**The Use of Simulation amongst Certified Registered Nurse Anesthetists**

**to Reduce Skill Decay**

Joshua Olson

University of Detroit Mercy

Nur 7800

Dr Rosanne Burson

Dr Gregory Bozimowski

February 28th, 2022

**Abstract**

The loss of acquired skills or knowledge (known as skill decay), is a well-known phenomenon that happens to every human. Some skills fade over time, and some knowledge gets lost over time, especially with disuse. Amongst Certified Registered Nurse Anesthetists (CRNAs), skill decay could have significant detrimental effects, as the decayed skill or knowledge could lead to a negative patient outcome. Current research seems to indicate that simulating a previously-learned skill, such as central venous catheter (CVC) insertion, can reduce skill decay. The purpose of this project was to determine if a longitudinal assessment and simulation of a CVC insertion (Q 6 month), would reduce skill decay amongst CRNAs.

A pretest-posttest design was used. Prior to any intervention, 46 CRNAs (N=46) were sent a longitudinal assessment in order to understand their perceived ability and willingness to insert a CVC. Next, using a standardized central line insertion checklist to track results, CRNAs were scored on their ability to simulate a CVC insertion via task trainer. After the initial insertion, an educational refresher was given and the proper insertion technique demonstrated. The CRNAs then demonstrated their insertion ability immediately following the education and showed significant improvement (P<.0001). Six months later, 20 of these CRNAs (N=20) returned to simulate a central line insertion again, this time with no education or demonstration. At the 6 month interval, the CRNAs retained almost all of their attained skill (P 0.0109). This study may have implications for reducing skill decay amongst CRNAs, and may be a part of a comprehensive longitudinal assessment plan nationwide.

**Keywords**: Skill decay, simulation, central line, nurse anesthetist, longitudinal assessment, anesthesia, education.

Most every adult has some skill that has either been eroded over time or has been completely lost. This is known as *skill decay*. More formally put, skill decay is the “loss or decay of trained or acquired skills (or knowledge) after periods of non-use" (Bennett, Stanish, & McNelly p 58). This decay can happen slowly over time, but it also happens in as short of a time as 1 month of “non-use” (McGaghie, 2015).

In a casual sense, skill decay may not have a significant impact on someone’s life, but in certain sectors it can be devastating. The U.S. military identified skill decay as a key problem for peace-time troops, and spends considerable time and money on maintaining a force that is ready for combat (Angel, 2000). A military force that does not know how to win a war is not much use. In healthcare, the cost for skill decay can be equally catastrophic. If a surgeon has not performed a particular surgery in a year, it is likely that they may not be able to perform the procedure proficiently (Barsuk, et al., 2010). If an emergency room physician works in an adult-only ER and has not worked with children in years, they will likely be unsafe when they need to run through routine pediatric interventions (Ansquer, et al., 2019). A Certified Registered Nurse Anesthetist (CRNA) who practices exclusively in an endoscopy center may not have used a fiberoptic scope to intubate since their training and might not be able to perform it safely.

One way that has been shown to be effective in mitigating skill decay is through the use of simulation. The use of simulation has been around for centuries, but with the advent of more improved technologies, the difference between “real world” scenarios and simulated ones can be negligible. The use of simulation to reduce skill decay, is cost-effective, relatively easy to implement, and can have a positive impact on job satisfaction.

**Background**

Amongst CRNAs, skill decay can be profound. CRNAs are trained to be independent practitioners, so they complete their training and education with the ability to treat children and adults, put in epidural catheters, central lines, and cricothyrotomies. They are trained on ultrasound, fiberoptics, and arterial line insertions. CRNAs are able to do complex nerve blocks or basic sedation for a colonoscopy. However, for numerous reasons, CRNAs can suffer significant skill decay, potentially leaving their practice unfulfilled and their patients at risk.

Three common reasons for skill decay amongst CRNAs are 1) practice setting, 2) scope of practice limitations/restrictions, and 3) infrequency of a procedure.

***Practice setting***

The type of patients or procedures done at a clinical setting determine the experiences a CRNA will face. A CRNA might work in the military (CRNAs are used extensively, almost exclusively, in the United States military) and never put in a labor epidural. Perhaps a CRNA practices in an endoscopy center and never needs to place an arterial or central line. Or maybe the CRNA works at a hospital that does not treat pediatric patients, so they only work with adults. Where a CRNA choses to practice will greatly influence their skill decay.

***Scope of Practice Limitations/Restrictions***

Amongst advanced practice providers (APPs), CRNAs may have one of the most restricted practices. This may be due to antiquated laws that were put in place decades ago by physicians (who were mostly male) to limit what CRNAs could do (who were mostly female) and to require undue supervision constraints. Also, many local facilities restrict CRNA practice at the behest of the physician anesthesiologists who want to control certain aspects of anesthesia practice. CRNA practice may be restricted because of billing issues, as physicians may able to reimburse more if they do a procedure themselves instead of the CRNA, even though the CRNA is performing the exact same procedure.

***Infrequency of a Procedure***

One example of an infrequent procedure is a cricothyrotomy. A cricothyrotomy is an emergency airway that is surgically placed directly into the trachea. Because of the many tools CRNAs now have at their disposal to perform intubation (video laryngoscopes, fiberoptic bronchoscopes) and because CRNAs may work somewhere where a surgeon is around who can perform a tracheostomy if needed, CRNAs rarely need to perform cricothyrotomies. In fact, most CRNAs will practice long and impressive careers without ever having done one, but if the time came, they would be expected to perform it. Another example of an infrequent procedure that is especially important to Henry Ford Hospital (HFH) is the insertion of central lines. There was a time when every patient in whom inserting a peripheral intravenous (IV) line was difficult, had a central line placed. Central lines were ubiquitous in the operating room, and CRNAs placed them frequently. Over time it became clear that placing central lines was not a benign procedure and was full of potential negative consequences (infections, pneumothorax, vessel injury, etc.). Central line insertion is now done only in special circumstances, and as a result, CRNAs rarely place central lines anymore.

**Significance**

HFH employs approximately 70 CRNAs. Because of the voluminous case load and diversity of patients at HFH, CRNAs are expected to be able to perform an array of techniques along a wide spectrum of patients. This may mean administering light sedation for a colonoscopy one minute, but later that day the CRNA may be asked to insert both central and arterial lines for a transplant patient. On a Thursday they may be putting in epidurals and spinals in the labor and delivery unit, but on Friday they are responding to emergency airway calls throughout the hospital.

