

Novel Artificial Intelligence and Smart Emerging Medical Technology Revolutionize and Transform Nursing Profession in 2020

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Abstract

In 2020, novel artificial intelligent, immersive and connected technological advances have made their way into nursing care delivery settings globally as 2020 had been the year of rapid overwhelming changes. Novel artificial intelligence has the potential to transform healthcare to the forefront of a new era in healthcare driven by its ability to create an energetic improvement in the concept of patients' care. This innovative technology can significantly help drive efficiency and productivity and empower healthcare providers worldwide by providing real time data and clinical interpretation. Emerging medical technology continues to revolutionize healthcare and nursing profession has entered an exciting new frontier of state of the art widgets with high technology communication systems. Some of these new technologies made it possible for nurses to have the ability to utilize all the available big sources of data to make an overall strategy for developing quality care services to improve patients' outcomes through the field of health informatics, awesome inspiring advancements in medical science, telecommunications, and even robotics. The Nurses' workload is astronomical. They have to do countless things at the same time, besides running in and manually doing patient's bed, measuring blood glucose or drawing blood so, these new technologies will provide numerous benefits for nurses, such as freeing up time to provide better-targeted patient care.

Keywords: Novel Artificial Intelligence, Smart Emerging Medical Technology, Nursing Profession

Introduction

Certainly, the future of healthcare is heading in an exciting direction because of the technological advancements that are happening in healthcare today, whether it is a 3D printer creating a model of a person's heart, or a chip monitoring a certain disease, that are truly life changing for both health providers and patients (Tabish SA. 2018). Artificial intelligence is the aptitude exhibited by smart machines through perceiving, thinking, planning, learning, and manipulating objects (National Institution for Transforming India (NITI) Aayog, 2018). This technology enables computer systems to perform tasks that usually require human intelligence (Pan, Y. 2016). Clinical intelligence is the product of its use in healthcare **Healthcare Information and Management Systems Society. US EMR Adoption Model(SM). Retrieved April 18, (2018)**, as it enables more precise and expedited decision making, particularly for nurses (Simpson, R. L. 2018). Artificial intelligence in nursing practice improves efficiencies and decreases low value administrative tasks that allow nurses to spend more valuable time with patients in care

settings (Carroll, W. M. 2019). Nursing profession widely agrees that the new medical technologies help with patient's care (Rotolo, D., et al., 2015). New technology is finding innovative ways to impact the healthcare industry. A new WHO survey over 600 professional nurses found that 82% agreed that new technology and equipment innovations positively influence patient's care (World Health Organization, 2018). Additionally, as more of the population diseases, as life expectancy increases, and as the nursing shortage continues, these new medical technologies are crucial for continued patient's care, plus the health care system is at a great need for it (Zadvinskis, et al., 2018). The nursing profession finds many of these new medical technologies help them with routine work processes, and can decrease human mistakes and errors that can come from too few nurses, working long hours, and exhausting workload with too many number of patients (Carroll, W. 2020).

The following lines will spot on some examples of this amazing technology.

I. Automated smart IV pumps

Automated smart Intravenous (IV) pumps accurately control the dosages and drips given to patients. Software and medical technology allows nurses to change the drip amounts and medication doses so patients are not waiting for changes (**Husch, M., et al., 2010**). There are IV pumps for nutrition, which gives needed meals at the right times that give nurses opportunities to focus on other areas of work, instead of having to measure and calculate to give medication or food. Additionally, there are self-pumps which allow patients to increase a controlled amount of pain medication for themselves (**Clarke, J., et al., 2015**). Automated IV pumps help speed up nursing processes, and can be crucial if there is a need for an immediate adjustment. Changing medication through an automated process furthermore, it removes or decreases the chance of human error that could present matters for clinical patients and hospitals (**Obsheatz, M. 2019**). Smart pumps are still not “smart” enough to ensure the “Five Rights” of right drug, dose, route, patient, and time, much less right response and documentation (**Obsheatz, M. 2019**). Barcode medication administration (BCMA) can help ensure these rights and works very well for tablets, unit-dose liquids, and injections for which the drug administration is a distinct event besides scanning the nurse, patient, and medication and administering the drug complete the event (**Russell, R. A., et al., 2010**). However, many IV infusions are a continuing process involving initial programming and often subsequent changes with multiple nurses involved in the therapy (**Vanderveen, T. 2013**), while smart pumps and barcode medication administration coexist in many hospitals, except in a very small number they are not integrated (**Ficarra, B. 2020**). Addressing the complexity of IV therapy requires an integrated approach (**Vanderveen, T. 2013**). Hospitals have different kinds of automated smart IV pumps, thus training and education must be based on the specific type used in the hospital or clinic where nurses work. Additionally, nursing schools and colleges' education must include giving a training and information on these different types of new software and technology including how automated smart IV

