The knowledge work of nurses is data intensive. Today, healthcare organizations use multiple, complex information systems, technology, and networks to manage clinical, financial, and claims data that must be integrated in a meaningful way. This sets the stage for the big data challenge. The ability to integrate disparate data and analyze these data to better understand outcomes is no small task. Having access to the right information at the right time to support clinical decisions is essential in planning and providing the right care for patients. All clinicians need real-time information to make timely, critical, clinical decisions.

Understanding big data is a priority for nurses, as the profession aims to provide the best possible care to patients. Capturing healthcare data in a structured way helps build the foundation for accurate, reliable information regarding a patient across multiple systems and settings of care. Using data elements consistently and reliably also allows for information to be collected once and reused for multiple purposes, including outcomes measurement, practice level improvements, surveillance, population health, research, and decision support.1 The use of big data technologies can help nurses and other healthcare providers improve care quality, optimize outcomes, and reduce healthcare costs.2

Defining big data
The McKinsey Global Institute defines "big data" as "datasets whose size are beyond the ability of typical database software tools to capture, store, manage, and analyze."3 While the data that comprise the elements of health information continue to expand in volume and complexity, the crux of big data is within the ability to analyze and use it in a meaningful way for continual improvements.2

The movement from paper-based systems to electronic health record (EHR) systems is enabling nurses to consider the potential power of big data. According to the Institute of Medicine, an EHR system has several key capabilities:4
- It is a longitudinal collection of electronic health information for and about persons.
- It provides immediate electronic access to person and population-level information by authorized users.
- It provides knowledge and decision support to enhance the quality, safety, and efficiency of patient care.
- It supports efficient processes for healthcare delivery.

As knowledge workers, nurses must leverage clinical data from the EHR in order to:
- optimize workflow and support clinical decision making
- tell the patient’s story
- collaborate to foster knowledge translation
- leverage analytics to extract actionable knowledge
- use sharable, comparable data
- build evidence out of nursing practice.

However, in spite of our best collective efforts, and after decades of implementing EHR systems, nurses still cannot consistently use big data for research or for reporting quality and patient safety outcomes. To advance the vision of a transformed healthcare system, nurses need a more coordinated structure where information can be easily and safely shared among patients, consumers, clinicians, and providers to enable improved outcomes, quality of care, and lower costs. This vision requires access to real-time, accurate, and actionable health information.

Preparing for the future of big data
EHRs are not the only source of big data today. Increasingly, medical data are being generated by patients and processed by computers. Wearable wireless sensors allow smartphone use to generate medical data, including measuring blood-oxygen
and glucose levels, BP, and cardiac rhythm. Sophisticated medical imaging devices are being miniaturized to replace the stethoscope. These smart devices are a part of the Internet of Things (IoT) in healthcare, and most of them can communicate with a smartphone app.

Monitoring data from a patient’s wearable technology or maintaining an accurate, up-to-date inventory of the right supplies and equipment will allow healthcare organizations to stay ahead of the curve. Implementing innovative solutions that capture and analyze data in real time can improve healthcare quality by finding common patterns and anticipating outcomes. With IoT technologies rapidly maturing, the healthcare industry stands to benefit from this enhanced intelligence to improve performance through innovation.

During his 2015 State of the Union address, President Barack Obama launched the Precision Medicine Initiative. This effort is intended to accelerate our understanding of individual uniqueness and the subsequent effect on disease onset, progression, prevention, and treatment. While cloud-based computing makes it possible to rapidly analyze large amounts of data, precision medicine will require universally accessible EHRs and scalable technology to process the data as useful information.

Patient-generated data are also flowing into traditional EHRs. When this abundance of data is properly assembled, integrated, and analyzed, it will offer huge new potential at two levels: the individual and the population as a whole. Once the relevant data are tracked and analyzed, nurses will be able to identify trends and interactions that no single EHR system or program could detect alone. But to do so, the privacy and security of the data need to be protected, and analytics need to be in place to extract meaningful information.

