

## The aging nurse workforce and technology

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*D.F. Mahoney. The aging nurse workforce and technology. Gerontechnology 2011; 10(1):13-25; doi:10.4017/gt.2011.10.01.003.00* This manuscript reviews the current nursing labor market in the USA and the demographic changes leading to marked increases in the median ages of actively employed nurses. With the aging of the 'baby boomer' cohort, more registered nurses (RNs) and advanced practice registered nurses (APRNs) will be needed at a time when retirement will be causing a large nursing exodus. This increasing demand for nursing services at a time of supply shortages creates an urgency to consider new ways of sustaining and retaining nurses no longer able to perform strenuous physical care activities. Technology usage is advocated as a key means to address the nursing shortage by re-tooling mature nurses with new career opportunities. Re-designing nursing practice to take advantage of various technology offerings has widespread implications for nurse educators, administrators and regulators. Specific health information technologies are discussed that support the coordination of care across sites and offer the potential means to bridge traditional divisions in health care services among primary, acute, post acute, and home care settings. Promising technology enabled nurse led initiatives are highlighted. Additionally, international data support that the nursing workforce issues have applicability beyond the USA. Conclusions suggest that technology offers both promises and pitfalls in addressing ways to support and retain the nursing workforce. Nurses want to adopt and use new technologies that support their ability to improve the efficiency and effectiveness of their nursing care across a wide range of settings. New opportunities through technology innovations present themselves for nurses seeking non-traditional roles and new ways of caring for patients that are not bedside focused. The challenge to gerontechnologists is to leverage the positive aspects and guide, direct, and counsel technology developers and adopters to overcome the challenges and pitfalls. Partnership approaches between technologists, nurses, and other clinical end-users are recommended from the design stages onward. Ultimately, nurses want to nurse their patients, not a technology.

**Keywords: nursing shortage, baby boomers, job redesign, telenursing**

In the USA a registered nurse (RN) is licensed and authorized to practice by a state as a professional RN. They must graduate from an approved school of nursing and pass a national examination to obtain licensure. According to the latest national survey of RNs, there are now 3.1 million in the USA with half holding at least a baccalaureate degree<sup>1</sup>. On average across the nation, for every 100,000 people there are 854 RNs. In the early eighties, almost half of the working RNs were younger than age 34; by 2008, almost half of the RNs were age 50 and only 29% were younger than age 40. Overall, the current average age of a registered nurse is

47 years with 1.5 million nurses eligible for retirement over the next five years, leading to a nursing shortage<sup>2</sup>.

Advanced Practice Registered Nurses (APRNs), are RNs who have several years of additional graduate education in nursing at the masters or doctoral level. APRNs include certified nurse anesthetists, nurse midwives, clinical nurse specialists, and nurse practitioners (NPs). Given the topic, for purposes of this discussion the focus will be on the NPs because they are primary care providers for older adults. The first NP program was established in 1965, and the first graduate level

gerontological nurse practitioner specialty program started in 1975. NPs obtain advanced education to enable them to expand their legal scope of nursing practice to assess, diagnose, manage and prescribe therapies for common primary care ailments. NPs work in collaboration with physicians and other health team members but they are independently licensed and can establish their own practices. NPs are the largest group of non-physician primary care providers in the USA and in 2010 numbered 147,000 in active practice<sup>3</sup>. NPs have improved access to care for vulnerable underserved populations especially with the rural and urban poor, the uninsured and underinsured and with community dwelling and institutionalized persons at high risk such as frail older adults with multiple chronic health problems. Geriatric Nurse Practitioners have improved access to care for nursing home residents and reduced the fragmentation of care when residents transition from acute to home or institutional care while reducing costs and improving satisfaction with care outcomes<sup>4-6</sup>.