Because of this large variety of cases, as well as the volume of anesthesia cases on any given day, it may be months or up to a year since a CRNA has performed a certain skill. One skill that HFH CRNAs rarely performs is central venous catheter (CVC) insertion. Of the 3 reasons for potential skill decay listed above (practice setting, scope of practice, and infrequency of a procedure), all of these apply to CVC insertions for CRNAs at HFH.

In the current practice setting, CRNAs share cases with physician residents training in anesthesiology. This is not a competition, but because residents are learners, they often are assigned cases that are more challenging and will allow them to get much-needed practice on skills like CVC insertions. As a result, most cases that require a CVC insertion are assigned to a resident.

While the scope of practice of CRNAs at HFH includes CVC insertion, the culture is that it is physician-led. This means that if the anesthesiologist does not want the CRNA to insert the central line, the CRNA would have to attempt to negotiate with the physician to do it, or ask the CRNA manager to intervene on their behalf. This requires some courageousness by the CRNA to call in a supervisor to mediate the situation or to professionally confront the physician. Often what happens is that the CRNA is not confident in their ability to insert the CVC (because of skill decay), and when the anesthesiologist resists their desire to insert it, they do not feel empowered to fight for their scope of practice.

Lastly, CVCs are used less and less frequently. As stated above, CVCs are not a benign procedure and always come with a risk. As a result, CVCs are inserted as a last resort or only when clinically necessary. This means that CVC insertion is much less common that it used to be.

For these reasons, the CRNAs at HFH suffer from significant skill decay as it relates to CVC insertion. In a recent survey sent by the HFH CRNA Education Committee to assess what skills the CRNAs at HFH wanted re-education on, CVC placement was the most requested (Olson, 2018). This likely means that the CRNAs’ self-perceived ability in CVC insertion is low.

According to a recent survey by Brown-Mahoney et al (2020), 15.4% of CRNAs plan to change jobs in the next 2 years. Of the reasons leading to this high turnover rate, autonomy and skill variety were the most significant. One way to increase both autonomy and skill variety is to empower CRNAs to perform CVC insertions. As CRNAs increase their autonomy and skill variety by maintaining proper CVC insertion technique, their likelihood to leave their current job may decrease.

The use of simulation for reeducation has been shown to significantly reduce skill decay. Although simulation has been around for centuries, its application in the health care world has grown tremendously over the past two decades. Its use has been well-documented and it is generally agreed that simulation is of added benefit to learners (Au et al., 2018). There are many reasons for this. Simulation has been shown to be as effective in training health care workers as real-world experience (Pfiefer et al., 2016). Many health care curricula are now requiring simulation as part of their training. This is because the training, debriefing, and technology of simulation has improved so much in recent years that simulation can be as similar and beneficial as the real thing. Furthermore, simulation allows a learner to practice a skill with no harm to a patient. For example, historically a CRNA student would intubate the first time on a real, live human. But with the implementation of simulation, a CRNA student could be proficient at intubating (or any other skill, for that matter) before ever touching a patient. The risk for harm is greatly reduced.

**Clinical Questions**

Would CRNAs’ CVC insertion skill be improved through a quality improvement process with simulation? Could CRNAs’ self-perceived ability to insert a CVC be improved following simulation? Would CRNA morale and job satisfaction increase through a simulation-based intervention?

**Literature Search**

A literature review was performed through the PubMed, CINAHL, and Cochrane databases. The terms “anesthetist” and “simulation” were used which generated 70 articles from the last 5 years. Articles were eliminated if they were not relevant to CRNA practice or did not include simulation as a learning tool. Eventually the reference list search in these articles (especially the Kelly, et al, 2019 article) were accessed which led to the final selection of 9 articles.

***Frequency and Type of Simulation***

Sullivan et al., (2019) helped explain some of the different ways in which simulation can be used, as well as timing of its use. This established an important concept: there are different types of simulation and ongoing training. Low-dose high-frequency training (LDHF) is of specific interest, as many of the studies (Eblovi et al, 2017, Wiggins et al., 2018, Pfiefer et al., 2016 & Picard et al., 2015) recommend that method to prevent skill decay. LDHF simulation is a method of retraining that occurs often (per the evidence, at least every 6 months) and the “low-dose” refers to a short training. Several of the studies offered a 30-minute retraining every 6 months as an effective LDHF program. Cepeda Brito et al., (2017), showed that ongoing training as early as 3 months after initial training showed no benefit when compared to ongoing training starting at 6 months. This quality improvement project seeks to use LDHF simulation as the method for preventing skill decay.

***Skill Decay Timeframe***

In their 2016 study, Pfiefer et al., suggested that the skill decay is present 6 months after initial training. Picard et al (2015) reinforced this timeline, suggesting that skill has decayed at 6 months, but perhaps begins even earlier. Eblovi et al., (2017) comes to a similar conclusion and assert that skill regression may begin as early as 4 months after initial training. With their 4-year project studying emergency physicians, Ansquer et al., (2019) indicated that skill regression begins at least as early as 6 months after initial training. Skill decay seems to begin at some point before 6 months.

***Simulation to Mitigate Skill Decay***

The article “*Improving skills retention after advanced structured resuscitation training: A systematic review of randomized controlled trials*” (Lam, et al. 2019) really set the groundwork for this discussion. It established that simulation is an effective learning tool for both initial training and for preventing skill decay. Wiggins et al., (2018) and Ostrowski, Morrison, & O’Donnell (2019) affirmed that simulation is an effective education tool. Both Pfiefer et al., (2016) and Picard et al (2015) reinforced the effectiveness of simulation. Eblovi et al., (2017) seemed to show that maintenance training with LDHF simulation might be the best way to reduce skill decay.

A summary of the literature review suggests that: 1) simulation is an effective educational tool, 2) skills decay occurs sometime between 4-6 months after an initial training, 3) ongoing training should happen between 4 and 6 months after initial training in order to maintain skill proficiency, and 4) maintenance training with low-dose high-frequency simulation might be the best tool for ongoing training.

