Information Architecture, and Innovation

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With the availability of data from electronic health record systems, nurse leaders are in a position to innovatively apply evidence-based medicine (EBM) into the clinical setting, but there are roadblocks that can only be addressed by domain experts with operational technical skills. This article discusses some of the roadblocks encountered and the skillsets nurse leaders should be looking for to efficiently leverage electronic health system data for EBM initiatives.

With the widespread use of electronic health records (EHRs), the new frontier of innovation is data-driven. Data are the core component of evidence-based medicine (EBM). Electronic health record systems provide nurse leaders with the opportunity to analyze large clusters of data in their efforts to improve managed care. To drive innovation that empowers EBM, you need to look for opportunities to improve data identification, accuracy, and accessibility. Aggregation of large longitudinal "Big Data" datasets has proven to be difficult due to interoperability constraints, but smaller-scale localized data can shed light in many areas such as quality metrics (e.g., falls, catheter-associated urinary tract infections, central line-associated bloodstream infection, or pressure injuries), inventory control, staffing, patient outcome, social determinants, or infection control. But even in these smaller localized initiatives, data extracted from the electronic health record system may not be useable. Large or small, health care datasets are often unusable for a number of reasons:

KEY POINTS

- **Qualified nurse informaticians can shorten the time necessary to acquire data for evidence-based initiatives.**
- **If you want to make your data more trustworthy, look for opportunities to engage your informaticians in interface design, data governance, and custom application development.**
- **Nurse informaticians need 3 core operational skillsets to effectively work with data: programming, database design, and data analysis.**

1. Sparseness: not enough data to make a decision.
2. Data stored in site or clinic specific free flowing text fields that are loosely identified and do not contain standardized glossary. For instance, glossary overlap between nurses and physician notes has been shown to be as low as 26%.[1,2]
3. Lack of access to information technology (IT) resources capable of extracting, cleaning, and providing data, or inability to translate what nurses want into things the IT department can understand.
4. Lack of data analysis resources.

The purpose of this article is to describe strategies to enable moving an EBM idea to the implementation stage when faced with these obstacles.

IT'S ALL ABOUT INFORMATICS

The National Library of Medicine defines medical informatics as, "The field of information science concerned with the analysis, use and dissemination of medical data and information through the application of computers to various aspects of health care and medicine. Medical informatics studies information, data, and knowledge—their storage, retrieval, and optimal use for problem-solving and decision-making within healthcare."[3] Informaticians are specialists who use tools to manage information in some real-world field.[2] At the core, medical informatics is applied computer science applied to a specific domain, and "use of technology" has always been stated as part of the definition of the nurse informaticist.[4] If you have informaticians available to you, there are some areas where you can engage them to ensure nursing data are identifiable, comprehensive, and trustworthy.

INTERFACE DESIGN AND DATA ENTRY INTO ELECTRONIC HEALTH RECORD SYSTEM

Nurses report low satisfaction and multilevel concerns with electronic health records.[5] It is important that nurses have a presence in interface design so the electronic health record system can better serve the needs of nursing.[6] If new fields are entered into the EHR, there needs to be oversite from an informatician who is familiar with nursing practice and documentation needs[7] to ensure the EHR better supports nursing. You can make this happen by making sure the informatician is integrated with the IT group in a way that allows the informatician to have editorial authority over the interface design that optimally supports the requested charting function with an interface that focuses on providing a selectable glossary, rather than free-text fields. This is where nursing domain knowledge plays a critical role.