## **NURSES AS FACULTY MEMBERS**

To meet the nursing shortage, nursing education programs need to increase their capacity at a time when they are turning away thousands of qualified applicants. A recent American Association of Colleges of Nursing (AACN) survey reported that almost 55,000 applicants were turned away because of a faculty shortage (61%), insufficient clinical teaching sites (60%), limited classrooms (47%), budget cuts (32%), and lack of preceptors (31%)<sup>7</sup>. However, the numbers of qualified nursing faculty are also dwindling and almost a third are over age 55. As more opportunities develop in healthcare for nurses with advanced education, it becomes more difficult to recruit and retain nursing faculty in the educational sector which sets high teaching, research, clinical practice, and service expectations, yet has not kept salaries in alignment with the clinical practice payments. Moreover, nurse administrators worry about an increasing practice-education gap, as clinical practices fueled by new technologies, quality improvement efforts,

and evidence based research, evolve more quickly than nursing education<sup>8</sup>.

Historically, nurses have started to rapidly withdraw from the workforce in the decade prior to reaching age 66. Consequently, if the average nurses' age today is 47 and nurse retirements start by age 56, we will experience a major nurse exodus from the workforce over the coming decade and imminently for nursing faculty. Ironically, the greatest outflow of nurses will occur at a time when the USA will face the greatest inflow of an elderly cohort. Between 1946 and 1964 the post World War II baby boom generation was born. In 2011, the first of the baby boomers enroll in Medicare and become eligible for geriatric health care coverage. The oppositional forces between increasing demand for nursing care and a decreasing supply of nurses coupled with a significantly greater escalation in geriatric patients amid declining resources are being labeled a 'Geriatric tsunami' or the 'Perfect storm' indicating a crisis condition. The remainder of this article will discuss both the nursing problems and the potential benefits present and potential technologies may offer to address this care crisis.

## **PROBLEMS IN NURSING**

The majority of RNs profess that the most satisfying aspect of their job is being able to provide direct hands-on care for their patients, usually at the bedside. Providing this direct care carries increasing risk as nurses age. In the USA, nursing ranks third among the top 10 most injury-prone jobs<sup>9</sup>. Studies have shown the heavy physical demands on nurses, especially from lifting and moving heavy patients, over time take a physical toll. Nurses experience a 15% rate of back pain per year which is 3% higher than non-nurse workers, and the incidence increases markedly with age<sup>10</sup>. Furthermore 12-18% of nurses leave the profession each year due to acute back injury or chronic back pain<sup>11</sup>.

Unfortunately, there has been a prevailing myth that proper body mechanics protect nurses from injuries related to manually lift-

ing patients despite strong evidence to the contrary. In response, several major initiatives have taken place to reduce this major source of injury to nurses and contributor to the nursing shortage. In 1981 the National Institute for Occupational Safety and Health (NIOSH) established guidelines for manual lifting and over subsequent revisions developed lifting equations that recommended a 35 pound (16 kg) maximum weight for patient-handling tasks<sup>12</sup>. In 2003, the American Nurses Association (ANA) started advocating for the abolition of manual patient lifting and now sponsors a related website<sup>13</sup>. By 2010 NIOSH in partnership with the Veterans Administration and ANA, released a Safe Patient Handling Training Toolkit for schools of nursing that is publically available<sup>14</sup>.

Research indicates that older nurses find the physical demands associated with providing patient care more difficult in their later years, but nurse administrators recommend the need for new workplace strategies to retain mature workers for their valuable organizational experience, clinical expertise and mentorship of recently employed and/or novice nurses<sup>15,16</sup>. More recent safety and quality improvement efforts have expanded recognition of 'at risk' and inefficient nursing tasks in the hospital setting and specifically recommended technology solutions.

