Urologic Care Army/Air Force/Navy Provider Education:

Urologic Emergency Simulation Curriculum

By

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Dedication

This thesis is dedicated to my husband, Brandon. Thank you for always supporting me and encouraging me to achieve my goals, no matter how extreme or far-fetched they may sometimes seem. Your love and support mean everything to me. I am so lucky that you are my husband and Elizabeth and Wesley are so lucky that you are their dad.

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Abstract

Urologic procedures are amongst the most commonly reported procedures performed at sea by military general surgeons. Yet, there are no required urologic procedure minimums in general surgery residency training, highlighting a gap between training and requirements in practice for military general surgeons. Furthermore, a needs assessment examining how often urologic emergencies are encountered by military general surgeons practicing in settings without a urologist physically present, revealed the desire for additional diagnostic training for testicular torsion, phimosis, paraphimosis, and acute urinary retention as well as additional procedural training for scrotal exploration, orchiopexy, orchiectomy, dorsal slit, dorsal penile block, open suprapubic tube placement, retrograde cystogram, and retrograde urethrogram. The purpose of this study was to develop an emergency urologic surgery curriculum using the principles of meaningful learning, scaffolding, and experiential learning with a focus on improving emergency urologic knowledge, procedural confidence, diagnostic confidence, and skill retention.

The curriculum's target audience was 27 general surgery residents and attending general surgeons at Naval Medical Center Portsmouth and Walter Reed National Military Medical Center. The curriculum is approximately one-third didactic instruction and two-thirds hands-on simulated skills practice using cost-effective, low fidelity simulators developed for each procedure, tested by board-certified urologists prior to implementation. Prior to the beginning of the instructional portion, participants completed a pre-instruction assessment, which will include demographic information, questions to gauge confidence in diagnosing the included pathologies and in performing the included procedures, as well as a series of multiple-

choice knowledge questions on the included topics. After completing the instructional portion, participants completed a post-instruction assessment, identical to the pre-instruction assessment, to again assess their confidence and knowledge on the included topics.

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Abbreviations

MTF- Military Treatment Facility

UCANPE- Urologic Care Army/Air Force/Navy Provider Education

OEF- Operation Enduring Freedom

IED- Improvised explosive device

WRNMMC- Walter Reed National Military Medical Center

FBCH- Fort Belvoir Community Hospital

NMCP- Naval Medical Center Portsmouth

PGY- Post-Graduate Year

Chapter 1: Introduction

Background

Urologic procedures are amongst the most commonly reported procedures performed at sea by military general surgeons,[1] yet there are no required urologic procedure minimums in general surgery residency training.[2] For example, the Clinical Practice Guidelines (CPGs) of the Joint Trauma System (JTS), published by the Defense Health Agency (DHA) as guidelines for deployed clinicians, do not include any guidance on the management of urologic emergencies.[3] Additionally, although most major military treatment facilities in the United States have urologists on staff, urologists are not included in the composition of Level II Army Forward Surgical Teams, Navy aircraft carriers and Fleet Surgical Teams, or Air Force Mobile Field Surgical Teams.[4] And while urologic services are often available at higher levels of care, the decision to transfer a patient is complex. Healthcare providers must consider several factors such as patient acuity, time to transfer, transfer distance, and operational conditions. To avoid a delay in treatment and decrease morbidity, care for patients with urologic emergencies often falls to the general surgeon present, even though they likely have minimal or no formal urologic emergency training.

Study Purpose

This project aims to evaluate the effectiveness of a newly designed urologic emergencies curriculum for general surgeons. The curriculum will help bridge the gap between current training and practice expectations, focusing on improving emergency urologic knowledge as well as procedural and diagnostic confidence.

Needs Assessment

We conducted a needs assessment in August 2020 to evaluate the need for urologic emergency training among military general surgeons. The needs assessment targeted military general surgeons with past and possible future deployments to settings without a urologist physically present. The data were collected using a survey (Appendix C) that included questions regarding past deployments to locations without a urologist physically present, the number and types of urologic emergencies encountered during past deployments, and urologic diagnoses and procedures for which they desired additional training. Twenty general surgeons with one to 20 years (m = 10 years) in practice since residency graduation participated. Participants represented diverse subspecialties (i.e., trauma and critical care, colorectal surgery, minimally invasive surgery, bariatric surgery, surgical oncology, and pediatric surgery). Participants reported a total of 78 deployments without a urologist physically present, with a range of zero to 20 per surgeon (m= 4 deployments). Participants reported 28 urologic emergencies encountered during those deployments, with a range of zero to 10 (m = 1.4). Fifty-five percent (n = 11) of those surveyed reported having encountered at least one urologic emergency that required surgical intervention. Urologic emergencies encountered included testicular torsions, bladder injuries, and urethral injuries. Urologic procedures performed by those surveyed included testicular detorsion, orchiopexy, bladder repair, open cystostomy placement, ureter repair, scrotal exploration, and testicular vein repair. Participants expressed interest in additional training on scrotal exploration, testicular detorsion, orchiopexy, suprapubic catheter placement, phimosis, paraphimosis, ureteral injuries, and urethral injuries.

Model Development

Based on the needs assessment results, we selected six diagnoses (testicular torsion, phimosis, paraphimosis, acute urinary retention, traumatic urethral injury, and traumatic bladder injury) and eight procedures (scrotal exploration, orchiopexy, trans-scrotal orchiectomy, dorsal slit, dorsal penile block, open suprapubic tube placement, retrograde urethrogram, and cystogram) for inclusion in the curriculum. After finalizing the course content, we developed cost-effective, easily reproducible simulation model prototypes for each procedure. The materials used and what they represent for each model prototype are detailed in Table 1.1. We constructed the phimosis and paraphimosis models on silicone penis models created by the WRNMMC 3-D Medical Applications Center.

Table 1.1. *Materials used for each model prototype*

Model	Model Materials	Representing
Dorsal Slit for Phimosis Model	1” Penrose Drain Silk Tape	Foreskin Constricting band
Dorsal Slit for Paraphimosis Model	1” Penrose Drain 1 Gummy Lifesaver candy 2 Scunci® Polybands	Foreskin Edematous tissue Constructing bands
Open Suprapubic Catheterization Model	1 party balloon Mefix tape 1 household sponge Transpore tape 1 square of SimMan Skin 1 snap-top plastic box	Bladder Bladder wall Subcutaneous fat Fascia Skin Pelvis
Scrotum Model for Scrotal Exploration/ Trans-Scrotal Orchiectomy/ Detorsion and Orchiopexy	1 Jumbo green olive 1 Jumbo black olive Yarn (red, blue, gray) 2 Finger cots 2 Nitrile glove fingers 3” Webril 1 Household rubber glove, everted	Non-torsed testicle Torsed testicle Cord structures Tunica vaginalis, parietal Tunica vaginalist, visceral Cremasteric fibers Dartos fascia

Model prototypes were quality tested by five board-certified urologists from WRNMMC and Fort Belvoir Community Hospital (FBCH) (I.R.M., D.J.H., J.G.M., J.A.M., T.S.G.). We provided model prototypes for each procedure to the participating urologists, and we asked them to perform the indicated procedure(s) on the models. We then asked the urologists to evaluate the models on their similarity to actual tissue and real-life procedure performance on a Likert scale of one to five, with one being very dissimilar and five being very similar. We also solicited for overall acceptability for use as a teaching tool, general comments, and suggestions for improvement. Table 1.2 contains a summary of prototype testing results.

