



Adapting to the Educational Challenges of a Pandemic: Development of a Novel Virtual Urology Subinternship During the Time of COVID-19

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OBJECTIVE	To design, implement, and evaluate learner attitudes of a virtual urologic surgery clinical rotation for medical students.
METHODS	Ten senior medical students at the Perelman School of Medicine at the University of Pennsylvania were enrolled. Students were administered a precourse test on their perceived confidence of their urologic knowledge, confidence in identifying urologic conditions, comfort with performing urologic evaluations, and confidence placing consults for urologic issues. Students participated in a 2-week curriculum that included both asynchronous and synchronous content. Asynchronous content included prerecorded lectures, self-paced problem-based learning modules, directed reading and video content, and an online discussion board. Synchronous content included real-time videoconferences covering case discussions, simulated patient presentations, and critical literature reviews. At the conclusion of the course, students were administered the postcourse survey evaluating changes in their ability to identify and understand urologic conditions.
RESULTS	The postcourse survey demonstrated this course significantly increases students' scores in: self-perceived urologic knowledge, confidence in naming urologic conditions, comfort with performing urologic evaluations, and confidence placing consults for urologic conditions ($P < .05$).
CONCLUSION	Virtual medical student rotations are scalable and effective at delivering surgical material and can approximate the interpersonal teaching found in clinical learning environments. They may be a useful tool to supplement or augment clinical learning in select situations. UROLOGY 148: 70–76, 2021. © 2020 Elsevier Inc.

The COVID-19 pandemic has affected every aspect of the healthcare system including medical education. In accordance with social distancing guidelines, in March 2020, medical students were removed from all clinical care at institutions across the United States.^{1,2} This major shift had a significant effect on

surgical upper-level students whose educations heavily rely on direct patient care in clinical spaces. In fact, a similar response was also observed for Urology resident learners, drastically reducing their direct patient care, and thus curtailing their education.³ In response, multi-institutional coalitions like the UCSF Collaborative Online Virtual Didactics (COViD) and New York Educational Multi-institutional Program for Instructing Residents (EMPIRE) lecture series swiftly pivoted to delivering virtual didactics to residents and medical students. Although filling some educational gaps, these didactics failed to recapitulate the benefit of networking, mentorship, and personable feedback that come from medical students interacting in-person with residents and faculty.⁴ We hypothesized that this may be approximated by an online subinternship that combines flexible, web-based, modular content with real-time interactions between medical students, residents, and faculty. Recognizing the urgent call to action, we describe our experience developing this

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virtual surgical subinternship and present early programmatic evaluation outcomes.

Following the decision to suspend all student clinical activity, Urology faculty and 2 senior medical students at the University of Pennsylvania Perelman School of Medicine developed a novel virtual urologic curriculum. All upper-level, postclerkship medical students were eligible to register for this 2-week virtual Urology subinternship over the course of 1 month. The course was advertised as a fundamental-level course with the only prerequisite requirement being the completion of the Surgery core clerkship.

The primary goal of this curriculum was to expose students to Urology while advancing their foundational knowledge of urologic evaluation and management. The secondary goal was to innovate methods for implementing a virtual curriculum that is scalable, sustainable, and adaptable to the needs of learners and instructors across surgical disciplines.

By the end of the course, learners were to achieve the following learning objectives: (1) Describe the steps to performing a urologic evaluation; (2) deliver urologic history, exam, assessment and plan in an oral case presentation; (3) list and describe the common conditions that urologists manage; (4) name key anatomical structures relevant to urological pathologies and urinary drainage;

and (5) demonstrate ability to appraise urologic literature that intersects with other medical and surgical specialties.

METHODS

Curriculum Format

The curriculum used both asynchronous and synchronous content (Table 1). The online learning management system, Canvas (Instructure, Salt Lake City, UT) hosted asynchronous readings, lectures, and discussion boards. BlueJeans (BlueJeans Network, San Jose, CA) videoconferencing was utilized for synchronous discussions and case presentations.

Asynchronous material accommodated the uncertainty of faculty clinical schedules. Faculty members prerecorded, introductory lectures on core topics for on-demand viewing by learners. Topics included medical and surgical management of benign, oncologic, and pediatric Urology and aligned with the American Urological Association Medical Students Curriculum.⁵ The majority of lectures were repurposed from pre-existing educational content created by each faculty member. Supplemental material included surgical videos, directed readings, and illustrations referenced from the AUA video library, *Urology* by Campbell's-Walsh-Wein, and the Penn Clinical Manual of Urology (Fig. 1). Following completion of the lecture and supplemental materials, a discussion board opened to facilitate asynchronous communication and feedback about lecture contents among students, residents, and faculty. Learners were required to post one

