass through and be processed by additional information systems. An illustration of this type of configuration is displayed in Figure 3.

In a situation where the hospital ENS notifications are being relayed through a health plan prior to being sent to care providers, the health plans infrastructure must be capable of timely processing

Figure 3. ENS notifies health plan who in turn notifies primary care physicians



the message for re-transmission. Any delay in receiving, processing, or resending of the message would delay receipt by the participating provider. Generally speaking, any introduction of additional systems and processing inevitably introduces delays. Additionally, in situations where resources are not capable of real-time processing and transmission, batch processing may be utilized to reduce resource demands. This means that the real-time notification of the ENS may be reduced to scheduled batch transmissions.

Furthermore, participating providers may prefer batch notifications as opposed to real-time notifications. As previously mentioned, real-time notifications may be disruptive to the provider's workflow. Offering batch notification allows participating providers to receive notifications at a time that is convenient for them (Morris & Bhasker, 2012). Thus, real-time notifications produced by a hospital or HIE ENS can be delayed by any external processing, network congestion or batch scheduling established by the third party or by the participating provider.

Optimizing Patient Matching Algorithms

A critical component of the ENS process is the patient matching algorithm. This algorithm is responsible for determining whether or not the patient at hand matches any of the patients contained within the patient panel (Purkis, Morris, Afzal, Bhasker, & Finney, 2012). This determination is the basis for triggering the event notification. Since each ENS must cater to the unique needs of its stakeholders, community and patient mix, patient matching algorithms can vary considerably (Morris, et al., 2014). However, the goal is the same: to be able to make a determination quickly, with minimized human intervention and to minimize to some pre-established threshold the number of false positive and false negative events.

A false positive event occurs when an incorrect match is found. A false positive would result in an unnecessary and incorrect notification being sent to a participating provider that their patient is experiencing an ADT event, when in fact that is not the case (AHIMA, 2014). Although this may appear inconvenient for the provider and seemingly harmless, there are serious implications (Morris, et al., 2014). The opportunity to correctly identify the patient may be lost. In this scenario, the correct event notification may not be triggered, thus the patient at hand and his/her participating providers will not benefit from the ENS. Therefore, it is imperative that patient matching algorithms do not produce unacceptable levels of false positive events. Conversely, a false negative event occurs when a correct match is not identified. Similar to the implications of a false positive event, a false negative event would cause the ENS to lose the opportunity to notify the correct participating provider, thereby eliminating the opportunity to benefit the patient and provider. False positive events also create a

situation where incorrect clinical data from another patient may be introduced, creating an opportunity for incorrect or potentially dangerous courses of treatment. For this reason, false positive events are deemed to present a greater patient safety concern than false negatives (Morris, et al., 2014).

Patient matching errors occur for a number of reasons. One source of error is the variation in patients' names. For example, John Smith versus Jonathon K Smith versus Jon Smith. This variation can be due to the spelling but also due to how the name was captured into the system. If the middle name is captured as part of the first or last name field, and in the patient panel it is stored differently, this could also cause incorrect matching (AHIMA, 2014). Another significant cause of mismatch is missing or incorrect information. In this scenario, accurate patient matching is compromised as there are errors in the data. Additionally, and although rare, coincidence can occur. Coincidence describes a situation where two or more patients have very similar or the same information, such as John Smith with the same date of birth. Lastly, errors can be caused by having too many or too few identification criteria. A system with too many identification criteria may be too selective, and may result in a high incidence of false negatives. Conversely, a system with too few identification criteria may result in a high incidence of false positives. In either case, both have serious implications as previous discusses. ENS designers must routinely fine tune their patient matching algorithms to optimize its speed and accuracy. (Morris, et al., 2014).

Utilizing the Right Delivery Method

Delivery method is also a factor that heavily influences the timely delivery of ENS messages. Ideally, providers will have electronic health record systems that can fully support inbound messaging and are configured to effectively process and manage the message. It is not surprising then, that surveys show that physicians request to receive notifications in the form of a message directly within their EHR (Moore, et al., 2012). Unfortunately, this level of integration is not widespread. Most providers do not have fully interoperable electronic health record systems. Although the national movement towards EHR adoption is growing, as of 2014 fewer than half of all physicians in small practices have implemented an EHR (Furukawa, et al., 2014). Furthermore, EHR vendors need to adopt communication standards and develop efficient workflows to facilitate seamless management and integration of ENS messages (ONCHIT, 2013).

Balancing Cost – Benefit Inequity

It is expected that ENS would reduce healthcare utilization, meaning lower costs for the health plans (Tzeel, Lawnicki, & Pemble, 2011). Also, health plans can benefit from the additional, up to date data on their members. Therefore, the value proposition for health plans is strong. Health plans also have resources necessary to establish connections and interfaces with ENS. Currently, health plans represent a significant funding source for active ENS (Morris & Bhasker, 2012). More importantly, patients benefit from ENS as well. The improved care coordination and patient care facilitated by ENS produces improved outcomes (Moran, Davis, Moran, Newman, & Mauldin, 2012). Unfortunately, patients are generally not willing or able to fund additional health expenditures, although they may be doing so unknowingly through their health premiums.

This produces a cost-benefit inequity. In the ideal situation, ENS would send notifications directly to participating providers who then can effect positive outcomes for their patients without delay. This would produce the maximum patient benefit as there is minimized delay in ENS messages. Unfortunately, this is not always the case. The configuration of ENS can be influenced by the payer. In many cases, the payers are the health plans. Therefore, in health plan funded ENS systems, event notifications are often sent only to the health plan and not directly to participating providers. ENS stakeholders need to strike a balance to ensure that their ENS is designed and operated in a way that can ensure effective notifications and timely responses by participating providers, while maintaining a sustainable business model (Morris & Bhasker, 2012). This has certainly proven to be a challenging endeavor.

Do Not Exclude Patients

One consequence of the cost-benefit inequity is that it creates non-ideal ENS designs where ADT messages are sent to health plans and not directly to participating providers. This creates another challenge in that self-pay patients are excluded from the patient panels and therefore cannot benefit from the ENS service. Since health plans create their patient panels based upon their membership, patients who are not a member of a health plan will not be included in the list and therefore excluded from EHS services (Florida-HIE, 2015). With over 40+ million uninsured Americans, this creates a large population that is excluded by ENS services.

CONCLUSION

Event Notification Systems are central to current efforts to improve care coordination and patient care. ENS has been attributed to producing real benefits to include reducing costly hospital readmissions and increasing patient satisfaction. While their number are steadily growing, the full benefit of ENS has yet to be realized. Each community must carefully consider how it will design and implement its own ENS. Among the many challenges faced by ENS stakeholders will be how to optimize their patient matching algorithms and balancing the cost-benefit equation while operating an ENS that is inclusive of all patients, to include self-pay patients.

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