NURSING DATA STEWARDSHIP AND DATA GOVERNANCE POLICY AND PROGRAMS

It is estimated 80% of health care data are unstructured.[8] As cross-disciplinary workgroups are formed, dedicated nurse informaticians need to play a key role in standardizing language so interoperability obstacles are minimized.[9] Because a large amount of nursing data are contained in flowsheets, it is important to make sure every effort is made to make metadata and coding information a part of the flowsheet in a way that optimally supports retrospective analysis. For example, some nursing care plans are designed with a hierarchy of menu selections commonly modeled to the concept hierarchy found in coding systems such as Nursing Interventions Classification (NIC)/Nursing Outcomes Classification (NOC). Unless effort is taken to store a crosswalk table mapping EHR menu codes to those represented in the coding standard, reverse engineering of EHR menu hierarchy labels is required to analyze concepts pulled out of care plans. This can be a laborious, error-prone process that involves looking at a lot of individual different care plans. You can make this happen by making sure the nurse informatician is included in any data governance initiatives as a proxy for nursing within your organization to make sure any nursing specific terms that are presented in the EHR using a standardized glossary derived from any coding systems have links to something (e.g., a hidden field or database table) that is populated with the actual codes for those concepts.

CAPTURING INFORMATION OUTSIDE OF THE ELECTRONIC HEALTH RECORD SYSTEM

Because most care facilities use electronic health record systems supplied by outside vendors, their IT departments are often only able to focus on implementing and maintaining the EHR's information architecture rather than augmenting it with new features to improve provider effectiveness.

There will be instances where modifying the electronic health record with flowsheets designed to capture information will not work. Sometimes this is due to the information not being present that needs to be charted. Other times when the information is there, the designed methods to chart the assessment may obtrusively create too high of a cognitive load on clinicians. For example, in an attempt to better chart pressure injury incidents when they happened, we added flowsheets enabling nursing staff to chart pressure injury specifics when they occurred. However, the nursing staff did not use the flowsheets correctly. The prior practice was to do manual pressure injury surveys of patients each quarter. It required 30 or more nurses moving through the hospital and examining patients to chart pressure-injury specifics on paper forms. It required manual entry and translation for analysis and reporting, a process that has legibility and translation errors,[10,11] regardless of the type of data. We saved money and removed data entry errors by building HAPI (Hospital Acquired Pressure Injury), a custom application to streamline our quarterly surveys using iPads to chart each patient's pressure injuries with an interface customized for the task. Survey nurses select injury locations by touching the corresponding location on a human figure pictured on the iPad, then selecting options to provide more specificity about the wounds (*Figure 1*). The unit selection screen also provides real-time survey status information (*Figure 2*). Because the data are properly identified and comprehensive, custom reports are automatically generated at the conclusion of the survey, and we automated the translation and transmission of the data to the appropriate national reporting agency, which, because we are an ANCC (American Nurses Credentialing Center) Magnet®-designated hospital, was the National Database of Nursing Quality Indicators (NDNQI).

START WITH DATA GOVERNANCE—THE BIGGEST BANG FOR YOUR BUCK

Data governance is the Achilles' heel of a retrospective data analysis. In a survey conducted by the American Health Information Management Association in 2017, only 53% of the hospitals had any data governance programs in place. Of those, only 14% had organization-wide programs. Technically, it is possible to simultaneously collect, aggregate, and process lots of data about all possible confounding variables associated with any specific health issue to gain new insight regarding the best possible treatment or care options in a very short space of time. However, the lack of data governance and poor information system design severely limit our capacity to do so. True interoperability and big data analytics cannot be achieved without a solid foundation of data governance.[12,13]

Data governance is an organization-wide framework for managing information throughout its lifecycle while

