EU*US eHealth Work Project H2020-SC1-HCO13-2016

Mapping Skills and Competencies; Providing Access to Knowledge, Tools and Platforms; and Strengthening, Disseminating and Exploiting Success Outcomes for a Skilled Transatlantic eHealth Workforce

Case Study: Developing Informatics Competencies of ICU Novice Nurses Based on Miller's Pyramid Model

Sir Run Run Shaw Hospital, affiliated with the Zhejiang University School of Medicine, Hangzhou, Zhejiang, China

TITLE Developing Informatics Competencies of ICU Novice Nurses Based on Miller's Pyramid Model

AUTHORS

Xiangping Chen, RN, BSN, ICU Nurse Manager, Sir Run Run Shaw Hospital, affiliated with the Zhejiang University School of Medicine in Hangzhou, China

Yiyu Zhuang, RN, MSN, Vice President for Nursing, Sir Run Run Shaw Hospital, affiliated with the Zhejiang University School of Medicine in Hangzhou, China

ORGANIZATION

Sir Run Run Shaw Hospital (SRRSH), affiliated with the Zhejiang University School of Medicine, was established in 1994 and is located at 3 East Qingchun Road in Hangzhou within the Zhejiang province in China. Over the last 23 years of comprehensive scientific development, SRRSH has developed into a tertiary, research-oriented general hospital with two campuses (Qingchun Campus and Xiasha Campus) totaling 190,333 square meters with 2,400 beds, 32 clinical specialties, 77 nursing units and 9 ancillary departments.

SRRSH is the first public hospital in China accredited by the Joint Commission International (JCI) for four times in succession. From 2014-2016, SRRSH was named in the "100 Best Medical Organizations to work for in China".

SRRSH pioneered the "Shaw Hospital Model", which combines the best of Chinese and western healthcare management models. SRRSH is the first pilot in China to develop an electronic patient platform using the telephone, which enables patients to register, pay, check medical records and link with government insurance systems, as well as remotely consult with physicians through the Cloud Hospital. On August 28, 2017, our hospital successfully achieved the accreditation of HIMSS Electronic Medical Record Adoption Model (EMRAM) Stage 7, which indicates that the hospital is employing the highest level of clinical information technology (IT) and advanced safety features to provide top care.

BACKGROUND

The nursing service campaign promoted by the National Health and Family Planning Commission of the People's Republic of China (PRC) have raised higher requirements for nurse core competencies. In addition, the growth of the nursing profession since the 21st century has developed substantial evidence which links IT with improved patient safety, care quality, access and efficiency.

However, nurses took over general documentation duties beyond primarily nursing issues, as they are highly involved in patient process and information management. It can therefore be concluded that there is a great demand for competencies in managing patient data and processes electronically, operating the technical systems, knowing about their context in terms of data quality and availability, confidentiality and integrity.

There is a concern that many nurses may not possess these capabilities and nurse educators may not get prepared to teach them. Furthermore, traditional methods applied in educating nurses do not concentrate on the clinical information competency.

STATUS/CURRENT DEVELOPMENTS

Deficits in IT competencies are a significant concern, because our hospital has mandated a complete implementation of an electronic health record (EHR) system early this year. EHRs require all nurses to use IT to deliver, document and obtain reimbursement for patient care. IT will no longer be an add-on; it will be ubiquitous, fully and seamlessly integrated into every aspect of care, documentation and reimbursement. Informatics competencies are essential for basic functioning at SRRSH and simply a foundation for higher-level practice. Therefore, informatics competencies must become a critical element of basic nursing orientation.

Intensive care units (ICU) are specialized medical environments with sophisticated monitoring facilities for critically ill patients. It requires nurses to have highly developed professional skills. ICUs at SRRSH abandoned manual documentation early this year. Informatics competencies were not a concern in the previous ICU orientation program.

Nurse managers, educators and five experienced instructors in the SRRSH ICU worked jointly to design activities that will help new nurses gain informatics competencies. We also invited 10 inexperienced nurses to engage in the design to fully understand how to support their learning needs. We chose Miller's pyramid model as the framework of this effort, as the team successfully completed a comprehensive orientation program for ICU novice nurses in 2010.