**Organizational Assessment**

Henry Ford Health System has made their mission, vision, and values very clear:

**Mission:**

We improve people's lives through excellence in the science and art of health care and healing.

**Vision:**

We will be the trusted partner in health, leading the nation in superior care and value -- one person at a time.

**Values:**

* Compassion: We provide a heartfelt experience to every patient, member and each other.
* Innovation: We continuously pursue what's possible through research, education, clinical and operational excellence.
* Respect: We honor the commitment to our communities by acting with integrity, courage and inclusion.
* Results: We reliably deliver on our promise to be leaders in safety and affordability, ensuring the health of our communities (Henryford.com, 2020).

This project seeks to “pursue what’s possible through research, education, [and] clinical …excellence.” Furthermore, this project seeks to help the CRNAs be “leaders in safety and affordability, ensuring the health of our communities.” A strengths, weaknesses, opportunities and threats (SWOT) analysis was performed to help determine HFH’s current situation and to see if there were areas that the mission, vision, and values could be met through this project.

***Strengths***

***CRNA Eagerness***

The CRNAs at HFH are both eager and interested in improving their skills and improving their practice. In fact, a recent survey of the CRNAs at HFH showed retraining of central line insertion as a top desire (Olson, 2018). The CRNAs have been eager to participate in CVC insertion retraining and often discuss their concern about skill decay.

Also, the simulation center at HFH has the equipment (including central line insertion mannequins and ultrasound machines), time and space to accommodate the CRNA simulation. The simulation center staff were supportive and eager to participate in this quality improvement.

***Organizational Support***

HFH has also made proper CVC insertion a top priority and has implemented a validated checklist that is easy to view and chart in EPIC. As a teaching institution with a high need for central lines, HFH also needs many providers who are proficient in CVC insertion.

***CRNA Leadership***

One significant value strength at HFH has is that the leadership team is headed by CRNAs. Having CRNA leadership helps ensure that there is a mutual goal of improving CRNA skills and practice. The CRNA leadership is eager for CRNAs to maintain central line insertion proficiency and has stated that as one of the main goals for the group.

***Weaknesses***

***Infrequency***

As mentioned earlier, the infrequency of CVC insertion has led to skill decay. This is related to staff restricting practice of CRNAs, residents getting cases that require CVC insertion instead of CRNAs, and CRNAs at times declining insertion because they do not feel comfortable with the skill. It is difficult to determine how frequently CRNAs are inserting CVCs at HFH main, but a verbal survey indicates it is less than 1/year (Olson, 2018).

***Physician Colleague Culture***

Occasionally physician anesthesiologists can be a stumbling block to CVC insertion for CRNAs. If a physician does not want a CRNA to insert a CVC but instead wants to do it themselves or even may ask a resident that is not assigned to that case to do it, then it infringes upon the CRNA’s opportunity for skill maintenance.

Also, other CRNAs see HFH as a place where the anesthesiologists do not collaborate or work well with the CRNAs. CRNAs in Michigan generally see the culture of HFH anesthesia department as physician-centered and that CRNAs work *for* the anesthesiologists, not *with* them.

***Staffing***

Getting time for CRNAs to participate in HDLF simulation could be a challenge. All health systems face significant budget challenges and HFHG is no exception. It is not uncommon to staff an anesthesia department with the minimum number of CRNAs needed to cover anesthetizing locations, which can mean allowing time for continuing education or other non-patient care activities may be restricted.

***Case Assignments***

Case assignment can be tricky, as the anesthesia residents do need to have an adequate number of cases in order to graduate, so they may receive preference over CRNAs for cases that require CVCs. However, once those goals have been met, those cases do not have to automatically go to residents. There needs to be collaboration in case assignments with the CRNA board runner and anesthesiologist board runner.

***Work Effort***

Because of the complexity of cases and tight staffing parameters, Henry Ford is generally seen as a place where CRNAs work hard. At many facilities the anesthesia team may have down time during the day, but that is typically not so at HFH. As a result, it is rare that an experienced CRNA will transfer to HFH main; they generally think the CRNAs work too hard.

***CLABSI***

In 2015 HFH had 64 Central Line Associated Blood Stream Infections (CLABSI). In the following 3 years (2016-2018), that number was reduced to 38, 31, and 36 respectively. But in 2019 that number increased to 56 and the hospital is on track to have 45-50 CLABSI for 2020. In an effort to reduce CLABSI nationwide, the Center for Disease Control and Infection Prevention (CDC) developed a 5-point bundle. Of the 5 points, 4 of them are related to insertion. Pronovost et al (2006) used this bundle in a multi-center cohort study and reduced CLABSI rates by 66%. For this bundle to have the significant impact that it had, Pronovost el al. performed an extensive education program to all providers who inserted central lines.

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***Opportunities***

***COVID***

As COVID cases continued to rise in the early days of the pandemic, changes in practice occurred at HFH. When the first wave of COVID cases hit, this led to an increase in CVC insertions by the CRNAs as they were providing care in the ICUs. How this will impact practice in the future is unknown, but it may lead to the use of CRNAs in atypical ways (as it did before), like CVC insertions.

***Scope of Practice Issues***

While Michigan recently passed legislation removing supervision requirements and potentially improving the general scope of practice for CRNAs, many facilities in Michigan do not let CRNAs insert CVCs. It has been demonstrated nationwide is that it is most efficient and cost-effective to let all APPs practice to their fullest scope, so, combined with the recent removal of the supervision requirement, this may change in coming years.

***Threats***

***Billing/Anesthesia Groups***

A common trend in the business of anesthesia is the outsourcing of anesthesia services. Hospitals and health systems often take CRNAs and anesthesiologists off of their payrolls and hire an anesthesia group to run the department. This often drastically changes the culture and scope of practice for CRNAs. Many hospitals and systems in the Southeastern Michigan market have already switched to this model.

**Turnover**

While Henry Ford’s reimbursement package is competitive for CRNAs, many CRNAs have left for other health systems. While HFH may not ever be able to compete financially with some other systems, it can offer a scope of practice and a culture that is very attractive and thereby increases retention.