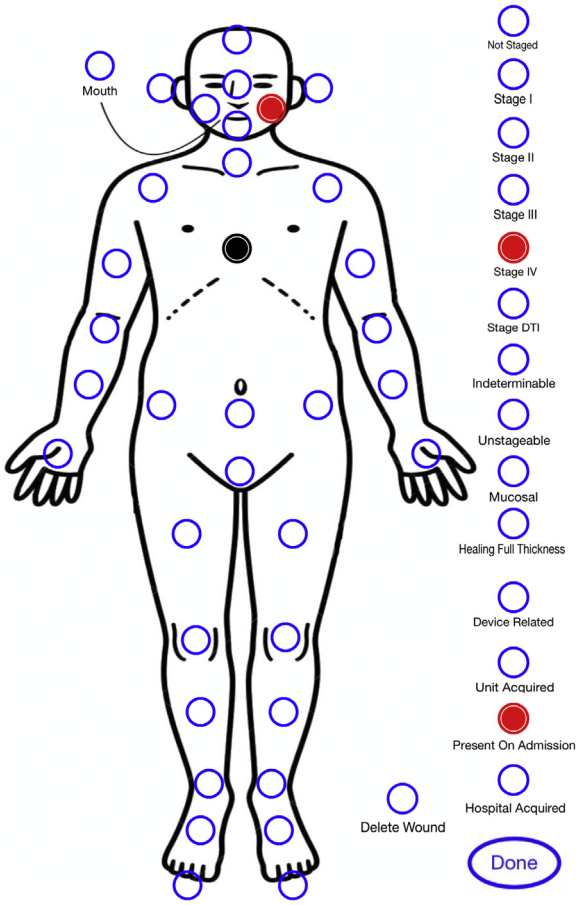

Figure 1. HAPI interface for charting pressure injury locations.

supporting an organization's strategy, operations, regulatory, legal, risk, and environmental requirements.[14] Inherent threats to data governance programs include: weak executive sponsorship; inadequate funding; organizational politics; poor collaboration of information technology staff with users; and suboptimal user engagement, support, and training.[15,16]

A few years ago, I participated in a data pull looking for patients in the medical intensive care unit (MICU) who had a specific diagnosis, were taking specific drugs, and who were put into the "prone" position as part of their care plan. On the surface, this seemed like a pretty straightforward data pull from Clarity, which is Epic's research data warehouse. Our instance of Clarity was updated every 48 hours from the operational Epic system.

What we found startled us. The term "prone" was nowhere to be found in the data representing patient position. However, there were more than 200 terms for patient position in our EHR, many of which–while requested–were never used. This prompted us to look at all of the terms that had been added as selection items in our flowsheets. We found that although we had happily placed any requested new terms in the interface, of 22,000 terms, less than 11,000 had ever been used. This is the case in most hospitals, regardless of the EHR vendor. A study at Partners Healthcare System, an integrated health care system in the Boston area, categorized 4188 data elements into 13 categories. Counts for the top 3 categories were: 1081 wound documentation data elements; 1440 tube and drain–related data elements; and 374 vital sign data elements. Additionally, 127 same or similar "alcohol use" data elements had been created. From a longitudinal perspective, Partner Healthcare found they had 28,400 data elements in 2007; the total number increased 2.2 times within 3 years to 62,600 data elements in 2010. Data elements continued to grow so dramatically in the following years, this phenomenon was coined the uncontrolled replication of "cancerous" data elements.[17]

The concept of pain is another good example, one that is important to nurses. Discussions with providers in other organizations echo a number of studies at our own hospital: we do not have standardized language for pain assessment, measurement, and outcome.

When electronic health record systems are implemented, costs often temporarily rise, providers suddenly have to attend to the "third person in the room,"[18-21] and there is increased provider burnout.[22-25] Many hospitals witnessed an increase in attrition due to providers selecting early retirement rather than learn to use this new technology. More often than not, if a new term or new field was requested in the EHR system, the group that oversaw the function was happy to accommodate the request; they did not want to increase the frustration level by imposing a process that made people wait for a standardized glossary to come down the pipeline after a request was made. The transition to the electronic health record system was increasing the cognitive load enough as it was.

Now, we have data warehouses containing many names for the same concept with poor or nonexistent data dictionaries or metadata. Nursing concepts have historically been poorly accommodated in the EHR, thus nurses are the biggest users of ad hoc data entry points. As a result, when nursing data are required for analysis in clinical or research purposes, it is the most difficult data to locate and verify. Because of this, some records pulled for data analysis and reporting should not be there, and some records are excluded that should be. If this is prevalent enough, you simply can't trust the data.