The American Academy of Nursing conducted research in 25 acute care hospitals across the USA on 200 patient care units with more than 1000 participants to analyze typical workday practices<sup>17</sup>. Overall, eight nursing workflow categories of concerns arose in medical-surgical units, all of which they reported could benefit from technology: admission, discharge, and transfer; care coordination; care delivery; communication; documentation; medication; patient movement; supplies. Results suggested that nurses need and want smart, portable, point-of-care solutions that are interoperable across devices and systems to address their concerns. Interestingly, smart cards to populate record data, smart pumps, smart beds, bar-coding, decision support, robotic supply deliveries,

viewing monitors, rfid staff/patient/supply tracking were all desired, and currently commercially available technologies. However, functional problems with battery life of less than one shift, interoperability and device integration, portability, and hands-free features such as voice activation remain limiting factors that need to be addressed by technology developers. Nurses want integrated systems to ease their workloads rather than requiring them to develop a work around to use a chosen clinical system that meets administrative needs but not nursing practice. They noted that not only nurses who are aging, but all nurses want a manageable workload unencumbered by inefficient systems. The Academy's Technology Drill Down research process that identified critical work environment factors that technology could address is described in detail<sup>18</sup>.

## NURSING POTENTIAL

By age 62, the 'early' retirement in the USA social security system, 42% of nurses remain working. And recent research suggests that the current economic downturn may cause some nurses to delay retirement and some retirees to re-enter the workforce due to financial constraints<sup>19</sup>. Thus there appears to be a window of opportunity to consider new roles for older nurses to maximize their experiential wisdom while minimizing physical demands. Organizationally, some employers have recommended more flexibility for nurses by reducing shift hours and workloads while increasing opportunities to mentor younger nurses<sup>20</sup>. However, a study of 290 health care facilities in the USA found that while awareness of the nursing shortage and need to retain nurses was commonplace, the vast majority (87%) had no specific plans to address the workforce issue<sup>21</sup>. Nurses under age 65 have also been studied and job dissatisfaction, higher education, ease of finding another job, work-family conflict and perceived lack of organizational support all contributed to nurses quitting their jobs<sup>22</sup>.

The USA historically struggles to address gaps in health care coverage, high costs, and

administrative inefficiencies through reform efforts that are continually buttressed by a capitalistic society divided in values and beliefs surrounding individual, societal, and governmental responsibilities. Technology has arisen, however, as a key area to fuel basic reforms in the way in which we collect and share health information across settings and end-users. Federal economic incentives have been put into place to stimulate development and deployment of scalable, interoperable, meaningful, secure, reliable, and cost-effective technology based systems to underpin electronic medical records, electronic health records, and/or personal health records according to one's viewpoint. The maturing of wireless technologies reduces the barriers from being tethered to the technology and wrapped in wires.

## HEALTH INFORMATION TECHNOLOGY

The value of health information technologies (HIT) to nurses is growing. Nurses are learning new ways to: access information using a variety of devices, record and store data, identify usability problems, and participate in product design and testing. Nursing informatics has arisen as a new focus and nurse informaticists provide the key linkage between nursing and technology to facilitate relevant product offerings and clinical adoption. Electronic Health Records (EHRs) for all Americans by 2014 is our national technology goal and nurse informaticists advocate for nursing involvement in designing, vocabulary selection and usability testing to ensure that the technology enhances nursing practice. A nursing minimum data set of key items related to nursing practice is being promulgated. In the past, site specific systems were developed that lacked interoperability and provided separated components for billing, labs, and pharmacy. These did not integrate or provide data in a clinically meaningful manner. Isolated data elements are not helpful to nurses but integrated patient data with means to flexibly add observations that tailor, prioritize, and personalize care for their patients are desirable. Through the Technology Informatics Guiding Education Reform (TIGER) project, nurse leaders

have joined together to become involved in shaping technology policies, setting related care standards and infusing technology into nursing curricula to further nursing's adoption and use of new technologies<sup>23</sup>.