Table 1.2. *Prototype Testing Results*

Model/Procedure	Similarity to Actual Tissue Average (1-5)	Similarity to Real-life Procedure Performance Average (1-5)	Overall Acceptability for Teaching Percentage	General Comments & Suggestions
Dorsal Slit for Phimosis	3.4	3.6	100%	Foreskin needs to be thicker
Dorsal Slit for Paraphimosis	3.4	3.6	100%	N/A
Open Suprapubic Catheterization	3.7	3.8	100%	Bladder wall needs to be thicker
Scrotal Exploration	3.0	2.8	60%	Dartos layer is too thin The olives smell Hard to identify vas deferens Testicles are too small
Trans-scrotal Orchiectomy	3.2	3.2	60%	
Detorsion/Orchiopexy	2.8	2.8	40%	

We refined the models per the feedback provided. The phimosis model prototype consisted of a four-centimeter segment of a one-inch Penrose drain with a slit cut into the drain, on the ventral aspect, proximally to the coronal sulcus. The cut edges were then overlapped and secured with silk tape. In response to the feedback provided, we applied a triple layer of Coban Self-Adherent Wrap (3M, Saint Paul, MN) over the Penrose drain. Figure 1.1 depicts the final phimosis model.

Figure 1.1. Phimosis Model

Like the phimosis model, the paraphimosis model prototype also employed a four-centimeter segment of a one-inch Penrose drain, placed around the simulated penis with the proximal extent of the drain approximately one centimeter proximal to the coronal sulcus with the remaining portion of the drain covering the glans. We placed one Lifesavers Gummies candy around the simulated penis at the level of the coronal sulcus to simulate edematous tissue. The drain was then folded on itself and over the candy. Two Scunci Polybands (Conair, East Windsor, NJ) were placed proximal to the Lifesaver to simulate the constricting paraphimotic bands. No adjustments were made to the paraphimosis model following prototype testing. Figure 1.2 depicts the final paraphimosis model.

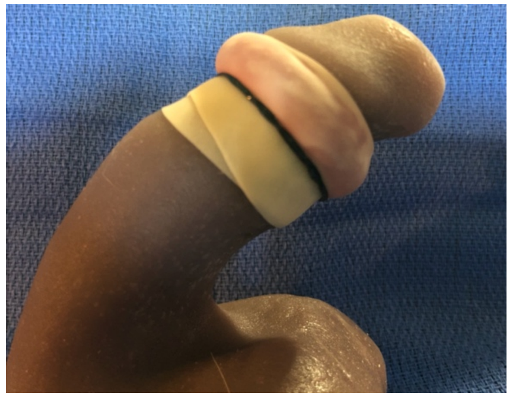

Figure 1.2. Paraphimosis Model

The open suprapubic tube model prototype, adapted from a percutaneous suprapubic tube model developed by Hossack et al.,[5] employed a water-filled party balloon with a square of Mefix tape to simulate the bladder and bladder wall, respectively. We used a household sponge cut in half with a triple layer of Transpore Tape (3M, Saint Paul, MN) to represent the abdominal wall. A snap-top plastic box simulating the pelvis housed the model. To address the feedback provided, we added a triple layer of Coban Self-Adherent Wrap (3M, Saint Paul, MN) around the balloon to increase bladder wall thickness. We also added a square of simulated skin from a repurposed diagnostic peritoneal lavage trainer to improve realism. (Simulab, Seattle, WA). Figure 1.3 depicts the final open suprapubic tube model without the overlying skin.

Figure 1.3. Open Suprapubic Tube Model

The scrotum model was developed for use in multiple procedures, including scrotal exploration, trans-scrotal orchiectomy, detorsion, and orchiopexy. Just as we developed this model for the most simulated procedures, it also needed the most changes following prototype testing. The olives, originally representing the testicles in the prototype, were replaced with commercially available Ecoflex 00-30 Silicone (Smooth-On, Macungie, PA). The silicone testicles were colored blue (torsed testicle) and white (non-torsed testicle), respectively, using Silc-Pig Silicone Pigments (Smooth-On, Macungie, PA) and then poured into a silicone egg treat mold (Wilton Industries, Woodridge, IL). The resulting testicle models are similar in size to average adult male testicles, approximately 30 milliliters in volume. A cut rubber band replaced yarn to improve the realism of the vas deferens. Blue and red yarn were used to simulate the testicular vasculature. The simulated spermatic cord structures were threaded through channels created in the simulated testes (Figure 1.4A). Party balloons replaced finger cots and nitrile glove fingers, representing both layers of the tunica vaginalis, and we employed Webril Undercast Padding (Covidien, Dublin, IE) to simulate the cremasteric fibers (Figure 1.4B). The spermatic cord of the torsed testicle was twisted 720-degrees and stapled in place inside a pouch created from an everted household rubber glove, simulating dartos fascia. We lined the rubber glove with silk tape in the final model to increase the thickness of the dartos layer. The non-torsed testicle was also stapled in the everted glove pouch without manipulating the simulated spermatic cord (Figure 1.4C).

Figure 1.4. A) Spermatic cord & testes, B) Tunica vaginalis & cremasterics, C) Dartos Fascia

The final model materials and their associated costs are summarized in Table 1.3.

Table 1.3. *Final model materials and associated costs*

Model	Materials and Material Sources	Cost
Open Suprapubic Catheterization	**Consumable Materials Per Single-Use**	
	1 party balloon*	$0.08
	10 cm of 2” Mefix tape (Molnlycke)^	$0.12
	1 household sponge*	$0.50
	30 cm of 3” Transpore tape (3M)^	$0.38
	75 cm of 3” Coban Self-Adherent Wrap (3M)^	$0.56
	½ skin from TraumaMan Non-Bleeding Abdominal Kit (Simulab)[+] or other simulated skin (optional)	*($33.00)*
	Consumables Total	**$1.64**
	Consumables + Traumaman Skin Total	***($34.64)***
	Durable (Reusable) Materials	
	1 snap-top plastic box*	$1.00
Dorsal Slit for Phimosis	**Consumable Materials Per Single-Use**	
	4 cm of 1” Penrose drain (Moore Medical)^	$0.48
	3 cm of 1” Durapore silk tape (3M)^	$0.02
	10 cm 1” Coban Self-Adherent Wrap (3M)^	$0.15
	1 unripened banana^	$0.16
	Consumables Total	**$0.81**
	Durable (Reusable) Materials	
	1 3D printed silicone penis model (WRNMMC 3-D MED)(optional)[#]	*($205.00)*
Dorsal Slit for Paraphimosis	**Consumable Materials Per Single-Use**	
	4 cm of 1” Penrose drain^	$0.48
	1 Lifesavers Gummies candy (Mars, Inc)^	$0.04
	2 Scunci Polybands (Conair)^	$0.02
	1 Unripened banana^	$0.16
	Consumables Total	**$0.70**
	Durable (Reusable) Materials	
	1 3D printed silicone penis model (WRNMMC 3-D MED)(optional)[#]	*($205.00)*
Scrotum for Scrotal Exploration/ Trans-Scrotal Orchiectomy/ Detorsion and Orchiopexy	**Consumable Materials Per Single-Use**	
	1 Household rubber glove*	$0.50
	2 Party balloons*	$0.16
	20 cm of 3” Durapore silk tape (3M)^	$0.08
	40 cm of yarn (Red Heart)^	$0.01
	2 Rubber bands (Advantage)^	$0.01
	Consumables Total	**$0.76**
	Durable (Reusable) Materials	
	1 Silc pig blue sample size (Smooth-On)^	$4.22
	2 Silicone testicle models 30 ml each ECOFLEX 30 (Smooth-On)^	$1.02
	1 Egg mold (Wilton)~	$5.19
	Durables Total	**$10.43**
Total Consumable Materials Cost Per Student (not including optional items)		$3.91
Total Up-Front Durable Materials Cost		$11.43