**Cost**

The cost of this project was concentrated in two main areas: materials and staffing. A central line kit that is used at HFH costs about $115. One central line kit can be used by many providers during the simulation, reducing the cost. Previous central line insertion courses have been able to use one central line kit up to 10 times. The ultrasound machines are already purchased, and their usage does lead to wear and tear, but the cost is minimal and an already assumed cost within the department budget. The SIM lab does have a significant support cost, but it is not billed directly to the anesthesia department, and it is not necessary to use the lab. This simulation could be done in any appropriate room or venue.

The CRNAs at Henry Ford are currently paid about $98.50/hour. An initial central line training course would take about 1 hour, with subsequent refreshers about 30 minutes. This would total 90 minutes for the first year, and 60 minutes a year after that. The first-year wage cost would be about $150/CRNA. With about 70 CRNAs in the department, that equals about $9,000 in wage costs for the first year and $5,910 for subsequent years.

However, it is possible to incorporate this training into existing scheduled time, leading to no extra wage cost. CRNAs could be participate in this simulation during scheduled downtime or meetings. If done during a Wednesday morning meeting, no additional cost would be incurred and the CRNAs could still earn continuing education credits (CEs).

If the highest cost at $11,300 (combine wage and supply costs) is assumed for the initial year, but CLABSIs are reduced by 1, at the estimated cost of $48,000 (Bell & O-Grady, 2017), Henry Ford Health System has saved $35,000. If CRNAs are able to perform this simulation in their normally scheduled working hours, the cost goes significantly down and the savings goes up. Add on top of that the increased job satisfaction from CRNAs, and this cost is a significant net benefit to the system.

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| --- | --- | --- |
| **Highest Possible Costs** | Year 1 | Year 2 |
| Central Line Kit | $2,300 | $2,300 |
| CRNA Wages | $9,000 | $5,910 |
| **Total** | **$11,300** | **$8,210** |
| **Cost of 1 CLABSI** | **$48,000** | **$48,000** |
| **Savings:** | **$36,700** | **$39,790** |

|  |  |  |
| --- | --- | --- |
| Lowest Possible Costs | Year 1 | Year 2 |
| Central Line Kit | $2,300 | $2,300 |
| CRNA Wages | $0 | $0 |
| **Total** | **$2,400** | **$2,400** |
| **Cost of 1 CLABSI** | **$48,000** | **$48,000** |
| **Savings** | **$45,700** | **$45,700** |

***Turnover Reduction***

The CRNAs at Henry Ford have stated that they are interested in CVC retraining. This program would have great potential to increase CRNA job satisfaction and reduce turnover. Mahoney et al., (2020) estimates that hiring and training of a new CRNA costs between $145,000 and $157,000. If just one CRNA stayed at HFH as a result of this program, this would pay for itself for years to come.

***Efficiency***

The ability for the department to have more providers proficient at inserting CVCs at a high level can only increase efficiency. When a CVC needs to be inserted, the amount of available providers to insert it would only go up. This potentially could lead to faster on-time starts and shorter operating room turnover times thereby eliminating costly wastes of time.

**Rationale**

As skill decay amongst CRNAs at HFH continues, there needs to be an intervention to mitigate this fade. One intervention that has proven to reduce skill decay is low-dose high-frequency (LDHF) simulation, completed at least every 6 months. This retraining has been requested by the CRNAs at HFH and could have a significant impact on job satisfaction and morale.

During the initial wave of COVID-19 admissions at Henry Ford Hospital, many health care workers were reassigned. CRNAs were asked to lead turn teams (to turn patients into the prone position), manage intubations across the hospital, facilitate code blue calls, and assist in line placement in the ICU. Using CRNAs in this way allowed them to work to the fullest of their scope of practice, and it allowed other personnel to spend time working to their fullest scope (like surgeons doing surgery instead of placing central lines). This crisis was a reminder for the need to keep providers competent in their skills. Simulating central line placement has been shown to be a safe and effective way to keep providers proficient.

**Purpose Statement**

***Scope***

This quality improvement project is focused on the CRNAs at Henry Ford Hospital Main (Detroit) campus. This project implements an education program via simulating a CVC insertion validated by Henry Ford’s CVC insertion checklist. Every CRNA at HFH Main was asked to do this supervised simulation every 6 months. The project was led by the CRNA Education Committee Chair and in cooperation with the CRNA Education Committee.

***Goals***

The goals of this project were to; 1) improve CVC insertion technique amongst the HFH Main CRNAs, 2) increase CRNA confidence in their CVC insertion technique, and 3) improve CRNA morale and job satisfaction at HFH Main.

**Conceptual Model**

The structural framework for this quality improvement (QI) project is based on the Institute for Healthcare Improvement’s (IHI) model for improvement. The IHI model for improvement has two basic components: a framework for understanding the QI and a step-by-step process for enacting it. The basis for the model asks 3 questions: 1) What are we trying to accomplish? 2) How will we know that a change is an improvement? 3) What change can we make that will result in an improvement? Those questions are answered utilizing the process outlined in figure 1.

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Figure 1- IHI Model for Improvement, partially taken from IHI.org.

The step by step plan IHI suggests for a QI is this:

1. Form a team
2. Set Aims
3. Establish Measures
4. Selecting Changes
5. Testing Changes
6. Implementing Changes
7. Spreading Changes

Since this intervention was focused on adult education, Knowles Andragogy theory was chosen as the framework for this quality improvement. Andragogy is broadly defined as the education of adults (Oxford, 2020). “Andragogy makes the following assumptions about the design of learning: (1) Adults need to know why they need to learn something (2) Adults need to learn experientially, (3) Adults approach learning as problem-solving, and (4) Adults learn best when the topic is of immediate value” (instructionaldesign.org, 2020).

Malcolm Knowles identified some specific principles of andragogy:

1. Adults need to be involved in the planning and evaluation of their instruction.
2. Experience (including mistakes) provides the basis for learning activities.
3. Adults are most interested in learning subjects that have immediate relevance to their job or personal life.
4. Adult learning is problem-centered rather than content-oriented.

(Adams, 2020)

This quality improvement project was designed to improve HFH CRNA CVC insertion technique utilizing an IHI framework and following Knowles andragogy theory. To follow these principles, this project surveyed the CRNAs on their preference on timing, location and methods. 1) Learners involved in planning/evaluation: Every participant was surveyed post-intervention on their desires for changes in the QI (timing, location, methods, etc.). 2) Experience as basis for learning: The experience of CVC insertion, including the pre-intervention CVC insertion attempt will be the basis for learning. 3) Immediate relevance: As this training was highly requested by the CRNAs, and it has immediate relevance to their job, this QI is very targeted. 4) Problem-centered: this QI was based on a known problem; skill decay. The focus was on mitigating that problem, not simply delivering content.