## TRANSFORMING CARE AT THE BEDSIDE

Technology offers the opportunity to redesign patient care and related nurse workflow processes. Investment in technology upgrades that promote ease of documentation, quick retrieval of key information, decision support, and meaningful and valid monitoring alerts will attract new nurses and help retain the current workforce. Putting nurses in positions where they can work smarter, not physically harder, is the key to success. Valuing workplace modifications by leadership staff is essential to demonstrate commitment to safe working environments. The Robert Wood Johnson foundation's report on nurses' use of technology suggests a promising future<sup>24</sup>. One of their examples comes from the University of Pittsburgh Medical Center where 22 smart rooms have been implemented. When nurses enter one of the smart rooms they trigger a sensor that activates a screen to display nurse-relevant patient data. This pro-actively provides instant access to the information nurses need at the point of care. They are informed about any allergies, latest medication dosing, and whether the patient is at risk for falls. The system was developed in response to a latex allergy incident in which documentation of a patient's allergy was buried in the clinical record and not known by the treatment nurse. Reducing the likelihood of human errors through technology is a win-win situation.

Another technology success story came from the Veteran's Health Administration. In the nineties, a nurse suggested using bar code technology to track and record medication administration to reduce the potential for human error. Subsequently medication related error rates were reduced by 75% for giving the wrong medication, by 62% for the wrong dose, by 93% to the wrong patient, 87% for the wrong time, and by 70% for wrongly omitting the drug. Today 25% of

hospitals equip nurses with similar scanning technology<sup>24</sup>. Given the positive outcomes for reducing patient safety errors one would think many more would have adopted the technology. Difficulties still remain with scanners whose batteries run down and need to be recharged at inconvenient times or get misplaced. Systems that require duplicate recording of medication administration in paper copies report more problems. One study of Bar Coding Medication Administration found that if nurses do not view the system as user friendly, enhancing productivity, or providing useful information at the point of care to help in their medication decision making, then adoption problems occur. One study recommended modifying Bar Coding systems based on nurses' input considering usability, functionality, and impact on nursing practice<sup>25</sup>.

## TELEROBOTS

Robot technology is making initial inroads for deliveries of supplies and medications to hospital units. At the hospital unit level robotic applications to directly help nurses are lacking and in need of development. A 'nursebot' named Pearl has been prototyped to create a virtual nursing presence for patient interactions but it did not commercialize<sup>26</sup>. By contrast 'Dr Robot', by InTouch, did commercialize and it allows doctors to remotely visit hospitalized patients with two-way interactions and to employ some medical sensing equipment during remote physical examinations<sup>27</sup>. It still requires a nurse's involvement to function. RONA, for 'robotic nursing assistant', is being designed for commercialization by Hstar technologies to provide actual task support for nurses, including lifting and moving patients, transporting supplies, and providing two-way communications<sup>28</sup>. To facilitate adoption by nurses, the design team included nurses experienced in gerontology and robotics and started with a workshop to sensitize the computer engineers to the shearing forces, sanitation, ergonomic, trust, and caring aspects that nurses attend to when moving patients. As the engineers personally experienced being moved, they expressed new

appreciation for the nursing skill set and the challenges to mimic them robotically in small equipment-filled rooms<sup>28</sup>. Currently, personal care robots lack multiple functional and multi-tasking abilities needed to make them a practical reality for nursing and 'hands on' geriatric care giving and their high costs limit widespread adoption.

In the Home Care setting nurses are rapidly adopting telenursing and using telehealth systems that provide remote monitoring of vital signs and provide nurse video visits for home health care patients. Nurses gain desirable efficiencies in time and effort through remote monitoring by decreasing their traveling and increasing their number of patient visits per day. Studies are accumulating consistently showing better patient outcomes and reduced hospitalizations for at risk elders with Congestive Heart Failure who have participated in nurse-managed telecare programs. As demand for these services increases, nurses with back injuries or those no longer able to work full time, could easily become the video visit nurse drawing upon their nursing assessment and counseling expertise. A new role of telepresenter is evolving that builds upon the RN's role by providing support to patients, maintaining their privacy and confidentiality of personal health information, and facilitating technology based physical exams by medical and nurse clinicians as needed. This typically entails attaching peripheral devices and ensuring transmission of vital signs, otoscopic views, cardiac sounds, wound pictures etc. as needed. Standards and guidelines for telepresenters and nurses in telepractice have been promulgated<sup>29,30</sup>.