Curriculum Design and Theoretical Frameworks

The target audience for the course included surgical trainees and attending surgeons possessing the fundamental surgical knowledge and skills required to perform the included procedures. The approximately three-hour course included a pre-assessment, one hour of didactic instruction, two hours of simulated practice, and a post-assessment. The pre-assessment included a survey to assess diagnostic and procedural confidence (Appendix A) and 20 written knowledge questions (Appendix B). The post-assessment included the same knowledge questions and diagnostic and procedural confidence assessments as the pre-assessment plus focused, semi-structured participant interviews. The multiple-choice, one-best answer knowledge questions were reviewed for content by two board-certified urologists (I.H.S. and J.M.Z.).

Three learning theories informed the curricular design, namely, meaningful learning, scaffolding, and experiential learning. According to Ridgeway et al. [6], there are three learning stages through which one must progress to learn a surgical skill: cognitive, associative, and autonomous. In this curriculum, the didactic portion meets the cognitive stage requirements. In addition, David Ausubel's Meaningful Learning Theory, which asserts that the student's previous knowledge is the most influential element to future learning,[7] will also be applied during the didactic session as participants apply their existing surgical knowledge to a new body system (i.e., urologic).

The next stage of learning a surgical skill is the associative stage, during which the surgeon practices the new skill.[8] Participants have the opportunity for hands-on training during the simulated skills session. Here, participants will build upon their established foundation of surgical knowledge and skill to perform the new procedures, thus resulting in accelerated progression towards the third and final autonomous stage. During the autonomous stage, the surgeon can confidently and reliably perform the skill independently. We selected simulation to help students reach proficiency in urologic procedures that will translate to the operating room due to its documented success for such in other procedures like cricothyroidotomy[9] and laparoscopic techniques.[10]

Throughout the simulated skills portion of the course, practicing urologists served as surgical mentors utilizing Vygotsky's Zones of Proximal Development (ZPD) and the instructional principle of scaffolding. Vygotsky defined ZPDs as the difference between what a learner can accomplish alone and what a learner can achieve with assistance from an instructor.[11] The instructor provides support to the learner via instructional scaffolding, which is temporary, tailored support provided during the learning process to help the student reach proficiency.[8]

Chapter 2: Development and Implementation of Urologic Care Army/Air Force/Navy Provider Education, a Urologic Emergency Simulation Curriculum (accepted for publication in *Military Medicine*)

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Abstract

Background: Military general surgeons commonly perform urologic procedures, yet, there are no required urologic procedural minimums during general surgery residency training. Additionally, urologists are not included in the composition of forward operating surgical units. Urologic Care Army/Air Force/Navy Provider Education (UCANPE) was created to provide military general surgeons with training to diagnose and treat frequently encountered urologic emergencies when practicing in environments without a urologist present.

Study Design: A literature review and needs assessment were conducted to identify diagnoses and procedures to feature in the course. The course included a one-hour didactic session and then a two-hour hands-on simulated skills session using small, lightweight, cost-effective simulators. Using a pre- posttest design, participants completed confidence and knowledge assessments before and after the course. The program was granted educational exemption by the Institutional Review Board.

Results: Twenty-seven learners participated. They demonstrated statistically significant improvement on the knowledge assessment (45.4% (SD 0.15) to 83.6% (SD 0.10), $p<0.01$). On the confidence assessment, there were statistically significant ($p\leq0.001$) improvements for identifying phimosis, paraphimosis, and testicular torsion, as well as identifying indications for suprapubic catheterization, retrograde urethrogram, and cystogram. There were also statistically significant ($p<0.001$) improvements for performing: suprapubic catheterization,

dorsal penile block, dorsal slit, scrotal exploration, orchiopexy, orchiectomy, retrograde urethrogram, and cystogram.

Conclusion: We created the first-ever urologic emergencies simulation curriculum for military general surgeons that has demonstrated efficacy in improving the diagnostic confidence, procedural confidence, and topic knowledge for the urologic emergencies commonly encountered by military general surgeons.

INTRODUCTION

Urologic procedures are frequently performed by military general surgeons while deployed (1,2), yet there are no required urologic procedural minimums in general surgery residency training (3). Additionally, although there are active duty urologists in practice at most major military treatment facilities (MTFs) in the United States, forward-deployed surgical units, including Role 2 Army Forward Surgical Teams, Navy aircraft carriers, Fleet Surgical Teams, and Air Force Mobile Field Surgical Teams, do not include urologists (4). And while urologic services are often available at higher levels of care, the decision to transfer a patient is complex, requiring consideration of several factors such as patient acuity, time to transfer, transfer distance, and operational conditions. Thus, optimal and timely care for patients with urologic emergencies often falls to the general surgeon present, even though they likely have minimal or no formal urologic emergency diagnostic or procedural training. Furthermore, a survey of over 200 military surgeons by Tyler et al published in 2012 found that while only 43.8% of general surgeons attended pre-deployment surgical training prior to their first deployment, 80%

endorsed desire for additional surgical training with 15% specifically endorsed desire for additional genitourinary surgical training (5).

This represents a gap between training and practice expectations for military general surgeons. Given this, Urologic Care Army/Air Force/Navy Provider Education (UCANPE), a urologic emergencies simulation curriculum, was created to provide military general surgeons with training to diagnose and treat frequently encountered urologic emergencies to improve their ability to address urologic problems in both combat environments and non-combat environments when a urologist is not accessible.

To gauge how to best bridge this training gap, a literature review and a survey-based needs assessment was conducted to identify diagnoses and procedures to include in the curriculum. The literature review was used to identify frequently encountered combat-related genitourinary injuries while the needs assessment helped to identify genitourinary diagnoses and procedures encountered outside of combat settings.