pumps work and why they are valuable (**Obsheatz, M. 2019**).



Figure1. Auto-Pump Programming Using Barcode Scanning (Russell, R. A., et al., 2010)

II. The Six Best Infrared Vein Finders in (2020)

As finding a vein is often the first interaction after hospital admission between nurse and a patient, it is usually during first cannulation so, a failed IV insertion not only holds up care from the beginning, but also can influence the patient’s satisfaction (**Clarke, J., et al., 2015**). The new vein finding tools were designed to help both adults and pediatrics in reducing hard sticks' pain and improving patient's satisfaction (**Ficarra, B. 2020**). Critical care nurses understand the value of not only quickly locating a vein, but receiving reliable information about vessel quality, so these vascular access tools does both, with the ease of a few on-screen touches (**Vanderveen, T. 2013**).

II.1. Accu-Vein 400 (AC-400) or EchoNous Vein Finder

The Accu-Vein 400 is a handheld, portable device used to reveal veins through illuminating them by drawing a veins' map on the patient’s skin surface. It gives a highly visible and easy current reading of the most easily accessible veins to minimize patient’s discomfort during injections, IVs, and draw blood sampling (**Carroll, W. 2020**).



Figure 2. Accu-Vein 400 (AC-400) or EchoNous Vein Finder (Carroll, W. 2020)

EchoNous Vein finder is designed for nurses inserting peripheral IV catheters by providing an immediate and clear image of veins using just two-button controls. The easy-to-use device also includes optimized settings for using with adults and pediatrics (Vanderveen, T. 2013). The device works by providing a proprietary vein visualization technology that shines an infrared light on the patient's skin. The hemoglobin within the patient's blood absorbs the light, creating a red pattern that can be seen on the surface of the skin, while the oxygen-depleted veins appear darker in the pattern, indicating the presence of a vein so; it is easy to find a suitable vein to use for treatment (Carroll, W. 2020).

II.2. Smart Medical Technology Mobile App

This technology uses artificial intelligence with augmented mixed virtual reality to find veins through an easy sitting up for a mobile app on smart android phone (Wahl, B. 2018).



Figure3. Smart Medical Technology Mobile App (Wahl, B. 2018)

II.3. Wee Sight infrared vein Trans illuminator finder

It is an amazing tool used for pediatric veins transillumination to decrease babies and toddlers' pain when drawing blood samples or starting IVs. A light tiny vein finder device is shaped to make it easy for the nurse to position it around the baby's tiny limbs as it can lie flat on a surface to allow draping the baby's arm or leg over it, and can be seen in many pediatric care units today (Li, A., et al., 2019).



Figure 4. Wee Sight infrared vein Transilluminator finder (Li, A., et al., 2019)

The vein mapper wavelength uses high-intensity LED bulbs (infrared light-629 nm) to illuminate the little veins. The LEDs do not heat up so they could not hurt babies' skin moreover; it works with only two AA batteries so it is cost effective (Li, A., et al., 2019).