Reducing high hospital readmission rates in the USA has become a national priority to reduce significant costs associated with problems related to care coordination. In a 2004 study of hospitalized elders enrolled in Medicare, approximately one in five were readmitted within 30 days and unplanned readmissions cost Medicare US\$17.4 billion<sup>31</sup>. Too often our acute care, long-term care, and rehabilitation sectors work as silos

treating each admission as a new event, unlinked to prior care services or settings. This has created gaps in care and the need for transitional care services that focus on coordination of patient care and better communication among care providers. Central to the transitional care movement are professional nurses. In several medical initiatives, however, the intervention role labels of transition coach, care integrator, discharge advocate, disease management coordinator, or care manager don't include the word 'nurse' in the title, only in the project descriptions<sup>32</sup>. This omission contributes to the devaluing of the nursing role and lack of public and professionals' awareness of nursing's expertise in indirect as well as direct bedside care. And these new role opportunities benefit from experienced registered nurses and use communication technologies that may help to retain staff nurses no longer able or willing to perform hospital nursing. Nurse Researchers have successfully tested a Transitional Care Nurse (TCN) model program using advanced practice geriatric nurses to coordinate care for older adults starting with daily hospital visits and following them for two months post discharge with home visits and telephone contacts. Findings from the TCN randomized clinical trial indicated significant positive care and cost savings outcomes<sup>33</sup>. According to Coleman, key to geriatric care transition interventions are medication reconciliation, up-to-date shareable personal health records, appointment scheduling, visit preparation, and awareness of condition worsening and how to respond<sup>34</sup>. Technology can facilitate each of these tasks.

Another approach under development in the USA stimulated by interest in health care reform efforts is the patient-centered 'medical home'. Here the emphasis is on the patients' engagement with their primary care physician and/or nurse practitioner who oversee a holistic approach to care from wellness through long-term services. While it has aspects that seem to overlap with the transitional care programs, the use of the term 'medical home' seems to ensure more probability of obtaining financial re-

imbursement for these services. Otherwise, why would any consumer want to have their home medicalized and known as a 'medical home'? If anything, the coordination elements reflect more nursing, but the moniker of nursing home has already been assigned to institutional care. Of note, the recently passed health care reform bill HR 3590 on March 21, 2010, used the term 'health home'. Regardless of terms, a technology infrastructure is seen as pivotal under health care reform to efficiently interface between and among patients, clinical providers, and payers within and across settings<sup>35</sup>.

A new wave of nursing opportunities is evolving for NPs working in the community. Retail health clinics run by NPs in local pharmacies and shopping centers have placed nursing at the forefront of increasing access to primary care services and reducing inappropriate use of emergency rooms for non-critical care. Starting with one clinic in 2000, there are estimates that by 2011, there will be 6000 retail clinics in the USA providing more than 50 million patient visits per year. Research indicates that they serve a population underserved by primary care physicians and show signs of becoming a safety-net provider with the potential of relieving the stress on emergency departments<sup>36</sup>. Central to this practice sector is technology enabled electronic medical record keeping, referrals, decision support guidelines and evidence based practice protocols to ensure standardization of high-quality care.

## NURSING EDUCATION

Many schools of nursing have embraced technology to complement faculty and extend their teaching and supervisory abilities. Distance-learning platforms with integrative abilities for online synchronous and asynchronous class discussions, webinars for real time transmissions and video archives for post reviews allow faculty to increase students' access to courses as well as class sizes. Simulation labs are rapidly increasing and these allow students to gain critical clinical experiences in a safe controlled environment with faculty feedback incorporating

video reviews. If one's facility cannot afford simulation labs on site, then virtual simulation labs can be created in Virtual Worlds such as Second Life<sup>37</sup>. Second Life is a three-dimensional computer-based environment where people create a persona called an avatar and interact with other avatars in real time. Several schools of nursing have created their own virtual school and offer simulation labs and classes. These technology driven approaches have become popular means to address the shortages in both the numbers of faculty and clinical sites available to students.