***Forming a Team***

The foundation of this QI team is the board. The chairperson is Greg Bozimowski, DNP, CRNA (Professor of Nurse Anesthesia- The University of Detroit Mercy). The organization board member and site mentor is Teresa (Terri) Carbone, MS, CRNA, CPHIMS (Director of Surgical Services- Henry Ford Hospital). The designated reader and implementation coordinator is Hassan Chaaban PhD, CRNA, CHSE (Director of Advanced Practice Providers- Henry Ford Health System).

Other key members of the implementation team were Claude Johnson MS, CRNA (CRNA Manager- Henry Ford Hospital) and Joshua Olson MS, CRNA (CRNA Education Committee Chair). Mr. Johnson is a key leader in facilitating the availability of CRNAs so they can be a part of this project. His leadership team consists of Katrina McKenna MS, CRNA (CRNA Supervisor- Henry Ford Hospital) and Christy Baginski MSN, CRNA (CRNA Supervisor- Henry Ford Hospital) who were also key in organizing this implementation.

***Set Aims***

The IHI states that all aims should be time specific and measurable. Furthermore, they need to be safe, effective, patient-centered, timely, efficient, and equitable (IHI.org, 2020).

*Safe*- the simulations took place on mannequin simulators and all safety protocols instituted by HFH were adhered to.

*Effective*- Low-dose high-frequency simulation has been shown to be a very effective method for mitigating skill decay.

*Patient-Centered*- This QI is focused on improving CVC insertion technique and improving CRNA satisfaction which both have significant outcome improvements for patients.

*Timely*- This QI seeks to began in 2021 and will follow the every 6-month pattern thereafter.

*Equitable*- All full-time CRNAs will be able to participate and designated time slots will be uniform.

***Establishing Measures***

The IHI established that measures should be focused on processes and outcomes. The aims of this QI have been stated above and represent the outcomes. To measure CVC insertion technique, the established checklist from HFH was followed (see Appendix B). In the initial training, prior to any intervention, CRNAs’ baseline for CVC insertion technique was measured following this tool. A percentage score will be given based on items missed and items out of order.

To measure CRNAs’ perceived ability to insert a CVC, they completed a 3-question survey prior to the QI intervention:

1. On a scale of 1-10, how comfortable are you with insertion of a central venous catheter?
2. On a scale of 1-10, how safe do you see your CVC insertion technique?
3. On a scale of 1-10, how likely would you be to insert a CVC on one your patients?

In an effort to measure CRNA job satisfaction, a survey that includes an Employee Net Provider Score (eNPS) was used. The eNPS tool asks employees how likely they are to recruit friends to work with them. In this case, how likely is a HFH CRNA to recommend HFH as a place to work? It can also be used to measure how likely an employee would recommend the product of their company. In this case, how likely would a CRNA recommend a friend to come to HFH for medical care (Leapsome.com, 2020)?

The questions are:

1. How likely are you to recommend Henry Ford as a place to work for CRNAs?
2. How likely are you to recommend that friends and family receive their medical care at Henry Ford?
3. How would you rate your overall job satisfaction at Henry Ford?
4. How likely are you to look for another job within the next 12 months?

***Selecting Changes***

Based on the evidence discovered in the literature review, low-dose high-frequency simulation was used as change agents for the desired outcomes. All full-time CRNAs at HFH were asked to complete a 30-minute CVC insertion re-training every 6 months. Because of the need for the CRNAs to complete surveys and to take a CVC insertion skill assessment, the initial training took about 45 minutes to complete. This QI took place over 4 phases: Assessment/Planning, Implementation, Evaluation, and Maintenance.

***Phase 1- Assessment/Planning***

The QI board reviewed all outcomes and goals and came to a consensus (see above). Key issues that the board addressed were: budget, time/scheduling, long-term maintenance, and SWOT analysis. Policies, procedures, and protocols were vetted and appropriate parties who are not on the board may need to be contacted for input (infection control, human resources, etc.).

Although not part of the board, the members of the CRNA Education Committee were critical to the implementation. Prior to implementation, Joshua Olson worked with the committee to train them to be trainers. The members of the education committee were critical manpower for this QI.

The board met twice prior to implementation. Meetings were over video conferencing software. All meeting notes and decisions were recorded by Mr. Olson and disseminated to all interested parties. The board, CRNA leadership team, and education committee have access to all meeting notes.

***Phase 2- Implementation***

Implementation of the program began in the 2rd quarter of 2021 with the training of the CRNA Education Committee. The members were refreshed on the QI project and any role they would need to play. This would include: CVC insertion technique, the use of the insertion checklist, the educational methods, time frame, surveys, and data collection.

Later in the 3rd quarter of 2021, the pre-intervention survey was sent to the CRNAs. The pre-intervention survey included: 1) CRNA self-perception on CVC insertion ability and 2) job satisfaction. The survey was made and sent via SurveyMonkey. Surveys were sent via text message and email, and each CRNA was only allowed to submit one survey. The survey had to have been completed prior to the intervention. If a CRNA had not completed the survey prior to the intervention, they could fill it out as part of their first re-training session.

In a concurrent timeframe with the survey submission, the initial re-training sessions began. Taking approximately 1 hour, all initial training was with 1-2 CRNAs at a time. To give the CRNAs time to attend, other CRNAs were sent to relieve each CRNA. This meant this intervention could only be done on days when there was extra staff available.

The SIM lab was primarily used as the location for the training. They had CVC insertion trainers, ultrasound machines, and even central line kits. On one occasion the SIM lab was not available, so the PACU was used.

As CRNAs arrived at the location, they verified that they had completed the pre-intervention survey. If they had not, they filled it out at that time. Once completed, the CRNA was observed in their CVC insertion technique as a baseline.. One educator was dedicated to observing this process and verifying the technique via the HFH checklist (appendix B). This gave a baseline measurement of CRNA CVC insertion skill. Once the CRNA completed the initial CVC insertion attempt, the education and demonstration began.