II.4. Vein Finder Glasses – Oxy-Iso Paramedic Glasses

Oxy-Iso Paramedic vein glasses look like a nice pair of sunglasses, act by filtering UV rays, whilst serving two major purposes are enhancing veins and correcting color blindness through improving the ability to see greens and reds so with these glasses, nurses and phlebotomists can clearly see superficial veins, detect blood oxygen levels, and even view rashes (Ficarra, B. 2020). This device has a specially tinted lenses, which filter light in a way that makes veins appear to fluoresce or glow and amplify the ability to see the oxygenated blood by hindering the perception of blood concentration variations (Husch, M., et al., 2010).



Figure 5. Vein Finder Glasses -Oxy Iso Paramedic Glasses (Ficarra, B. 2020)

The Paramedic vein glasses could be worn all the day without hurting eyes because of their comfortable lightweight and can be used effectively by colorblind medical staff. However, they will not break, as they are impact-resistant and have an anti-scratch coating plus anti-fog and anti-static ability with relatively low-cost, moreover its large lenses

protect staff from blood splatters but it necessitates bright sunlight or strong indoor light or a strong flashlight or a portable lamp and cannot be used over prescription glasses (Carroll, W. 2020).

II.5. NeoGlo® Transilluminator



Figure 6. NeoGlo® Transilluminator (Chan, E., et al., 2018)

This device is depending on multiple LED light settings which is either forward or upward facing white lights with its cool touch allows patient safety and comfort (Chan, E., et al., 2018).

II.6. Venoscope Trans illuminator



Figure 7. The powerful LEDx Venoscope Trans illuminator (Huston, C. 2013)

The powerful LEDx Venoscope Trans illuminator has thirty-two bright LEDs embedded around its large opening; (24 orange lights and 8 reds). This device is regarded as the best of all presented previously because of its color combination, which makes it very effective for seeing deeper veins even if the skin is thick or dark-colored. Nevertheless, as a vein finder light will be used on multiple patients, it will necessitate extra accessories before performing venipunctures and cannulation to ensure contamination avoidance and protection against infection such as; disposable slip covers and gentle germicide wipes (Huston, C. 2013).

II.6.1. Disposable Slip Covers

These covers are made to protect from cross-contamination. Most vein finders come with them in the package (Huston, C. 2013).



Figure 8. Disposable Slip Covers (Huston, C. 2013)

II.6.2. Gentle Germicide Wipes

Most vein lights cannot be cleaned with alcohol to avoid damage to the light area so; these wipes are used instead though following the cleaning instructions carefully (Huston, C. 2013).



Figure 9. Gentle Germicide Wipes (Huston, C. 2013)

III. Portable monitors.

Portable monitor equipment allows nursing professionals to check up on patients even if they are on the move, or busy helping someone else. Portable devices can monitor vital signs like ECG, respiratory rates, and oxygen saturations, while transmitting the information back to a central monitor. This means that nurses will get an alarm notification if there is any emergency (The Joint Commission, 2013).



Figure 10. Portable device monitoring system (The Joint Commission, 2013)

Most hospitals have nurses check on these levels hourly. Portable monitoring technology allows nurses to track and note a mistake at the right time, even if there are many other things happens at the same time. This helps patients to be constantly monitored from anywhere in the hospital, and alarms sent to nurses through the portable monitor can save lives (Simpson, R. L. 2018).

The same as for automated IV pumps, nurses learn at their specific hospital how to utilize portable monitors, and nursing education programs at colleges and schools help teach their students the value and general use of many common pieces of this technology (Obsheatz, M. 2019).

IV. Smart beds

Smart bed technology can help nurses track movement, weight, and even vital signs on top of they play a major role in keeping patients safe and comfortable during a long hospital stay. With the number of falls and patient injuries inside hospitals, smart beds are very important for patient safety (The Joint Commission, 2013).



Figure 11. Smart bed (The Joint Commission, 2013)

Smart bed technology gives nurses a constant monitor in a room that provides them with regular updates and communications on a patient's activities. It can also help them identify patterns, which can lead to a new diagnosis or a different understanding of a condition. it allow spending less time for nurses in adjusting supplies and medical equipment for comfort or safety, because they can help control that with this smart bed. It allows providers to finish other important work (The Joint Commission, 2013).