Turner and colleagues examined all genitourinary cases performed at United States Role 2 and Role 3 MTFs in Iraq and Afghanistan between 2002 and 2016 and found that 2.1% of all procedures performed were for genitourinary injuries (2). The procedures were divided into groups, with testicular procedures representing the most frequent procedure group at 20.6%, followed by bladder (18.8%), scrotum (17.7%), and kidney (13.5%). From these groups, the most common overall procedure was orchiectomy at 9.9% followed by scrotal and tunica vaginalis repair (9.4%), nephroureterectomy (9.4%), and open suprapubic tube placement (6.8%) (2). Furthermore, in 2010, Jacobs and colleagues' examination of surgical workload from a United Kingdom Role 3 MTF in Afghanistan from 2008 to 2010 found that scrotal exploration was the most frequently performed genitourinary procedure, representing 1.9% of surgical procedures (6). The increased prevalence of combat-related genitourinary injuries observed during Operation Enduring Freedom (OEF) is attributed to increased injuries secondary to improvised explosive devices (IEDs) (6).

The needs assessment, a survey composed of five free-response questions regarding previous deployments and underways without a urologist physically present, prior experiences with genitourinary emergencies, and desires for further genitourinary emergency training, was completed by twenty general surgeons. They reported a total of 78 deployments or underway periods without a urologist physically present (*m*=4). The mean number of genitourinary procedures performed per respondent was 1.4. The most frequently performed procedures included scrotal exploration and orchiopexy for testicular torsion (61%), bladder repair (17%), dorsal slit (11%), and suprapubic catheterization (6%). They endorsed desires for additional training on scrotal exploration, testicular detorsion, orchiopexy, suprapubic catheter placement, phimosis, paraphimosis, ureteral injuries, and urethral injuries.

The purposes of this project were to improve urologic emergency knowledge, diagnostic confidence, and procedural confidence for general surgeons and general surgery trainees. We sought to determine the degree to which participants' emergency urologic knowledge, confidence for diagnosing urologic emergencies, and confidence for performing emergency urologic procedures changed as a result of course participation.

METHODS

Based on the results of the literature review and needs assessment, we selected six diagnoses (testicular torsion, phimosis, paraphimosis, acute urinary retention, traumatic urethral injury, and traumatic bladder injury) and eight procedures (scrotal exploration, orchiopexy, trans-scrotal orchiectomy, dorsal slit, dorsal penile block, open suprapubic tube placement, retrograde urethrogram, and cystogram) for inclusion. Despite their frequency of performance at Role 2 and Role 3 MTFs, renal and ureteral procedures were excluded from this course due to limited options for simulation (2).

Equipment

After finalizing the course content, small, lightweight, and cost-effective simulation models were developed for each procedure. Scrotal exploration, phimosis, and paraphimosis models have no commercially available equivalent and required creation specifically for UCANPE. Model prototypes were quality tested by board-certified urologists from Walter Reed National Military Medical Center (WRNMMC) and Fort Belvoir Community Hospital (FBCH) (I.R.M., D.J.H., J.G.M., J.A.M., T.S.G.) and then refined per provider feedback. Materials for all models were purchased from a variety of online and discount retailers. Table 1 contains a summary of materials used for each model, their associated costs, and where they were purchased. The models are pictured in Figure 1. Surgical supplies including forceps, needle drivers, scalpels, scissors, hemostats, and assorted sutures were borrowed from our simulation center and used to complete the procedures.

Sample

General surgeons and general surgery trainees who had not previously participated in a dedicated adult urologic emergencies training course, and who were likely to practice in a setting without access to a urologist from WRNMMC, FBCH, and Naval Medical Center Portsmouth (NMCP) were recruited for participation in UCANPE. Participation was voluntary. This project was granted education exemption by the Institutional Review Boards at NMCP and WRNMMC.

Conceptual Frameworks

Three learning theories informed the design of UCANPE: meaningful learning, experiential learning, and scaffolding. Meaningful learning theory, which holds that a student's previous knowledge is the most influential element to future learning (7), pertains as participants apply their existing surgical knowledge to a new body system (i.e., urologic). Experiential learning, which emphasizes learning through practice (8), is achieved using procedural-based simulation to help students reach proficiency in urologic procedures. Simulation was selected due to its success when previously employed for other procedures (e.g., cricothyroidotomy (9), laparoscopic techniques (10)). In addition, the instructional principle of scaffolding, when learners apply knowledge from prior experiences to new tasks under the guidance of a mentor, was employed. Urologists and urology trainees served as surgical mentors and provided tailored and graded support to learners during simulated practice, to help them improve their procedural confidence (11).

Measures

We selected a pre-posttest design to examine the impact of the new educational intervention. Before the UCANPE course, participants completed a pre-course assessment comprised of questions regarding basic demographics, numbers of previous emergency urologic procedures performed, level of confidence in diagnosing the included urologic pathologies, and level of confidence in performing the included emergency urologic procedures. Confidence was measured on a 5-point Likert scale (1- not at all confident, 2- slightly confident, 3- somewhat confident, 4- quite confident, and 5- extremely confident) (Appendix A). Participants also completed a knowledge assessment that consisted of 20 multiple-choice, single-best answer questions on urologic anatomy and physiology, key features of the included diagnoses, indications and contraindications for the included procedures, and proper procedural techniques (Appendix B). Both the confidence and knowledge assessments were developed by the authors (A.S.H., B.R.F., W.B.S.) and were reviewed by board-certified urologists from NMCP (I.H.S., J.M.Z.) who served as subject matter experts.

Procedures and Analysis

The UCANPE course was three hours in duration and consisted of one hour of didactic instruction followed by two hours of skills-based simulation practice. The didactic session included instruction on pertinent anatomy and physiology and clinical features of the included diagnoses, as well as indications and contraindications, necessary supplies, and operative steps for each of the included procedures. The didactic content was reviewed by board-certified urologists from NMCP (I.H.S., J.M.Z.).

The two-hour simulated skills session followed the didactic session. During simulation practice, participants practiced the included procedures on the models previously developed for this course. They worked in small groups and rotated through three procedure stations: open suprapubic catheterization, dorsal penile block and dorsal slit, and scrotal exploration/orchiopexy/orchiectomy. Learners spent approximately 40 minutes at each station and were guided by urologists and urology trainees as they completed the included procedures.

Following the course (range 1-7 days; *m*=2 days), participants completed a post-course confidence assessment indicating their diagnostic and procedural confidence for the pathologies and procedures included in the curriculum. Participants also completed the same 20-question multiple-choice, single-best answer urologic emergency knowledge assessment.

Statistical Analysis

Scores from the pre-course and post-course confidence and knowledge assessments were compared using paired-samples t-tests. All p values less than 0.05 were considered statistically significant. Due to small sample size, Hedge's g was used to calculate effect size (12). Effect sizes of 0.80 or greater were considered large (13). All statistical analysis was conducted using SPSS version 27 (IBM, Chicago, IL).

RESULTS

Demographics

Twenty-seven learners participated in the UCANPE courses from December 2020 to March 2021 at WRNMMC and NMCP. Twelve participants were female (44%), consistent with the general surgeon and trainee populations at both WRNMMC and NMCP. Three participants were from the US Army (11%), and the remainder were from the US Navy. Twenty-three (85%)

participants were general surgery residents: ten PGY-1 (37% of total), four PGY-2 (15% of total), three PGY-3 (11% of total), six PGY-5 (22% of total). The remaining four participants were attending general surgeons (15% of total). Attending general surgeons reported having one to 31 years of post-graduate practice (*m* = 7.6). Three of the four (75%) participating attending general surgeons were fellowship-trained, representing pediatric surgery, minimally invasive/bariatrics, and trauma/critical care.