Following Knowles principles, at the beginning of the training session a short discussion was led in order to establish the current problem of CRNA and CVC insertion, how the CRNA would like their re-training time to go, and what immediate impact this has on their profession. Between the discussion group and the initial CVC insertion attempt, all of Knowles 4 principles of andragogy were covered.

The following questions were asked in order to cover all the topics: where should we insert a CVC? What are possible complications of a CVC insertion? How do you document a CVC insertion? The key points of this discussion were taken from HFH’s Central Venous Access policy (see Appendix 1).

Mannequin models were available for the initial practice, but participants were also encouraged to practice preparation and identification of anatomical landmarks on one another. No insertion took place on any live humans, only landmark identification.

During the education/demonstration, the trainer went through the steps of a CVC insertion. The CRNAs were each given a checklist to observe and validate the educator. After the education/demonstration was complete, the CRNA completed another CVC insertion, following the checklist.

During the 1st quarter of 2022, the 6-month CVC QI program began. This same intervention will occur every 6 months thereafter. Prior to the 6-month QI intervention, CRNAs will again be sent the same survey that they were sent prior to the initial training (rating self-perceived CVC insertion skill). With no further education, each CRNA simulated a CVC insertion and was scored via the checklist.

***Phase 3- Evaluation***

Evaluation took place concurrently with implementation. If any unforeseen issues, roadblocks, or problems arose during the 1st part of implementation, the board was available to address them. Three sources of information will help shape the evaluation: the surveys, the checklist scores, and feedback from the educators.

Our initial clinical questions were evaluated at this time. *Did CRNAs’ CVC insertion skill improve through this quality improvement? Did CRNAs’ self-perceived ability to insert a CVC improve? Did anesthesia staff morale and satisfaction increase through this intervention?* Although the implementation is not considered completed until 1 year, the answers to these questions may have been impacted.

***Phase 4- Conclusion and Dissemination***

The conclusion of this program included handing these responsibilities over to the CRNA Education Committee. The ongoing nature of this intervention will be run through the CRNA Education Committee. Lead by the committee chair, they will be responsible to administer and keep documentation for this program. They will also be key in deciding if this program will grow to include other locations within the HFH system (they would be a big part of helping those other locations establish this program) or if it should include other fading CRNA skills. The board left contact information for the committee in case questions or issues arise in subsequent years.

Because this program has shown the ability to make a positive impact on the chosen indicators, the board is preparing for broader dissemination. This includes publication, poster board presentations, and speaking engagements. Abstracts are currently being submitted.

Furthermore, the results of this program should be presented at the annual HF APP symposium. This annual meeting includes APPs from all disciplines: NPs, PAs, CNMs, and CRNAs. These APPs will be given a chance to discover if a program like this would be helpful for them.

**Ethical Considerations**

All ethical and moral issues followed the Henry Ford and University of Detroit Mercy standards for QI implementation. Site approval was given by CRNA leadership at HFH. An application was sent to the Internal Review Boards (IRB) at the University of Detroit Mercy and HFH. Because there was little-to-no risk to the participants, this application was given expedited status.

All participant data was only available to the participant, the CRNA leadership, and the QI project team. No names or personal information will be kept. Badge IDs were used for identification. All participants were made aware of their information being stored and anonymously reviewed by leadership.

**Data Analysis**

As mentioned before, the pretest questionnaire data was administered via Survey MonkeyTM. Insertion scores were entered manually into an excel spreadsheet. Based on the CVC insertion checklist, a maximum score of 33 was attainable. Each CRNA attempted a CVC insertion and was scored out of 33 possible points. This was documented as 1st Insertion. After the education/demonstration, each CRNA attempted another insertion and scored out of 33 possible points. This was documented as 2nd Insertion. Six months later, when the CRNAs returned to attempt another central line insertion (with no education or demonstration), they were once again scored out of 33; this was documented as 3rd Insertion.

A pretest-posttest statistical design was used to compared the results. Of the 46 CRNAs that completed the 1st and 2nd insertions, they had a median score of 16 on their first attempt. The median of their 2nd insertion score (after the education/demonstration) was 30 (p <0.0001). This was an 81% improvement in their score. 20 CRNAs returned 6 months later to attempt their 3rd insertion, this time with no education or demonstration. This group had a median score of 29 (p 0.0109).

Despite the growth in proficiency, there was not a significant improvement in the CRNAs’ comfort level of inserting a CVC, their perceived ability to safely insert a CVC, or their likelihood to insert a CVC in one of their patients. Also, there was no significant improvement in their overall job satisfaction scores.