V. Artificial Intelligence in Healthcare

Wearable devices and mobile apps all are depending on artificial intelligence which are transforming the healthcare industry several

decades in the future (Healthcare Information and Management Systems Society. US EMR Adoption Model (SM). Retrieved April 18, 2018). Devices that help track heart rates, exercise, sleep, respiration, and more, are helping people take their health into their own hands. With increased accessibility to smart phones, nurses benefit from apps and devices that help them care for patients (Carroll, W. M. 2019)..

Wearable devices are ranging from health tracking to specific patient monitoring, which are often called the future of healthcare. With access to huge amounts of data, wearable devices can help the entire healthcare process starting from diagnosis until recovery (Pan, Y. 2016).

Wearable devices help remove elements of human error for nurses, because the communication of data comes directly from the device itself. It allows for faster record keeping, and helps patients and nurses maintain consistent monitoring of health (Zadvinskis, et al., 2018).

V.1. Stethee 'Smart' Stethoscope

The smartphone stethoscope is essentially a stethoscope app that allows nurses and doctors simply use their smartphone to get breathing sounds and see heart rates. Using smartphone can be less frightening, especially for younger patients, moreover it gives providers a full range of information and easy tracking of medical needs (Alqahtani, F.E. 2018).

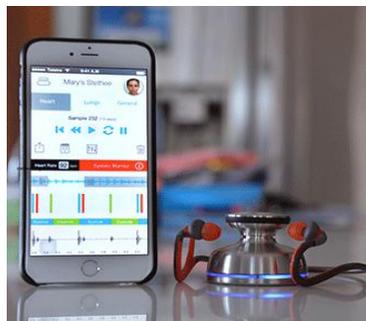


Figure 12. Stethee 'Smart' Stethoscope (Alqahtani, F.E. 2018)

The newly launched, FDA-cleared Stethee Pro features technology to capture and analyze heart and lung sounds and data via Bluetooth, operating around smartphone applications for

both Apple and Android devices (**Healthcare Information and Management Systems Society. US EMR Adoption Model (SM). Retrieved April 18, 2018**)⁽⁴⁾.

V.2. Mini Portable Clip Spo2 sensor



Figure 13. Mini Portable Clip Spo2 sensor monitor (Ficarra, B. 2020)

It is a portable digital finger pulse oximeter that can accurately measure three parameters within 10 seconds are; blood oxygen saturation level (SpO₂), pulse rate (PR), and PI (perfusion index). Moreover, it is small, easy to carry and use with low power consumption and low battery indicator. Today and after Covid-19, it is widely used in families, medical institutions and community centers (**Ficarra, B. 2020**).

V.3. Chip Monitors Blood Sugar Levels

It is a laboratory on a chip. This is what will be able to replace what is done in the laboratory today ⁽²⁴⁾. A medical company has created a solution that can constantly monitor blood sugar levels in real time. It depends on an artificial intelligence algorithm then triggers its software to administer either glucose or insulin via the drip connected to the patient and a screen instantly shows the metrics for the patient (**Graham J. 2016**).



Figure14. Chip Monitors Blood Sugar Levels (Li, A., et al., 2019)

V.4. 3D Bioprinting

In both medicine and healthcare, Three Dimensional (3D) Bioprinting revolutionize drug creation and the production of medical equipment; however, it could also offer new

methods for practicing medicine, optimizing supply, and propose cheaper and more personalized medical services (**Alqahtani, F.E. 2018**).

The 3D Bioprinting is the automated fabrication of multicellular tissues via spatially defined deposition of cells in specific patterns or compartments resemble architecture that mimics key aspects of human biology because 3D Bioprinting uses the patient's own cells to repair tissue damage (**Cui, X., et al., 2012**).

Using 3D bioprinting scientists in USA created a blueprint for producing finger splints and Dutch surgeons replaced the entire top of a 22-year-old woman's skull with a customized printed implant made from plastic. Therefore, Prosthetics and implants can be 3D printed in the nearer future (**Xu, T. et al., 2013**).