Thirteen participants (48%) endorsed prior performance of at least one of the included procedures. Table 2 contains a summary of participants' previous procedural experiences by cohort. No participants had previously completed a dedicated adult urologic emergencies training course.

Knowledge and Confidence Assessments

There was a statistically significant improvement in scores, with large effect size, on the 20-question, multiple-choice, single-best answer knowledge assessment, from a pre-course mean score of 45.4% (SD 0.15, range 20% to 70%) to a post-course mean score of 83.6% (SD 0.10, range 60% to 100%) ($p<0.001$, Hedge's $g=2.94$). There were statistically significant improvements for every item included in the confidence assessment (Table 3).

DISCUSSION

UCANPE provides military general surgeons with needed training on urologic emergencies through a concise course that significantly increases knowledge and confidence for the included diagnoses and procedures with large effect sizes for all but two of the evaluated variables (Hedge's $g \geq 0.80$) (13). These outcomes align with previously published data regarding the efficacy of simulation training for cricothyroidotomy (9) and laparoscopic techniques (10).

Our open suprapubic catheterization model was adapted from a previously published percutaneous suprapubic catheterization model (14). All the simulators are cost-effective, with costs per use ranging from $0.70 to $11.19, not including optional items. This equates to a total consumable cost of $3.91 per learner per course, with $11.43 in durable reusable material upfront costs (e.g., egg mold, silicone testicles), which is a reasonable expense for training on rare urologic surgical emergencies and when compared to commercially available models and non-commercially created models. For example, in a recently published review, Pelly and colleagues examined the cost of several urological models that were developed non-commercially, finding that among open suprapubic catheterization models, costs ranged $2.00 to $60.00 per model. Furthermore, at least one commercial model available for this procedure is approximately $1080.00 plus an additional $42.50 per student for replacement tissue (Limbs N Things, Bristol, UK) (15).

These costs could vary depending on what models and resources are already available for use or adaptation. For example, simulated skin tissue composed on commercially available silicone on a mesh frame can be made in lieu of the TraumaMan skin (Simulab, Seattle, WA). Additionally, our phimosis and paraphimosis models were constructed on silicone penis models created from a 3D printed mold designed and produced by the WRNMMC 3-D Medical Applications Center. The design and production costs for the mold totaled $200 and the silicone for each model, Ecoflex 30 (Smooth-On, Macungie, PA), was an additional five dollars. In lieu of silicone penis models used in this study, as these models are not commercially available, other male pelvic trainers or unripened bananas can be substituted. Bananas are a more affordable alternative but must be replaced more frequently. If costs are still prohibitive, there are other components that can be omitted without effect on procedure performance (e.g., the skin for the suprapubic catheterization model serves to increase visual realism).

There were limitations to this study that warrant attention. First, the post-course assessments of knowledge and confidence were administered shortly following the course (one to seven days). Thus, score improvements on these assessments may have been due to recency bias versus durable improvements in knowledge and confidence. To address this limitation, we plan to conduct a follow-up study with retention testing six months following course completion using a new assessment tool. Six months is the average length of a ship-based deployment and studies examining retention of advanced life support knowledge and skills have demonstrated decay starting at six months post-training (16). As curriculum development is an iterative process, retention testing results will be used for future curricular improvements.

Another limitation is that attending surgeons represented only 15% of the participants, but are the only group that completed residency training, deployed, and have potentially performed the included procedures independently in the past. Thus, with residents comprising the majority of participants, improvements in confidence may have been falsely inflated, as those with less skill may overestimate their abilities (17) due to less prior real-life experiences with the included procedures and less experience operating independently than their attending counterparts. Too few attendings participated for an accurate sub-group analysis to determine effects on confidence for each cohort. In the future, increased numbers of fellows and attending general surgeons will be targeted for inclusion, so that a sub-group analysis of confidence data can be completed.

The confidence assessment examined subjective ratings of confidence rather than objective measures of competence. This study does not directly measure improvement in surgical performance; however, studies of skill training in other surgical disciplines employing a similar pre-post design assessing confidence have demonstrated that, while baseline confidence is not correlated with successful pre-training skill performance, post-training confidence scores do correlate with successful post-training skill performance (18).

Future directions for UCANPE include sessions at other MTFs, incorporation into “just in time” training, such as the ASSET+ Course for military surgeons preparing for deployment (19), “UCANPE at Sea” for ship-based surgical units specifically addressing the logistical and equipment limitations faced by general surgeons while underway, and modified versions of the course focusing on procedures that can be performed under local anesthesia for emergency medicine and family medicine providers who practice without a urologist or general surgeon readily available. Additionally, future iterations of the course would benefit from inclusion of renal and ureteral procedure instruction, potentially utilizing cadaveric or live-tissue models.

CONCLUSIONS

UCANPE is a novel urologic emergencies simulation curriculum for military general surgeons that has demonstrated efficacy in improving the diagnostic confidence, procedural confidence, and topic knowledge for the urologic emergencies commonly encountered by military general surgeons. Continued course enrollment will help to ensure prompt recognition and treatment of commonly encountered urologic emergencies to, ultimately, improve the medical readiness of our soldiers, sailors, airmen, and marines.

Model	Materials and Material Sources	Cost
Open Suprapubic Catheterization	**Consumable Materials Per Single-Use**	
	1 party balloon*	$0.08
	10 cm of 2" Mefix tape (Molnlycke)^	$0.12
	1 household sponge*	$0.50
	30 cm of 3" Transpore tape (3M)^	$0.38
	75 cm of 3" Coban Self-Adherent Wrap (3M)^	$0.56
	½ skin from TraumaMan Non-Bleeding Abdominal Kit (Simulab)[+] or other simulated skin (optional)	*($33.00)*
	Consumables Total	**$1.64**
	Consumables + Traumaman Skin Total	***($34.64)***
	Durable (Reusable) Materials	
	1 snap-top plastic box*	$1.00
Dorsal Slit for Phimosis	**Consumable Materials Per Single-Use**	
	4 cm of 1" Penrose drain (Moore Medical)^	$0.48
	3 cm of 1" Durapore silk tape (3M)^	$0.02
	10 cm 1" Coban Self-Adherent Wrap (3M)^	$0.15
	1 unripened banana^	$0.16
	Consumables Total	**$0.81**
	Durable (Reusable) Materials	
	1 3D printed silicone penis model (WRNMMC 3-D MED)(optional)[#]	*($205.00)*
Dorsal Slit for Paraphimosis	**Consumable Materials Per Single-Use**	
	4 cm of 1" Penrose drain^	$0.48
	1 Lifesavers Gummies candy (Mars, Inc)^	$0.04
	2 Scunci Polybands (Conair)^	$0.02
	1 Unripened banana^	$0.16
	Consumables Total	**$0.70**
	Durable (Reusable) Materials	
	1 3D printed silicone penis model (WRNMMC 3-D MED)(optional)[#]	*($205.00)*
Scrotum for Scrotal Exploration/ Trans-Scrotal Orchiectomy/ Detorsion and Orchiopexy	**Consumable Materials Per Single-Use**	
	1 Household rubber glove*	$0.50
	2 Party balloons*	$0.16
	20 cm of 3" Durapore silk tape (3M)^	$0.08
	40 cm of yarn (Red Heart)^	$0.01
	2 Rubber bands (Advantage)^	$0.01
	Consumables Total	**$0.76**
	Durable (Reusable) Materials	
	1 Silc pig blue sample size (Smooth-On)^	$4.22
	2 Silicone testicle models 30 ml each ECOFLEX 30 (Smooth-On)^	$1.02
	1 Egg mold (Wilton)~	$5.19
	Durables Total	**$10.43**
Total Consumable Materials Cost Per Student (not including optional items)		$3.91
Total Up-Front Durable Materials Cost		$11.43