ACTIVITIES/MEASURES
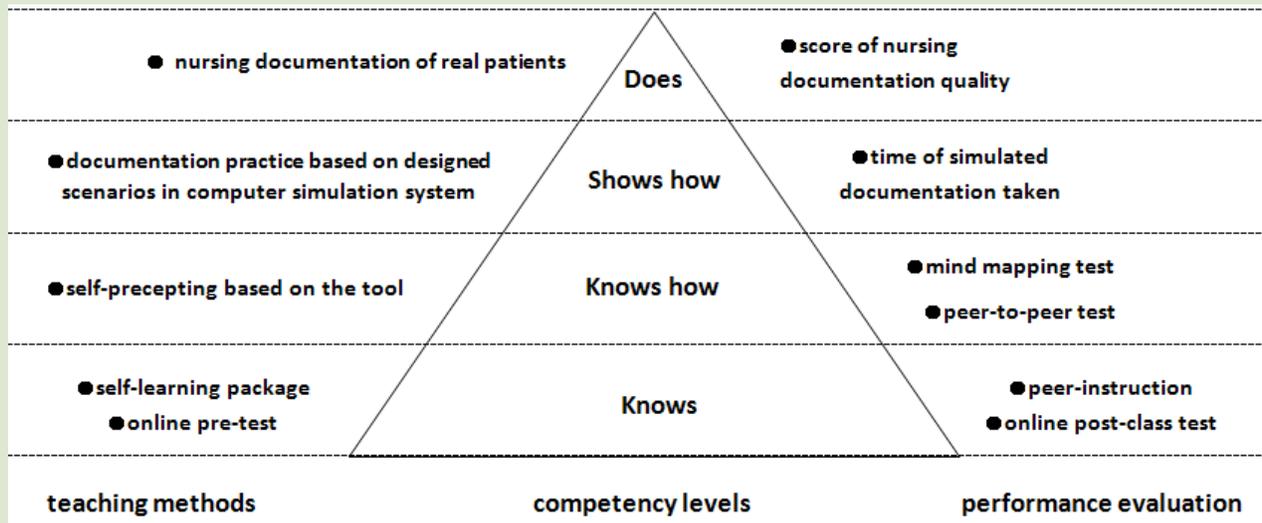
Miller's Pyramid Model describes clinical competency according to the relationship between knowledge and skills, and classifies the competency as "knows", "knows how", "shows", or "does." Based on the categorization, one is classified as a novice to an expert, by his or her "professional authenticity". "Knows" and "knows how" correspond to the "test cognition" or knowledge domain, which refer to those lacking experience (or novices). "Shows how" and "does" correspond to the behavior domain: the "shows how" level refers to one's performance on artificial simulation exercises, while the "does" level links with one's clinical practice in the workplace [1, 2]. Below, there is the detailed introduction of teaching methods and performance evaluation of each competency level.

Knows Level：
1) Teaching methods. A self-learning package is delivered via email to all new nurses ahead of the class. The package includes all workflows, rules and policies. Workflows are mainly about admission from, as well as transfer to, the operating room (OR)/emergency room (ER)/floor/catheterization laboratory/endoscopy suite/dialysis unit/outpatient department/or other hospitals. Rules and policies refer to nursing documentation, handover, multidisciplinary rounds, information privacy, information security, etc. A peer-instruction approach is utilized during the three-hour-course [3]. The course is divided into five short presentations followed by some multiple-choice questions (MCQs). New nurses are then divided into groups of five. New nurses must record their initial answers and then have 10 minutes to discuss them with the peer group and then submit the revised answers. An in-class assistant reviews the answers and marks the tests. The correctness/incorrectness of the answers can serve as a quick hint for the lecturer to assess whether the new nurses understood the topic or whether there is a need to clarify issues or to deepen the knowledge.

2) Performance evaluation. New nurses take an online test prior to class. The pre-test has 20 MCQs and three open-ended questions that are self-scored to measure their readiness for class. After the course, new nurses immediately take an online post-class test named *Version A* with 25 MCQs to be answered within 40 minutes with the goal of achieving a score greater than 90%. If they score below 90%, they are required to take another online post-class test named *Version B* with 30 multiple-choice questions answered within 40 minutes.

Knows How Level：
1) Teaching methods. We created a standardized assessment tool based on practice rules and documentation standards. The tool consisted of 85 items to ensure completeness and inclusion of current practices centered on the hospital information system. We encourage the new nurses to prepare themselves according to the tool. Of course, once they have questions, their instructors are always accessible to provide clarification. To get them acquainted with each workflow, the team leader during each shift will notify the new nurse to be onsite if they are on that shift. The team leader will also appoint one bedside nurse to explain the workflow in-depth.

2) Performance evaluation. Mind-mapping [4] methodology is employed to examine whether new nurses have a clear understanding of workflows. Mind-mapping is a teaching strategy that encourages people to depict the relevant clusters and branches of information in a diagram. Mind-maps are useful for note taking, visually representing ideas, planning, brainstorming and summarizing, organizing and recording information. We randomly select two workflows and ask the new nurses to employ the mind-mapping technique. For scoring purposes, if any of the multi-steps are missing, the relevant workflow is considered incomplete. The new nurse is then asked to re-map the workflow and map an extra workflow.