If you want the most bang for your buck, have your informaticians look at existing glossaries and work to standardize language at the start of any major project where EHR data will be used in the assessment. Utilizing the training and expertise of informaticians gives you the best chance of aggregating information that is identified and retrievable moving forward in a way that not only more effectively empowers your EBM initiatives, but will

Figure 2. HAPI interface for unit selection and survey status.

also optimally meet any interoperability requirements for big data–fueled decision support moving forward.

SOME THOUGHTS ON NURSE INFORMATICIANS: ONE SIZE DOESN'T FIT ALL

If the word *informatics* is in the title of a degree, there are some fundamental skills the curriculum should teach regardless of whether it is a nursing course or not. If you look under the hood of many nursing informatics programs, you will find curricula that do not appear to teach any of the hard skills needed, and course titles with "informatics" in them are not much more than existing courses with some additional informatics concepts sprinkled in. Often, it is because faculty do not have the necessary operational skills themselves, so they cannot teach them. As a result, nurse informaticians may lack the basic skills necessary to work with data stored within the EHR or to communicate with people who do.

Of the many skills an informatician may have, there are 3 that you should look for:

1. Operational database skills are absolutely necessary

Applying informatics solutions to decision making requires a fundamental core skill: the ability to extract and manipulate information from a database.[26,27]

If the nurse informatician is going to be part of an effort to augment the user interface of the electronic health record system to allow more comprehensive nursing documentation, having a working knowledge of database systems will give them insight that will empower them to be able to add additional data capture fields that are truly identified.

For any data governance program, having a working knowledge of database systems is the best way to empower the nurse informatician to authoritatively communicate the requirements of nursing in a language IT people can understand.

When you need custom, task-specific applications that augment the electronic health record system, having working knowledge of database systems is critical to having nursing data stored in a way that can readily support automated reporting, translation, and insertion of data into existing EHR systems.

Data-mining algorithms applied to health care datasets are beginning to impact EBM, and comorbidity is one of the areas of study becoming increasingly important as our population ages. Databases are the foundation of data mining.

2. Knowledge of at least 1 general-purpose programming language

Most of the work necessary to prepare data for analysis involves clean-up and translation. If the informatician is capable of writing small programs that can automate many of the steps, the task is simplified and much easier to do. This training also teaches the informatician to identify and integrate existing programs and create libraries of programs that can be reused and maintained by other people as necessary.

3. Ability to use a statistical package and an understanding of data-mining techniques

The informatician should be able use a statistical package to analyze data and present the results. Many nurse informaticians will have some level of experience because most nursing programs require some form of statistics. Understanding data mining techniques can be useful when analyzing very large multivariate datasets where identifying data correlation needs to begin with cluster analysis. An example would be datasets that represent multiple morbidities or any true big data datasets.

CONCLUSION

Informatics concepts, properly applied to nursing data, can be a powerful tool for nurse leaders who seek to prioritize EBM initiatives. Nurse informaticians who can combine their domain expertise with the ability to write programs, operate databases, and analyze data can mitigate many of the obstacles that mire down the acquisition, translation, and analysis necessary to use data that is authoritative and focused on the needs of the nursing clinician wanting to improve managed care. It is important you look for nurse informaticians with these skills and make sure you properly qualify them. Operational database skills are absolutely necessary, so find a database analyst who can vet any potential hires. A good place to look for a database analysis is within the IT department that maintains the EHR for your organization.

A FINAL THOUGHT

Because 80% of an informatician's time is spent locating, extracting, cleaning, and translating analogous terms in the EHR to a standardized glossary at the beginning of any project, you should look for every opportunity to remap those terms back into the EHR as part of any data governance initiatives within your institution. This pays huge dividends by removing these steps if those data elements ever need to be extracted from the EHR again, and over time, you can begin to automate the data analysis of multivariate, complex datasets through an interface—opening the doorway for creation of real-time decision support tools that can be used at the point of patient care.

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