Table 1. Model materials and associated costs

	PGY-1	PGY-2	PGY-3	PGY-5	Attending	Total
Suprapubic Catheterization	0	0	0	2	1	3 (11%)
Dorsal Slit for Phimosis	0	0	1	2	0	3 (11%)
Dorsal Slit for Paraphimosis	0	0	1	0	0	1 (4%)
Scrotal Exploration	1	0	1	5	1	8 (30%)
Orchiopexy	1	0	1	2	1	5 (19%)
Trans-Scrotal Orchiectomy	0	0	0	2	1	3 (11%)
Retrograde Urethrogram	2	0	0	2	3	7 (26%)
Cystogram	2	1	0	2	2	7 (26%)

Table 2. Number of participants with previous procedural experience

	Pre-course Mean (SD)	Post-course Mean (SD)	p-value	Hedge's g
Identification of indications for suprapubic catheterization	2.1 (1.0)	3.7 (0.7)	<0.001	1.85
Performance of suprapubic catheterization	1.4 (0.9)	3.8 (1.0)	<0.001	2.25
Performance of dorsal penile block	2.0 (1.2)	4.2 (0.9)	<0.001	2.07
Identification of phimosis	2.3 (1.2)	4.3 (0.7)	<0.001	2.04
Identification of paraphimosis	2.3 (1.2)	4.3 (0.7)	<0.001	2.04
Performance of dorsal slit	1.6 (0.9)	4.0 (1.1)	<0.001	1.02
Identification of testicular torsion	3.0 (0.8)	3.8 (0.8)	0.001	0.63
Performance of scrotal exploration	1.8 (1.0)	3.7 (1.1)	<0.001	1.80
Performance of orchiopexy	1.6 (1.0)	3.4 (1.1)	<0.001	0.38
Performance of orchiectomy	1.5 (0.9)	3.7 (1.2)	<0.001	2.07
Identification of indications for retrograde urethrogram	2.7 (1.3)	3.9 (0.9)	<0.001	1.07
Performance of retrograde urethrogram	2.0 (1.4)	3.5 (1.4)	<0.001	1.07
Interpretation of retrograde urethrogram	2.3 (1.3)	3.6 (1.1)	<0.001	1.08
Identification of indications for cystogram	2.4 (1.2)	3.8 (0.9)	<0.001	1.32
Performance of cystogram	2.1 (1.3)	3.4 (1.4)	<0.001	0.96
Interpretation of cystogram	2.4 (1.1)	3.7 (1.0)	<0.001	1.24

Table 3. Impacts of course on diagnostic and procedural confidence

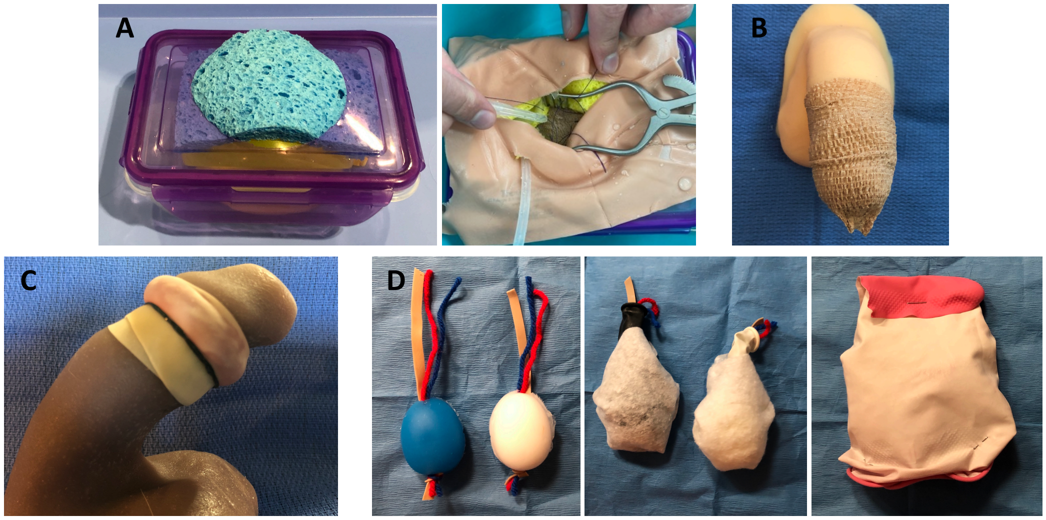

Figure 1. Simulation models used. (A) Open suprapubic catheterization model without skin and with skin showing simulated bladder under sponge. (B) Phimosis model. (C) Paraphimosis model. (D) Simulated testes and spermatic cord structures, testes covered with simulated tunica vaginalis and cremasteric fibers, and complete scrotum model.

Appendix A

Urologic Care Army/Air Force/Navy Provider Education (UCANPE)
Confidence Assessment

1. What is your level of confidence in identifying indications for suprapubic catheter placement (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

2. What is your level of confidence in performing open suprapubic catheter placement (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

3. How many previous open suprapubic catheter placements have you performed? ___________

4. What is your level of confidence in performing a dorsal penile block (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

5. What is your level of confidence in identifying phimosis (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

6. What is your level of confidence in identifying paraphimosis (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

7. What is your level of confidence in performing dorsal slit (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

8. How many previous dorsal slit procedures for phimosis performed? ___________
9. How many previous dorsal slit procedures for paraphimosis performed? ___________

10. What is your level of confidence in identifying testicular torsion (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

11. What is your level of confidence in performing scrotal exploration through a midline raphe incision (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

12. What is your level of confidence in performing an orchiopexy (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

13. What is your level of confidence in performing a trans-scrotal orchiectomy (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

14. How many previous scrotal explorations have you performed? ___________
15. How many previous orchiopexies have you performed? ___________
16. How many previous trans-scrotal orchiectomies have you performed? ___________

17. What is your level of confidence in identifying indications for performing a retrograde urethrogram (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

18. What is your level of confidence in performing a retrograde urethrogram (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

19. What is your level of confidence in interpreting a retrograde urethrogram (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

20. What is your level of confidence in identifying indications for performing a cystogram (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