Technology has already enabled nurse educators to gain easy access to gerontological nursing educational materials including courses, case studies, video clips, and links to other geriatric resource sites through a non-commercial site supported by a collaboration of academic nurse educators and educational funders<sup>38</sup>. And student nurses are now expected to be able to use their smart phones, personal computers, and on-site clinical systems to access relevant health information applications to help them prepare and conduct their clinical assignments. Social media and virtual schools, hospitals and avatars on Second Life provide innovative means to outreach, spread information, and provide new forms of educational experiences. Faculty can gain time efficiencies by reducing long distance travel time and costs through remote preceptor visits and student virtual visits.

Nurse educational researchers now need to turn their attention to the educational competencies and outcomes related to technology usage to help inform optimal curriculum integration. With the knowledge that nurses who perceive a manageable workload stay employed longer, greater understanding is needed about faculty workload perceptions due to technology adoption. Assistance with the learning curve and ongoing support to use new technology platforms and programs are necessary to avoid wasting time and frustrating faculty. Informal faculty discussions indicate increased student expecta-

tions for 24/7 response to online class participation and negative faculty evaluations on responsiveness when instant messages are not returned instantly. To avoid student and faculty dissatisfaction, realistic response periods to routine communications could be explicitly stated on course syllabi.

## **FALSE ALERTS, DISABLING SAFETY ALERTS**

Technology generated sound alerts on equipment can lead to difficulties. Does the alert beep mean an immediate crisis, a critical notice to forestall the crisis, an important notice to prevent the crisis, a routine notice to check a setting, a nice to know but not critical notice that an upcoming event will need attention – i.e. battery recharge? At present, one can have multiple devices sending the same sounding alert but for different reasons. How is a nurse supposed to quickly decipher among a variety of beeps and a multitude of patients which alert takes precedence? Clearly there needs to be a way for the nurse to interface with the technology to control the beeping and tones and prioritize the alerts to those that need immediate nursing attention.

One of the early electronic record components offered a medication alert triggered when the medication order dosage was wrong, too high, too low, incompatible with other drugs, an allergen, or not medically indicated. The pharmacy program set the level so low that the majority of medications called for immediate attention while after review the clinicians would find their indications and usage still appropriate. The alerts became annoying, a time burden, and raised concerns about liability if documented as unimportant. There was an immediate need to fine tune the alerts and build in more intelligent aspects with greater specificity to serious situations. Programs were refined accordingly. Similarly, all telemetry patients are being monitored for cardiac, respiratory, urinary outputs and multiple alarm alerts are noticeable on any unit. Smart devices are becoming more commonplace such as smart IV pumps, infusion pumps can help prevent medication errors by alerting you

to a pump setting that doesn't match your facility's drug administration guidelines. At times the noise level from alerts on acute care units can be so high as to be distracting to the staff, annoying to other patients, and disruptive to patients' sleep cycles<sup>39</sup>. Staff may have to bypass the alarm mechanisms when working on monitored patients to stop the noise from false alerting. Human error can result in forgetting to turn back on the alarms when staff is called away to an emergency situation<sup>40</sup>. To address patient safety, technology enabled quiet failsafe systems need to be developed in conjunction with nurses. One hospital nurse shared with the author that on her unit they tested using smart phones with applications designed for vibratory notifications to the nurses. Difficulties arose in remembering to handoff the phones to the oncoming shift, breaking, and losing them while giving nursing care. They also had tried a waistband holster for multiple alerting devices and found that too cumbersome. Product opportunities exist for nurse-wearable smart alerting systems.