This iterative flow of personal data will also require changes in the mindsets of healthcare stakeholders. For example, patients, consumers, and clinicians must be willing and able to trust and learn from person-generated data; this is a personal evolution as much as an analytical one. The potential value that can be gained from these innovative technologies is great, but the necessary behavior change to depart from traditional practices will be challenging for both individuals and professionals.

How can nurses leverage big data?
The ability of nurses to make optimal clinical decisions is dependent upon having access to accurate, real-time information. Executive dashboards can be used as tools that enable a leadership team to visualize metrics to guide decision making based on actionable information. Data must also be structured in standard ways to enable sharable, comparable information. The value of consistent and accurate data can be realized through interoperable systems, advances in EHRs, and alignment on standards and terminologies. Nurses were among the first professional groups to standardize this terminology, but the pure number of terminology options makes such standardization difficult.

The Healthcare Information and Management Systems Society (HIMSS) chief nursing officer-chief nursing informatics officer Vendor Roundtable Big Data Principles Workgroup has identified the following recommendations to guide the ability to capture and use big data in nursing.

Promoting standards and interoperability
• Nurses should promote the use of standardized and accepted terminologies that address the documentation needs of the entire care team regardless of care setting. All care delivery settings should create a plan for implementing an American Nurses Association (ANA)-recognized nursing terminology that is mapped to national standards (for example, Systematized Nomenclature of Medicine—Clinical Terms [SNOMED-CT] and Logical Observation Identifiers Names and Codes [LOINC]).
• Nurses should recommend consistent use of research-based assessment scales and instruments that are standardized through an international consensus body. The lack of standardization makes data comparison challenging and adds to the burden of cost for copyright permissions and/or licensing of such instruments.
• ANA-recognized nursing terminologies should be consistently updated and made available to international standards organizations for translation and complete, comprehensive mapping.
• Consistent use of discrete data elements in support of research, analytics, and knowledge generation is necessary, thereby minimizing free text use and “within defined limits” documentation.

**Advancing quality eMeasures**

Measuring quality data, including clinical quality measures and nursing-sensitive performance indicators, is a complex process. The data needed to populate these measures come from multiple sources, some of which are not available in the EHR today. Therefore, data alignment, how data are collected, and the use of terminologies are critical to sharing data across settings and organizations.

Clinical quality electronic measures (eMeasures) are integral to these efforts and, as they evolve, will become essential for enabling analytics and big data initiatives to generate new evidence and knowledge.

The following are big data principles for quality eMeasures:

- Efforts to develop and design quality eMeasures must ensure the data to be collected and measured are aligned with the clinician’s workflow, not as additional documentation.
- Paper measure sets must be evaluated for appropriateness to advance nursing-sensitive quality eMeasures; expectations should be set for which data are to be collected, how the data are collected, and the required terminologies to be used.
- Initiatives and programs that define and promote new quality eMeasures and their requirements should allow time for testing and piloting with defined timeframes that consider all stakeholders.
- Clinical quality eMeasures must support evidence-based, cost-effective care that follows clinical practice guidelines and minimizes the negative impact on clinician workflow.

**Leveraging nursing informatics experts**

Nursing informatics is a specialty that integrates nursing science with information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice. Informatics nurses support the entire healthcare team by applying their knowledge of information structures, information processes, information technology (IT), and analytics.

Applying nursing informatics knowledge is essential to capturing health and care data in a structured way to achieve accurate, reliable, clinically meaningful measurement across systems and settings of care. Big data principles for nursing informatics include the following:

- Healthcare organizations should use nurse informaticists who will provide valuable insight into concept representation, design, implementation, and optimization of health IT to support evidence-based practice, research, and education.
- Nurse informaticists should have formal informatics training education and certification to achieve the desired outcomes.

**Influencing patient outcomes**

Large amounts of data are collected today through genomic research, registries, EHRs, and devices; additionally, data are captured in a wide variety of locations, including the home. Now we can analyze these data to identify patterns, trends, and gather evidence that will in turn influence patient outcomes. But to be of value, these data must also reflect nursing, medical, and other healthcare professional information and knowledge. The use of big data offers a tremendous opportunity to accelerate the growth and synthesis of new knowledge to make a positive impact on nurses and the individuals/populations nurses serve.

**REFERENCES**


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