21. What is your level of confidence in performing a cystogram (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

22. What is your level of confidence in interpreting a cystogram (please circle)?

1	2	3	4	5
Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident

23. How many previous retrograde urethrograms have you performed? ___________
24. How many previous cystograms have you performed? ___________
25. Have you ever completed emergency urology training? Yes No
26. What year did/will you graduate from residency? ___________
27. Please list any fellowships you have completed ____

Appendix B

Urologic Care Army/Air Force/Navy Provider Education (UCANPE)

Knowledge Assessment

1) Which of the following is a relative contraindication to suprapubic catheterization?
   a. Non-distended bladder
   b. Coagulopathy
   c. Extensive abdominal adhesions from previous surgeries
   d. Suspected bladder malignancy
2) Which of the following is an absolute contraindication to suprapubic catheterization?
   a. Coagulopathy
   b. Active skin infection overlying site
   c. Orthopedic hardware present in the pubic symphysis
   d. Suspected bladder malignancy
3) All of the following can potentially prohibit successful transurethral catheterization except:
   a. Traumatic urethral disruption
   b. Severe BPH
   c. Neurogenic bladder
   d. Bladder neck compression
4) What is the proper order of the following anatomic structures from most external to most internal?
   a. Skin, subcutaneous fat, anterior rectus sheath, rectus abdominus, posterior rectus sheath, space of Retizus, dome of bladder
   b. Skin, subcutaneous fat, anterior rectus sheath, rectus abdominus, space of Retizus, dome of bladder
   c. Skin, subcutaneous fat, anterior rectus sheath, rectus abdominus, peritoneum, space of Retizus, dome of bladder
   d. Skin, subcutaneous fat, anterior rectus sheath, rectus abdominus, posterior rectus sheath, peritoneum, space of Retizus, dome of bladder
5) The correct position for planned insertion of suprapubic catheter is:
   a. Just above the symphysis pubis, in the midline
   b. Just above the symphysis pubis, slightly off midline on either side
   c. 2 finger breadths above the symphysis pubis, in the midline
   d. 2 finger breadths above the symphysis pubis, slightly off midline on either side
6) When performing a dorsal nerve block, where are the target nerves located?
   a. 3 o'clock and 9 o'clock
   b. 10 o'clock and 2 o'clock
   c. 12 o'clock and 6 o'clock
   d. 8 o'clock and 4 o'clock
7) All of the following are indications to perform a dorsal slit procedure for phimosis except:
   a. Need for access to the urethral meatus for catheterization
   b. Prevention of recurrent balanitis and/or abscess formation
   c. Desire treatment for phimosis without circumcision
   d. Failed manual reduction techniques, such as micro-puncture or with Babcock clamps

8) Which of the following is a non-invasive method of paraphimosis reduction?
    a. Iced-glove method
    b. Micro-puncture
    c. Hyaluronidase
    d. Dorsal slit
9) During the dorsal slit for phimosis procedure, failure of the foreskin to tent following hemostat insertion indicates which of the following?
    a. Presence of a concomitant paraphimosis
    b. Likely failure of the dorsal slit procedure
    c. Insertion of the hemostat inadvertently into the urethra
    d. Congenital etiology
10) When performing a dorsal slit for paraphimosis, what is the proximal extent of the incision?
    a. The coronal sulcus
    b. The mid region of the penile shaft
    c. The urethral meatus
    d. Approximately 2 finger-breadths proximal to the coronal sulcus
11) What is the last anatomical layer that must opened before completing orchiopexy?
    a. Internal spermatic fascia
    b. Visceral layer of tunica vaginalis
    c. Dartos muscle/fascia
    d. External spermatic fascia
    e. Parietal layer of tunica vaginalis
12) Which of the following are the proper locations to place fixation sutures during orchiopexy?
    a. 10 o'clock and 2 o'clock
    b. 3 o'clock, 6 o'clock, 9 o'clock
    c. 6 o'clock and 9 o'clock
    d. 12 o'clock, 9 o'clock, 6 o'clock
13) In which direction should manual detorsion be performed?
    a. Clockwise
    b. Counterclockwise
    c. Toward the ipsilateral thigh
    d. Away from the ipsilateral thigh
14) What are the average degrees of rotation needed to completely detorse a testicle?
    a. 180
    b. 360
    c. 480
    d. 720
    e. 1080
15) During orchiopexy, the testis should be anchored to which anatomic layer?
    a. Internal spermatic fascia
    b. Visceral layer of tunica vaginalis
    c. Dartos muscle/fascia
    d. External spermatic fascia
    e. Parietal layer of tunica vaginalis

16) Which portion of the male urethra is most susceptible to traumatic disruption?
    a. Penile urethra
    b. Bulbous urethra
    c. Membranous urethra
    d. Prostatic urethra
    e. Intersection of the urethra and bladder neck
17) Which of the following is the ideal patient positioning for performance of a retrograde urethrogram?
    a. Supine
    b. Oblique
    c. Prone
    d. Lateral decubitus
18) What is the recommended volume of contrast mixture used to perform a retrograde urethrogram?
    a. 10 ml
    b. 25 ml
    c. 50 ml
    d. 100 ml
    e. 150 ml
19) What is the recommended volume of contrast mixture used to perform a cystogram?
    a. 100 ml
    b. 150 ml
    c. 200 ml
    d. 300 ml
    e. 400 ml
20) Which of the following cystogram findings necessitate urgent operative intervention on the bladder?
    a. Presence of a pelvic flame
    b. Presence of mucosa-based filling defects
    c. Presence of air in the bladder
    d. Presence of contrast in the paracolic gutters

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Chapter 3: Discussion

Learning theories

Three learning theories informed the curricular design, namely, meaningful learning, scaffolding, and experiential learning. In his 1968 book, Educational Psychology: A Cognitive View,[12] Davis Ausubel introduced Meaningful Learning Theory. This theory asserts that existing knowledge is the most critical factor for building new knowledge[13] because when an association of new information with previously learned information facilitates information processing[11] and transfer into long-term memory. For this process to be effective, three standards must be met. First, the learner must possess organized knowledge structures to build upon. Learners must also have the motivation to integrate new knowledge into their pre-existing knowledge structures. Last, the new concepts must be presented clearly. If these requirements are met, the learner will be able to add to their knowledge base meaningfully.[13]

We considered the tenets of Meaningful Learning Theory while developing the UCANPE course. We selected practicing general surgeons and general surgery trainees to participate in the course because of their pre-existing cognitive structures in medicine and surgery. Additionally, participation in the course was optional to hopefully attract participants with motivation to learn. Finally, we designed the curriculum in a manner intended to provide participants with enough new information to allow them to learn the new skills without burdening them with excessive detail.

David Wood, Jerome Bruner, and Gail Ross developed the concept of instructional scaffolding in the 1970s.[11] Scaffolding involves providing temporary support to a learner by an instructor to help the learner reach proficiency for a content area or skill.[8] The concept of instructional scaffolding aligns well with Lev Vygotsky's Zone of Proximal Development (ZPD). ZPD is defined as the difference between what a learner can achieve independently compared to what a learner can achieve with assistance from a skilled instructor.[11] In the UCANPE course, instructional scaffolding was employed during the simulated skills portion when urologists, senior urology residents, and pediatric surgeons trained to perform urologic procedures interacted with learners in a small group setting and provided individualized support to help them complete the included procedures.