In home care and institutional care settings, sensor monitoring is proliferating and similar alert issues need to be considered as illustrated in the following scenario. Mrs. Jones awakes at night to urinate and leaks a small amount of urine in her bed triggering the wetness sensor alarm. She gets out of bed triggering more alarms from the mattress sensor and the vital sign sensor as her blood pressure drops and her heart rate rises. She peeks out the door on her way to the bathroom thereby triggering the room exit alarm. When she quickly drops herself onto the toilet seat, her rapid positional change triggers the fall alarm. Although five alert alarms were triggered, Mrs. Jones returned to bed safely by herself. What the nurse does not need is to have the five alarms go off on her pager requiring her to stop performing Mr. Smith's wound care and run to Mrs. Jones. What she needs is more intelligent monitoring that integrates data, records the events (Mrs. Jones up at night two times in bathroom) and only sends useful alerts (vital signs exceeding parameters, or stopped moving,

did not return to bed) or other aspects tailored to Mrs. Jones's usual routines. Technology offerings for long-term care settings have been reviewed in the research literature with suggestions for improvement<sup>41,42</sup>.

Recently an advanced practice Geriatric Nurse Practitioner mentioned to the author that several home care agencies were using automated vital sign monitoring programs for her and her collaborating physicians' frail geriatric patients living at home. To her concern, they were forwarding all the transmissions daily requiring her to now spend an extra hour per day after her workday ended to review these e-files. She worried that she would miss real changes in the midst of a lot of irrelevant readings and that so much data would eventually overwhelm her attention capacity. Her practice group feared liability issues if the data were not reviewed in a timely manner. When asked, the NP clearly expressed the desire for trend data, portrayed in a graph form that could be related to weight gain, medication usage, and other clinical aspects exportable in a form usable for patient education. Then the data would be clinically meaningful to her. Recommendations for technology developers (*Table 1*) and nurses (*Table 2*) are offered to reduce similar frustrations.

## NURSING RESEARCH IN GERONTECHNOLOGY

Gerontechnology nurse researchers have advanced understanding of the feasibility, usability, and outcomes from new technologies. Two randomized studies comparing face-to-face home care assessments with automated interactive voice response (IVR) system assessments<sup>43</sup> and an IVR Alzheimer's family caregiver stress monitoring and counseling program compared to usual care<sup>44</sup> both demonstrated favorable outcomes. The first deployment of elder remote activity and functional monitoring in actual home settings across a variety of housing types identified signal problems and implementation challenges unapparent in laboratory settings<sup>45</sup>. That nursing research was the first to use the monitoring technologies to help working family caregivers unobtru-



# Aging nurse workforce

Table 1. Recommendations for technology developers

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Ask nurses what they want and need the technology to do
Step into the shoes of the nurse (Experience role aspects, do the task)
Observe for and address nurses' technology workarounds
Align with nurse champions of technology
Conduct formative evaluation and make immediate adjustments
Integrate affective dimensions into technology offerings
Imbed few but meaningful alerts
Analyze end-users evaluations and make revisions

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Table 2. Recommendations for nurses

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Verbalize your needs and actively participate in the process
Share experiences that inform technology development
Identify problems with proposed or actual implementation
Be open to try new ways of doing old routine
Participate in all the evaluative aspects
Give insights that improve the likelihood of successful technology adoption and usage
Realize if using a testing version that the improvements may not occur until the next release
Persevere to attain desired features

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sively oversee their elderly family members at home from their workplace through their choice of Internet, cell phone, or pager technologies and individually tailored alerts. Monitoring technologies were advanced into independent living settings for the first time and tailored and stratified alerts to the needs of the elder, family caregiver, building manager, and NPs. End-users reported great satisfaction in this approach that sent meaningful alerts<sup>46</sup>.

Distinguishing the nursing approach was the grounding in real world practicalities,

and the use of the Nursense™ model with individualized tailoring of the monitoring integrated with a data reduction algorithm approach. Unique to these nursing research studies has been the imbedding of an on-line nurse counseling role in each system and the overwhelming consensus across the program evaluations by the end-users that they were willing to pay for similar access to nurse counseling.

Online or telephone based nurse counseling offers new role opportunities for nurses who desire to work out of their homes due to spousal, parent and or child care responsibilities and benefit from flexible full or part time options. Call Centers sponsored by insurers and health plans already use nurses as site monitors to proactively manage complex cases or serve as wellness coaches to prevent patient illnesses. Telepresence health care technologies are maturing and use video interactions with patients to reduce their isolation and monitor basic health and safety parameters. 'Cisco Health Presence' allows multiple members of a patient's care team to simultaneously participate in consultations<sup>47</sup>.