Figure 15. 3D printed cast (Zopf, D.A., et al., 2013)

The 3D printed cast allow the patient to have a shower with a cast on, but without a bunch of plastic bags wrapped around it (**Zopf, D.A., et al., 2013**). The orthopedist could open and close the cast in seconds; it costs around fifty dollars and only few hours to be created (**Kruth, J. P. 2016**).

A group of volunteers made a network called the e-NABLING the Future project, share 3-D printing designs, video tutorials and other information about building prosthetic hands which enables volunteers, doctors, nurses or anyone in the field to make a difference by literally "giving a helping hand" to those in need (**Allard, T., et al., 2015**), (**Derby, B., 2012**).

Researchers at Harvard University were the first to use a custom-built 3D printer and a dissolving ink to create a swatch of tissue that contains skin cells interwoven with structural material that can potentially function as blood vessels in the future (**Mironov, V., 2011**).



Figure 16. A swatch of synthetic skin tissue (Marga, F. 2012)

In addition, researchers of Madrid University have developed the prototype of a 3D printer that can create synthetic skin. It is adequate for transplanting to patients, who suffered burn injuries or have other skin issues (Steer, D.L. & Nigam, S.K. 2014).

Moreover, in 2018, the Organovo scientists; which is the pioneering company in 3-D Bioprinting of human tissues for drug discovery; had successfully bioprinted liver tissues that mimic key aspects of human biology with tight control of composition and geometry but they seemed to be four to six years away from printing liver parts for transplantation (Nair, K. 2009).

Bioprinted livers are of a great help in pharmaceutical industry to replace animal models for more accurate and proper analyzing toxicity of new drugs since bioprinted tissues can allow screening for targeted drugs to a targeted organ for blocking disease progression in a cell (Duan, B., 2013).



Figure 17. An epilepsy drug called Spritam (Nair, K. 2009)

A few months ago, Organovo launched its second commercial product; bioprinted human kidney tissue. The company suggests that within a decade they will be able to print solid organs such as liver, heart, and kidney (Duan, B., 2013). Moreover, the FDA approved an epilepsy drug called Spritam that is made by 3D bioprinting that

prints out the powdered drug layer by layer to make pills dissolve faster than average^(34&36).

VI. AvaSys Tele-Sitter video-observation system

The AvaSys Tele-Sitter System is an audiovisual remote monitoring of patients at risk for falling. Many hospitals today are implementing the AvaSys Tele-Sitter video-observation system to improve patients' safety and lower staffing costs (Murdoch TB, & Detsky AS. 2013).

The AvaSys room unit is offered in three alternatives: a mobile cart, a portable wall-mounted unit or a permanent ceiling unit (Dilsizian SE, & Siegel EL. 2014). Healthcare providers can monitor patients from a centralized workstation using one-way video and two-way audio from the patient room using movable/portable or permanent AvaSys room unit hardware (Dilsizian SE, & Siegel EL. 2014). Via video on up to 12 patient rooms from a command center healthcare providers can immediately intervene when a patient is at risk for fall or self-harm through verbal redirection of patient whereas in an emergent situation the technology activates an alarm by room number telling the nurse to get there right away (Patel VL, et al., 2019).

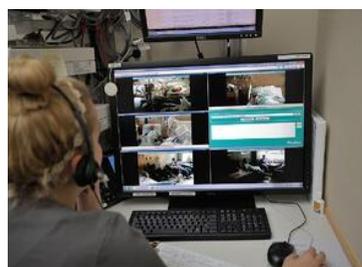


Figure 18. AvaSys Tele-Sitter video-observation system (Murdoch TB, & Detsky AS. 2013)

Generally, Tele-Sitter is used for patients who have dementia, a history of falls, medical safety restraints, a risk of running away, are being taken off drugs or alcohol, are on a ventilator, or are potentially aggressive or violent (Jha S., & Topol EJ. 2016).

Overall, AvaSys Tele-Sitter System is a remarkable benefit for health system as it allows patients' monitoring, reduces fall rates and gives a great nursing assistant to be in one place instead of watching patients one by one (Neill DB. 2013).