Experiential learning, or learning through experience, should be considered a general educational concept rather than a defined educational theory. The work of several theorists contributed to the development of the concept, including Jean Piaget, Lev Vygotsky, and David Kolb, among others. I focus on the work of David Kolb for this discussion. Kolb proposed a four-stage experiential learning cycle that begins with concrete experience followed by reflective observation, abstract concretization, and active implementations.[14] When applied to this curriculum, concrete experience describes the starting point for the learner in the course, before any instruction, and reflects their prior knowledge and skill. Reflective observation occurs during the introduction of new concepts during the didactic session and simulated skill demonstrations. Learners then experience abstract conceptualization when they practice the simulated skills themselves, reconciling their previous experiences with new experiences to build knowledge and assign meaning. The learner experiences the last stage, active experimentation when encountering a clinical situation that necessitates implementing their new skills.[14] Critics of Kolb's experiential learning cycle contend that it oversimplifies learning and fails to account for social context. In the end, no singular perfect learning theory exists, highlighting the purpose behind combining a variety of learning theories in the curricular design.

Qualitative Data

Qualitative data were collected via focused semi-structured participant interviews conducted following the MAR2021 course at Naval Medical Center Portsmouth. The interview guide included the following questions:

1) What aspect(s) of the curriculum had the greatest impact on your acquisition of urologic emergency knowledge?
2) What aspect(s) of the curriculum had the least impact on your acquisition of urologic emergency knowledge?
3) What aspect(s) of the curriculum had the greatest impact on your confidence in diagnosing urologic emergencies and performing emergency urologic procedures?
4) What aspect(s) of the curriculum had the least impact on your confidence in diagnosing urologic emergencies and performing emergency urologic procedures?

Interview participants were also asked for general comments and feedback regarding their experiences during the course. Seven learners participated in the interviews, three PGY-1s, two PGY-2s, one PGY-3, and one PGY-5. Despite the wide range of learner experience between the interview participants, from intern to chief resident, no divergent trends were observed in the responses between year groups.

Most learners felt that the opportunity for hands-on skills practice had the most significant impact on their acquisition of emergency urologic knowledge. One learner noted, "…for me, one of the most beneficial things was to be able to perform the skill once in a monitored setting, being able to ask questions as I was going, and being able to take notes that I could take with me." While the learners felt that the hands-on portion of the course had the greatest impact on knowledge acquisition, many thought that the didactic portion had the least impact on their knowledge acquisition. At the same time, all recognized that some amount of foundational didactic instruction was necessary.

Regarding the acquisition of procedural confidence, participants again endorsed the hands-on skills portion as most impactful. One participant commented, "practicing on the model 100% had the greatest impact on improving my confidence." This sentiment was repeated frequently throughout the interviews. Many participants felt that their procedural confidence would have been further enhanced through the opportunity to perform these skills in real life instead of simulated experiences. Still, all recognized the impracticality of this sentiment. There were no aspects of the course that any participants identified as contributing least to their procedural confidence.

Overall, the course was very well received by the interview participants. Many had positive comments about the simulation models developed for the course. One interviewee, when asked for general feedback, remarked, "I thought it [the course] was excellent and very important because I never did urology at all, not even as an intern, and it is certainly important for us, as general surgeons, to be comfortable with these procedures."

Societal and Scientific Relevance

We created the first dedicated urologic emergency curriculum for general surgeons. Development, implementation, and publication of this curriculum helps fill a training gap and benefits military general surgeons and general surgeons practicing in an area without a urologist physically present, such as rural surgeons and those on humanitarian missions. Additionally, the strategy of relying on low-cost, easily reproducible simulation models developed for this curriculum further supports the goal of supporting surgeons working in low-resource settings, as cost is a common barrier to the use of simulation.

Presentations about curricular development, simulation model development, and curriculum implementation have been presented at three national conferences. The course has been conducted for general surgeons and trainees at Walter Reed National Military Medical Center and Naval Medical Center Portsmouth. Additionally, a modified version of the course focusing on bedside emergency urologic procedures was created and hosted for a group of emergency medicine trainees at Naval Medical Center Portsmouth.

Future Directions

In the future, we plan to conduct the original course for military general surgeons in different venues, such as on a ship for our operational surgical teams. We also plan to conduct the modified course for additional emergency medicine providers and to extend the modified course's reach to include military primary care providers.

Military Relevance

The composition of our currently deployed surgical teams is such that a urologist is not usually physically present,[4] and the most frequently used surgical guidelines for deployed surgeons do not include guidance on urologic emergency care.[3] Men account for 83.5% of all active duty service members.[15] Emergencies requiring a dorsal slit procedure can happen at any age. Still, other urologic emergencies, such as testicular torsion, are more common in younger men.[16] Younger service members; specifically those under 30, make up 70% of enlisted active duty personnel and 20.7% of active duty officers.[15] Prompt recognition and treatment are essential for the preservation of fertility and the prevention of complications that could impair military readiness in our soldiers, sailors, airmen, and marines.

Limitations

There are several significant limitations to this thesis, in addition to those mentioned in Chapter 2. First, by employing a pre/post design, there was no control group, limiting our ability to draw generalizable conclusions about the efficacy of the curriculum from a purely statistical viewpoint. Additionally, we used convenience samples from both participating institutions, which is potentially problematic because both institutions have training programs with robust simulation curricula. Thus, participants from these institutions, already familiar with simulation learning, may perceive greater improvements in confidence after taking part in a simulation curriculum compared to learners with less simulation experience. Last, we did not use any objective measurements of diagnostic or procedural skills; instead, we relied on subjective confidence self-assessments as surrogate markers for knowledge and skill attainment. The curriculum could be improved in the future by recruiting a larger population from outside of WRNMMC and NMCP, changing the design to include a control group, and adding objective measurements of skill acquisition, such as checklists completed by expert observers.

Conclusions

Military general surgeons frequently need to perform emergency urologic procedures in settings without a urologist present, yet current general surgery residency training standards do not include urologic procedure minimums. The curriculum presented provides a cost-conscious and highly effective means for training general surgeons to diagnose and treat common urologic emergencies, thereby helping to bridge the present gap between training and practice expectations for military general surgeons.

Appendix C

Name _________________________

Urologic Care Afloat in the Navy Provider Education (UCANPE)

Needs Assessment

1) What year did you complete general surgery residency? ________________
   a. What is your subspecialty (if applicable)? ________________________
2) How many deployments/underways on ship or other environment without immediate access to/assistance from a urologist? ________________
3) How many urologic emergencies encountered during deployments/underways without immediate access to/assistance from a urologist? __________________
   a. Please list emergencies encountered:
4) How many emergency urologic procedures performed during deployments/underways without immediate access to/assistance from a urologist? ________________
   a. Please list specific procedures here:
5) What urologic emergencies or emergency procedures would you have liked more training on prior to deployment?

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