We emphasize that feedback from peers promotes the learner's self-monitoring. This process helps learners to further evaluate and identify deficiencies and to take remedial measures. We utilize peer-to-peer review and feedback processes to provide opportunities to enhance nursing competencies in a supportive environment. The educator matches pairs of new nurses who mutually review the 85 items listed in the tool. If all items can be answered within 60 minutes, it will be marked as a "pass".

Shows How Level

1) Teaching methods. We collaborated with an IT vendor to develop a specially designed version of the Clinical Information System (CIS) for the lecture room. The new nurses can operate the system independently from the clinical setting, which complies with patient-privacy rules. We built several virtual scenarios that are typical cases of the ICU for learning and testing purposes. These scenarios help prepare the nurses for working in real-world clinical practice.

2) Performance evaluation. Nurses who are already using the information system for at least seven months are tested again via a simulated documentation scenario. Three experienced nurses' completion times were averaged; this information was documented before each scenario was completed. The new nurses are required to accomplish the documentation scenario within the 1.2-fold of the average time. The new nurses randomly select two testing scenarios; if they fail to complete the documenting process within the requested timeframe, they are retested again two days later.

Do Level

1) Teaching methods. In early 2017, our team developed a scoring scale based on the documentation standard to monitor the quality of electronic documentation. In addition, one experienced nurse is available each week to act as a Nursing Documentation Quality Auditor.

2) Performance evaluation. After three months of supervision, new nurses begin to work independently. We require the new nurse to achieve a score of 90 on the documentation quality. The auditor will also contact the appropriate person to give feedback about documentation improvements if necessary.

CHANGES

In China, nursing colleges have not yet provided curricula on the use of CIS. However, new nurses in our hospital are expected to work successfully in the modern, electronic environment provided at the hospital after three months of supervision. Nurse managers and educators in the SRRSH ICU recognize informatics knowledge and skills as essential components of the nursing field. We also integrated informatics content into our orientation program with the major goal to develop new nurses' skills in using technology and the management of information for the delivery of high-quality and effective patient care. The nursing informatics (NI) competencies orientation program for ICU novice nurses is based on the Miller's pyramid model and is focused on the clinical practice competency, which can facilitate new nurses to being better prepared for working independently.

RESULTS

Thirty new nurses in the ICU have moved through this innovative program, which is attempting to formally prepare nurses with specialized informatics skills. Recently, we have finished the "knows" level and "knows how" level. All of the new nurses received scores higher than 90 on the online post-class test within 40 minutes, and a post-class questionnaire was administered. All respondents claimed that the peer-led instruction and mind-mapping helped them better understand the workflows. Feedback showed that they preferred the lecturer to utilize peer-instruction and mind-mapping as opposed to conventional teaching and testing formats. We expect that these new nurses will have advanced documentation skills when they care for patients independently this November 2017, and will therefore feel less anxious and have more time with critically ill patients and families.

OUTLOOK/LESSONS LEARNT

This orientation model aims to improve new nurses' informatics competencies, thus enhancing performance and efficiency of clinical nursing. Our hospital has constructed an Advanced Technology Learning Center that can be used to simulate the clinical practice environment through built-in patient cases and coordination with realistic manikins (both high- and low-fidelity human patient simulators). In simulation labs, new nurses are able to apply their nursing knowledge to care for simulated patients within a safe environment. We currently use virtual simulations in advanced cardiac life support (ACLS) training courses and have accumulated a wealth of experience. We have ideas for future research on the utilization of high fidelity manikins to simulate some emergency events (such as cardiac arrest, gastrointestinal hemorrhage, etc.) and to examine the effectiveness of virtual simulation technology on enhancing the informatics competency of a new nurse. We believe a standard high fidelity simulation approach will contribute to better patient outcomes.

References

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Case Study Checklists

Checklist of eHealth topics (competencies)	Apply? Yes/No	Describe how topic applies to your organization/case study
Role of "Peopleware": human factors, awareness, satisfaction and acceptance of health IT, usability measurements, evaluation of health IT, communication, leadership, change management, ethics and IT and similar topics	*Yes*	Our hospital has a Health Information Governance team, which includes several functional teams, such as a medical information team and a nursing information committee. Every team has champions to collect clinical needs and give feedback to the developers and IT staff.
Role of inter-professional approaches: inter-professional versus mono-professional training and learning activities. What subjects lend themselves to inter-professional vs. mono-	*Yes*	Our hospital has one informatics nurse to help the nursing department improve NI within the department and to provide inter-professional training and stimulate learning activities.