**Results**

|  |  |  |
| --- | --- | --- |
| Table 1. Descriptive Statistics | |  |
|  | Round 1 | Round 2 |
|  | Total  (N=49) | Total  (N=24) |
| **What is your gender?**, n (%) |  |  |
| Male | 14 (28.6%) |  |
| Female | 35 (71.4%) |  |
|  |  |  |
| **What is your age?**, n (%) |  |  |
| 21-30 | 4 (8.2%) |  |
| 31-40 | 28 (57.1%) |  |
| 41-50 | 14 (28.6%) |  |
| 51-60 | 2 (4.1%) |  |
| 61-70 | 1 (2.0%) |  |
|  |  |  |
| **How many years have you been practicing as a CRNA?**, n (%) |  |  |
| 1-3 | 21 (42.9%) |  |
| 4-7 | 12 (24.5%) |  |
| 8-10 | 6 (12.2%) |  |
| 11-15 | 8 (16.3%) |  |
| 16-20 | 2 (4.1%) |  |
|  |  |  |
| **When was the last time you placed a central venous catheter?**, n (%) |  |  |
| <6 months ago | 2 (4.1%) | 1 (4.2%) |
| 6-12 months ago | 7 (14.3%) | 4 (16.7%) |
| 1-2 years ago | 10 (20.4%) | 3 (12.5%) |
| 2-3 years ago | 6 (12.2%) | 4 (16.7%) |
| >3 years ago | 24 (49.0%) | 12 (50.0%) |
|  |  |  |
| **How comfortable are you with insertion of a central venous catheter?** |  |  |
| N | 49 | 24 |
| Median (IQR) | 38.0 (13.0, 50.0) | 38.0 (11.0, 51.5) |
|  |  |  |
| **How safe do you see your CVC insertion technique?** |  |  |
| N | 49 | 24 |
| Median (IQR) | 50.0 (30.0, 75.0) | 56.5 (42.0, 71.5) |
|  |  |  |
| **How likely would you be to insert a CVC on one your patients?** |  |  |
| N | 49 | 24 |
| Median (IQR) | 43.0 (17.0, 50.0) | 36.0 (8.5, 53.0) |
|  |  |  |
| **How likely are you to recommend Henry Ford as a place to work for CRNAs?** |  |  |
| N | 49 | 24 |
| Median (IQR) | 92.0 (75.0, 100.0) | 90.0 (80.5, 100.0) |
|  |  |  |
| **How likely are you to recommend that friends and family receive their medical care at Henry Ford?** |  |  |
| N | 49 | 24 |
| Median (IQR) | 100.0 (90.0, 100.0) | 98.5 (90.0, 100.0) |
|  |  |  |
| **How would you rate your overall job satisfaction at Henry Ford?** |  |  |
| N | 49 | 24 |
| Median (IQR) | 80.0 (75.0, 94.0) | 85.0 (76.0, 92.0) |
|  |  |  |
| **How likely are you to look for another job within the next 12 months?** |  |  |
| N | 48 | 24 |
| Median (IQR) | 10.5 (0.0, 40.0) | 2.5 (0.0, 48.0) |
|  |  |  |
| **First insertion** |  |  |
| N | 47 |  |
| Median (IQR) | 16.0 (12.0, 21.0) |  |
|  |  |  |
| **Second Insertion** |  |  |
| N | 46 |  |
| Median (IQR) | 30.0 (28.0, 31.0) |  |
|  |  |  |
| **Third insertion** |  |  |
| N |  | 24 |
| Median (IQR) |  | 29.0 (26.5, 30.0) |
|  | |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 2. Comparison of first and second insertion scores | | | | |
|  | Insertion 1  (N=47) | Insertion 2  (N=46) | Difference  (N=46) | P-Value |
| **Difference between First insertion and Second insertion** |  |  |  | **<.0001** |
| N | 47 | 46 | 46 |  |
| Median (IQR) | 16.0 (12.0, 21.0) | 30.0 (28.0, 31.0) | 13.0 (10.0, 17.0) |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 3. Comparison between round 1 and round 2 | | | | |
|  | Round 1  (N=20) | Round 2  (N=20) | Difference Between Round 1 and Round 2 | P-value |
| **Difference between second insertion and third insertion** |  |  |  | **0.0109** |
| N | 20 | 20 | 20 |  |
| Median (IQR) | 31.0 (29.0, 32.0) | 29.0 (27.0, 30.0) | 3.0 (-0.5, 4.0) |  |
|  |  |  |  |  |
| **How comfortable are you with insertion of a central venous catheter?** |  |  |  | 0.3346 |
| N | 20 | 20 | 20 |  |
| Median (IQR) | 36.0 (16.5, 50.0) | 35.5 (10.5, 50.5) | 1.5 (-4.0, 16.0) |  |
|  |  |  |  |  |
| **How safe do you see your CVC insertion technique?** |  |  |  | 0.9345 |
| N | 20 | 20 | 20 |  |
| Median (IQR) | 51.5 (30.0, 72.5) | 56.5 (31.5, 73.0) | 8.0 (-25.0, 19.5) |  |
|  |  |  |  |  |
| **How likely would you be to insert a CVC on one your patients?** |  |  |  | 0.3867 |
| N | 20 | 20 | 20 |  |
| Median (IQR) | 33.0 (20.0, 51.0) | 28.0 (4.0, 53.0) | 4.5 (-11.5, 22.5) |  |
|  |  |  |  |  |
| **How likely are you to recommend Henry Ford as a place to work for CRNAs?** |  |  |  | 0.9147 |
| N | 20 | 20 | 20 |  |
| Median (IQR) | 98.5 (75.0, 100.0) | 90.5 (80.5, 100.0) | 0.0 (-4.5, 9.5) |  |
|  |  |  |  |  |
| **How likely are you to recommend that friends and family receive their medical care at Henry Ford?** |  |  |  | 0.9805 |
| N | 20 | 20 | 20 |  |
| Median (IQR) | 100.0 (91.5, 100.0) | 100.0 (90.0, 100.0) | 0.0 (-1.0, 0.0) |  |
|  |  |  |  |  |
| **How would you rate your overall job satisfaction at Henry Ford?** |  |  |  | 0.5866 |
| N | 20 | 20 | 20 |  |
| Median (IQR) | 88.0 (72.0, 97.5) | 86.5 (76.0, 94.5) | 0.0 (-6.5, 10.0) |  |
|  |  |  |  |  |
| **How likely are you to look for another job within the next 12 months?** |  |  |  | 0.5111 |
| N | 19 | 20 | 19 |  |
| Median (IQR) | 11.0 (0.0, 30.0) | 0.5 (0.0, 19.5) | 1.0 (0.0, 19.0) |  |

**Sustainability Plan**

For this project, we have focused on a two-part sustainability plan. First, the education committee is committed to continuing the Q 6 month plan of reinforcement through simulation. The committee is training multiple members to administer the education and simulations, and plans to incorporate every CRNA in the effort. We are also hoping to add other rarely used skills into the cycle, like fiber optic bronchoscope use, spinal and epidural insertions, and cricothyrotomies.

Second, there is a plan for dissemination of our project and results. The first is to report to our department our findings. This will hopefully reinforce the efficacy of this project, but also encourage the CRNAs who haven’t participated to take part. On top of that, we are applying to present at the American Association of Nurse Anesthetist’s (AANA) Mid-Year assembly, as well as the AANA’s conference for educators. There is also a plan to submit our work for publication.

**Implications for Practice**

As longitudinal assessment gains momentum amongst the medical community, most of the attention has focused on knowledge acquisition and retention. Despite the evidence showing the significance of skill decay, there does not appear to be any current program from the American Society of Anesthesiologists (ASA) or AANA that incorporates physical skills into the longitudinal assessment. This program shows a possible template for using simulation to mitigate skill decay amongst CRNAs.