VII. Robotics

Robotics can provide improved diagnostic abilities through much less invasive and more comfortable experience for the patient plus their ability to do smaller and more precise interventions. In addition, they could be used as adjunct care providers for some physical and mental health care provision that can improve care, save time, prevent medical errors and minimize the potential for adverse effects (Neill DB. 2013), (Administration UFaD. 2017).

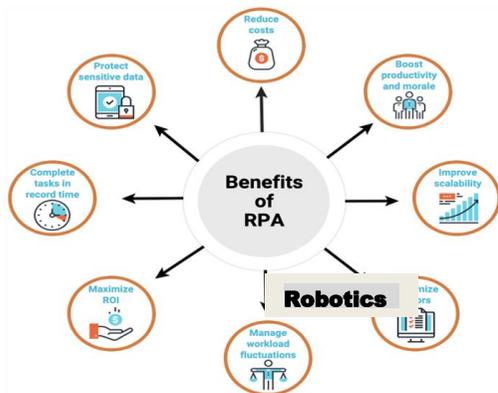


Figure 19. Source: Summit Healthcare (Administration UFaD. 2017)

Robots can collaborate in the healthcare field through tasks like; assisting in surgeries, disinfecting rooms, scheduling appointments, drawing blood, dispensing medication, and keeping patients' safe nevertheless robots are likely to be costly that has been a barrier for adoption (Murff HJ, et al., 2011). In 2020, more hospitals decided to use them for easing clinician workloads and closely and accurately patients' monitoring. Although using robots necessitates some forethought and preparation, but it will be important for healthcare leaders to make sure that the human touch stays relevant in the patient experience (Darcy AM, Louie AK, & Roberts LW. 2016).

While nurses agree that new healthcare technologies and innovative medical devices can help them, they are also being in agreement that technology should not replace the nurse-patient human interactions (Haddad L. M., & Toney-Butler T. J. 2020). Working directly with patients is a massive element of healthcare, as nurses provide a crucial element of interaction that allows patients to feel ease.

Working with patients and their families, explaining procedures, health education and psychological support are all part of nursing jobs, which could not be substituted by technology (Zadvinskis, et al., 2018). Many healthcare professionals worry that increased healthcare technology could eradicate that human element (Clarke, J., et al., 2015).

Unlike other sectors, the human interaction in healthcare is crucial for patient success. It is critical to find the right balance between technology and the human nuance that make nursing and healthcare successful (Huston, C. 2013).

Professionals also strongly agree there should not be an over-reliance on healthcare software and technology, and that there is no substitute for human eyes on patient's symptoms and needs, while technological advancements aren't a magic potion as healthcare solutions, new technology is changing the way nurses work in positive ways (Murff HJ, et al., 2011).

Conclusion

As the healthcare industry continues to change with the support of different types of new technology, future advancements and innovative artificial intelligence, so nurses have to change right along with it to elevate patient's care in this process.

Emerging healthcare technology is exciting and transformative, with smart innovations launching every day that are revolutionizing healthcare industry and has a direct impact on the nurses' role, which represents a challenge to nurses who are tasked with learning about this new technology and implementing it into their field to get their career advancement.

Technology application in nursing is fascinating as it allows helping to drive nursing professionals' success. Innovative healthcare devices facilitate nurse's job and help ensure that patients receive the best care possible while decreasing errors. Nurses use and encourage application of various types of technological innovations for treating and maintaining positive patient's health outcomes.

Obviously, with the advancements of new technology in the healthcare industry, it become crucial for nurses to keep abreast of

these innovations and elevate their capabilities to go with what both patients and the healthcare industry require for exceptional care. Nursing education is the key component for navigating these new challenges, where skilled and knowledgeable practitioners pass on their wisdom to the next generation of nurses.

Consequently, nurses necessitate enhanced and up-to-date training courses that can help not only furthering their education but also become more comfortable in managing the technological needs of the advancing healthcare industry and preparing them for future advancements and innovations that may impact their role as nurses.

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