professional classes, learning environments and
similar topics

Role of healthcare data sciences: data and information acquisition including documentation, data quality, data, information and knowledge management, data analysis and statistics, clinical decision making instruments, reporting and similar topics	*Yes*	Quality management uses a business intelligence (BI) system for healthcare data.
Fusion of medical technology & informatics: software as a device, smart devices, automatic data acquisition via devices, risk and safety management	*Yes*	Medical staff can use portable equipment such as iPads to do their ward rounds; nurses can collect the automatic data from the monitor after manual check, high risk factors will trigger the system to produce an alert.
Role of process and workflow management, clinical and administrative processes, information continuity and information logistics, management of processes, workflow management systems and similar topics	*Yes*	Teamwork is used to improve the processes, every functional team attends a meeting to discuss the process and workflow and make a plan to manage improvements.
Role of ethics, legal and data protection issues: ethics and IT, legal requirements, data protection and information self-determination, data safety and similar topics	*Yes*	The ethics council of the medical department guides the IT activities to ensure that the legal requirements are being met. Each member of the medical staff has their private password and must to change the password every 60 days.
Role of learning and teaching: learning techniques ("learn how to learn"), learning and teaching styles (online, blended, face-to-face), learning management, information management for learning and teaching and similar topics	*Yes*	Our hospital offers online continuing education (CE) courses and online exam systems. The medical staff can browse the internet webpage to learn about online course options. The education department can collect and analyze the data.
Role of management related topics in health informatics and IT: principles of management, strategic management, stakeholder and change management, leadership, financial management, risk management, quality and safety	*Yes*	The Health Information Governance team manages the change of health informatics (HI) and IT. Quality Management (QM) uses the BI system to ensure quality and safety; the Human Resource department uses a Human Resource Planning system to manage resources; the Finance Department depends

management, resource planning and management and similar topics		on the principles of cost-performance to do the financial management and uses an IT system to achieve these goals.
Role of technology: information and communication systems, telemedicine, telematics, assistive technologies, mHealth, life-cycle-management including systems development/engineering	*Yes*	Our hospital uses a Cloud platform for telemedicine and assistive technologies.
Role of consumers and populations: consumer health informatics, public health informatics	Yes	The hospital information system (HIS) provides a data interface to WeChat and Alipay, thus patients and their families can use these apps to receive public service information.
Role of Research: information management in research, data analytics	*Yes*	Our EHR system has a clinical data repository; medical staff can log in to the HIS and collect the data to conduct research and data analytics.
Role of interoperability: systems integration, IT standards, terminologies and classifications	Yes	We have the unified landing system platform "clinical care classification system", ICD-10 terminology and other classifications.

Checklist of eHealth topics (gaps and deficiencies)

Teaching the teachers: Are there any activities in your organisation to teach health IT/eHealth to teachers in healthcare?

 Yes, the Health Information Governance team

Supporting participatory design and acceptance testing/research: Are there any educational activities to teach or practice participatory design? Are there any activities including research in user acceptance testing and satisfaction measurement?

 Yes, our hospital offers online continuing education courses and online exam systems

Integrating eHealth/health informatics into traditional curricula: Are there any activities to include eHealth/health informatics into traditional curricula of physicians, nurses and other health professionals with direct patient care?

Yes, HI is integrated into our new staff orientation.

Motivating clinicians and managers: Are there any incentives and opportunities for clinicians and healthcare managers to acquire and update digital eHealth/health informatics skills and knowledge?

Yes, clinical staff are members of the Health Information Governance team and also serve as representatives for each department.

Engaging women: Are there any activities to attract female students in eHealth/health informatics or employ female health IT staff?

No

Adjusting job descriptions and enable continuing education: Are there any activities to adjust job descriptions, e.g., for clinicians, that include health informatics competencies (also proper use of health IT/eHealth systems) and are there activities to support staff updating and upgrading their health IT related skills and knowledge? This topic is mainly related to provider organisation and to IT vendors.

Yes

Updating teaching and learning material: Are there any activities to ensure that the material is up-to-date and of high quality?

Updated information is released by the Health Information Governance committee.

Availability of courses including electronic courses: Are there any additional activities to improve the availability of courses such as implementation of new courses, new course formats that recognise previous experiences/training in particular for continuing education?

Online CE courses and an online exam system

Informal caregivers: Are there any educational activities to teach health IT usage to informal caregivers, e.g. for assistive technologies?

No

Shortage of health informatics specialists: Are there any programmes to attract health informatics specialists?

No

eHealth Budget: Does your organization, area or region have a dedicated budget set aside for eHealth/health informatics training, education or workforce development initiatives?

No

eHealth Specialty Areas: Does your organization address any of these speciality settings/areas of training or outreach for eHealth education or workforce development: ambulatory care, social medicine, geriatric/ageing medicine, rehabilitation?

No