Improving the CVC insertion skill of CRNAs should reduce central line infection rates, reduce other complications related to CVC insertion, and improve delivery of care to patients. CRNAs who might not have been able to insert a central line prior to this intervention, and would have to wait for another provider, could now insert the line themselves. This could be essential during an emergency, but it also could reduce delays in delivery of care for routine cases.

Although this program demonstrated significant improvements in CVC insertion skill, this same technique likely could be used for other infrequently used procedures. Depending on the need, this program could be implemented for fiberoptic intubations, axial/regional anesthesia, arterial line placements, and cricothyrotomies, among others.

**Limitations**

With sample sizes of 46 of 20, these results are harder to generalize. However, when combined with the substantial body of evidence that already exists amongst non-CRNA healthcare providers, it seems likely that these results are reproducible. More work needs to be done.

Another challenge was getting CRNAs to participate. For this study, CRNAs had to be relieved of their current assignment so they could participate. This meant there needed to be enough extra staff in order to cover each CRNA’s case so they could participate. The first round of the intervention took about 45 minutes, and the second about 20. Many institutions would not be able to do an intervention like this during scheduled work hours, and would have to either pay CRNAs to come in during off hours, or encourage them to volunteer.

This project was able to collect 6 months’ worth of information, but it would be helpful to continue to collect results over multiple years. The plan is to continue this project indefinitely, so more data should be available over time and might answer the question: Will a simulation performed every 6 months mitigate skill decay indefinitely?

Another limitation this data shows is that the CRNAs did not feel more proficient or safe in their CVC insertion ability. If a CRNA shows proficiency in CVC insertion during a simulation, but they are still unwilling to do it for one of their patients, the net gain is very limited. It is worth noting that each CRNA was not able to see their scores at all times. If the CRNAs had seen their significant improvement in their scores, it may lead to higher levels of confidence. Also, it seems possible that over time these results might change. If a CRNA has simulated a dozen CVC insertions over the course of 6 years, will their confidence level change? This question, and ones like it, might be answered with ongoing data collection.

**Conclusion**

Because of the significance of skill decay amongst healthcare workers, there is a need to reduce it. Simulation and longitudinal assessments have been shown to reduce skill decay. This project demonstrated a significant improvement in CVC insertion skill through simulation and longitudinal assessment. Even after 6 months the CRNAs who participated maintained their skill. This project could be a part of a broader plan to reduce skill decay amongst CRNAs. As longitudinal assessment gains momentum to reduce loss of knowledge, this program shows it can be done with tactile skills as well.

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Last Updated November 30th, 2018, 06:53 pm

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Appendix A- HFH CVC Policy



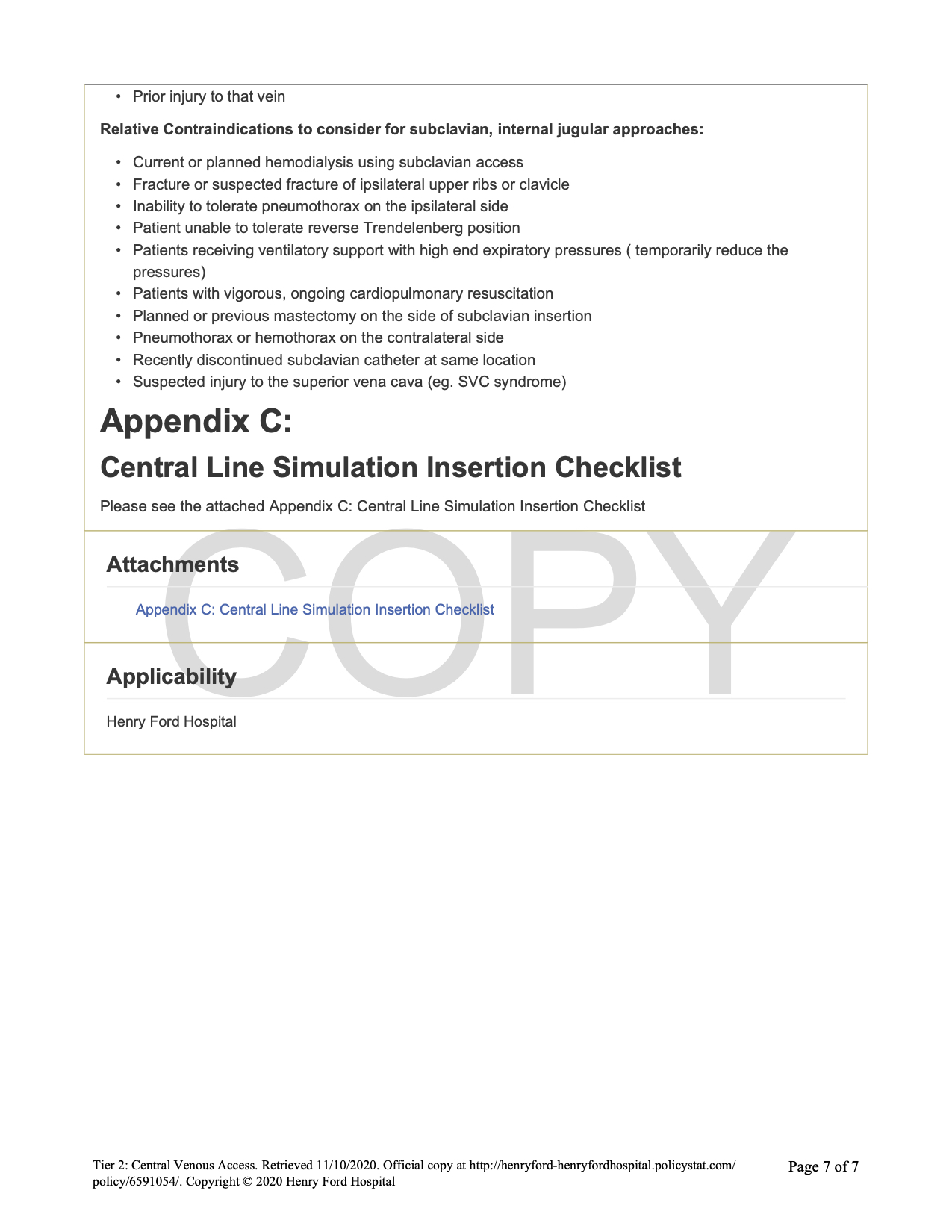
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Appendix B- HFH CVC Insertion Checklist