New technologies supporting virtual professional continuing education (CE) programming and simulations can support lifelong learning and the necessary skill building to adapt to evolving practices. One on-line CE example has been tested with NP prescribers to reduce marketing influences and improve evidence based therapies<sup>48</sup>. And geriatric nurse practitioners were found to strongly desire technologies to enable real-time medication consultations with geriparmacists for elderly patients with multi-system illnesses on multiple drug regimens and experiencing declines in glomerular filtration rates of the kidney complicating drug administration<sup>49</sup>.

## WORLDWIDE AGING NURSING WORKFORCE

This review of nursing workforce issues has centered primarily on the issues facing nurses in the USA. While local issues may vary, research suggests that there are similar concerns in other countries about losing nurses to early retirement<sup>50,51</sup>. Nurses represent

the largest group of health care providers in the world with an estimated 13 million nurses employed in health care settings around the globe. This century is experiencing an unprecedented growth in the aging of the world population with a related surge in geriatric patients and demand for professional nursing care<sup>52</sup>. The average age of an employed nurse ranged from 39 in Germany to 47 in Sweden. In between, Canada's nurses were on average 45, Denmark 44, Iceland 44, Ireland 41, Japan 38, New Zealand 44, Norway 42, and the UK 42 years of age<sup>53</sup>. Nurses worldwide are aging and in need of attention.

According to the latest international survey of advanced practice nurses, 71% of the respondents noted that the APN role was officially recognized in their country and over half were prepared for this role at the Master's level<sup>54</sup>. Despite differing degrees, regulatory titles, practice models, and some physician opposition, NPs continue to grow in numbers and develop new ways of practice that can be facilitated by technology as discussed previously. Remote monitoring technologies and video visits offer NPs serving geographically widely dispersed regions in areas with difficult travel, a new means to access and oversee the health situations of at-risk patient populations. Similarly, faculty can collaborate with students and colleagues from around the world, no longer limited by classroom time and space. Intellectual resources can be more easily shared and online discussions held bringing in expertise from beyond one's locale to enrich the faculty and curriculum offerings.

## CONCLUSION

In conclusion, technology offers both promises and pitfalls in addressing ways to support and retain the nursing workforce. Nurses want to adopt and use new technologies that support their ability to improve the efficiency and effectiveness of their nursing care across

a wide range of settings. New opportunities through technology innovations present themselves for nurses seeking non-traditional roles and new ways of caring for patients that are not bedside focused. The challenge to gerontechnologists is to leverage the positive aspects and guide, direct, and counsel technology developers and adopters to overcome the challenges. Partnership approaches between technologists, nurses, and other clinical end-users are recommended from the design stages onward.

Nurses want to use technology to improve patient care and not have to nurse the technology to make it fit into their clinical practice. They are frustrated by redundant paperwork, recording data in logs, in checklists, and in multiple locations, and wasting time securing equipment and supplies. They would like the electronic medical records to be more than a repository for data and to intelligently capture the data from all end-users, coordinate it, and display it in a manner that highlights deviances from normal parameters, weighs priority factors tailored to the patient, and gives decision support to clinicians. Nurses would like supplies and equipment to be bar coded with Radio Frequency Identification (rfid) tags for easy location and automated reordering of supplies. And smart rooms for patient care that will individualize to the patient and deliver real time up-to-date information. They would like to wear or carry one device that integrates valid clinical data from multiple communication devices and uses intelligent technologies to prioritize alerts and needed responses. Nurses would like reliable wireless devices, easily portable, cleanable, and adaptable to point-of-care usage in clinical environments. They would like to use new technologies to reduce inefficiencies in nursing practice, human errors, technology workarounds, and expand their work opportunities. Ultimately, nurses want more time to nurse patients, not technologies.

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