Table 1. Breakdown of synchronous and asynchronous materials

Overview of Penn Medicine Virtual Urology Curriculum				
	Type of Activity	Learner Hours Per Course	Additional Educator Hours Per Course	Description
<i>Asynchronous Material</i>	Recorded lectures	20	2	Faculty recorded 30 min lectures in benign, pediatrics, and oncology
	Online cases	10	0	1-2 problem-based learning cases accompanied each lecture
	Additional readings	15	0	Supplemental reading from AUA medical student curriculum, Campbell-Walsh-Wein, Penn Urology Handbook, and landmark articles
	Discussion board post	15	0.5	Students posted one question, comment, or article a day. Students replied to at least one of their peers. Faculty and resident provided comments on board
<i>Synchronous material</i>	Cumulative Live discussion sessions	60	2.5	Faculty and resident facilitated on rotating schedule
	Live lecture- urology department grand rounds (once per week)	10	1.5	Review of online cases with students
	Live student presentations (once)	3	0	Students were invited to attend weekly virtual grand round meetings
	Cumulative	2	2	Students delivered final evidence-based medicine presentations to department
<i>Cumulative course total (2-wk)</i>		15	3.5	
		75	6	

	Monday Benign Urology	Tuesday Benign Urology	Wednesday Benign Urology	Thursday Benign Urology	Friday Benign Urology
AM	Lectures: <ul style="list-style-type: none"> • Introduction • Urologic evaluations • Urinary Catheters 	Lectures: <ul style="list-style-type: none"> • LUTS • Urinary incontinence • Strictures 	Lectures: <ul style="list-style-type: none"> • Urinary tract calculi • Urologic emergencies 	<ul style="list-style-type: none"> • Urology Grand Rounds • Lectures <ul style="list-style-type: none"> • Pelvic Organ Prolapse • Pelvic and Testicular Pain 	<ul style="list-style-type: none"> • Lectures <ul style="list-style-type: none"> • Male Infertility • Varicocele • Erectile Dysfunction
PM	<ul style="list-style-type: none"> • PBLs/readings: <ul style="list-style-type: none"> • Urinary Catheters • Discussion board post 	<ul style="list-style-type: none"> • Discussion section • PBLs/readings <ul style="list-style-type: none"> • LUTS • Urinary incontinence • Strictures • Discussion board post 	<ul style="list-style-type: none"> • Discussion section • PBLs/readings <ul style="list-style-type: none"> • Urinary Tract Calculi • Urologic Emergencies • Discussion board post 	<ul style="list-style-type: none"> • Discussion section • PBLs/readings <ul style="list-style-type: none"> • Pelvic Organ Prolapse • Pelvic and Testicular Pain • Discussion board post 	<ul style="list-style-type: none"> • Discussion section • PBLs/readings <ul style="list-style-type: none"> • Male Infertility • Varicocele • Erectile Dysfunction • Discussion board post
	Monday Pediatric Urology	Tuesday Pediatric Urology	Wednesday Oncology	Thursday Oncology	Friday Oncology
AM	Lectures: <ul style="list-style-type: none"> • Urinary tract anomalies • Bladder exstrophy and Epispadias • Hypospadias • Circumcision 	Lectures: <ul style="list-style-type: none"> • Peds Emergencies • Cryptorchidism • VUR and Re-implant 	Lectures: <ul style="list-style-type: none"> • Prostate Cancer Screening and Workup • Prostate Cancer management 	<ul style="list-style-type: none"> • Urology Grand Rounds • Lectures <ul style="list-style-type: none"> • Hematuria • Bladder Cancer • Urinary Diversion 	<ul style="list-style-type: none"> • Lectures <ul style="list-style-type: none"> • Renal Tumors/Cancer • Testicular Cancer
PM	<ul style="list-style-type: none"> • PBLs/readings: <ul style="list-style-type: none"> • Urinary tract anomalies • Bladder exstrophy and Epispadias • Hypospadias • Circumcision • Discussion board post • Work on EBM 	<ul style="list-style-type: none"> • Discussion section • PBLs/readings <ul style="list-style-type: none"> • Peds Emergencies • Cryptorchidism • VUR and Re-implant • Discussion board post • Work on EBM 	<ul style="list-style-type: none"> • Discussion section • PBLs/readings • Prostate Cancer Screening and Workup • Prostate Cancer management • Discussion board post • Work on EBM 	<ul style="list-style-type: none"> • Discussion section • PBLs/readings <ul style="list-style-type: none"> • Hematuria • Bladder Cancer • Discussion board post 	<ul style="list-style-type: none"> • Discussion section—EBM Final presentation • PBLs/readings <ul style="list-style-type: none"> • Renal Tumors/Cancer • Testicular Cancer • Discussion board post • Give us your feedback!

Figure 1. Two weeks schedule of virtual urology subinternship. (Color version available online.)

comment per day, with their activity identified by a distinct username. This served to increase interaction and participation with personal feedback on individual topics of student interest (Fig. 2).

Synchronous material included daily virtual discussion sessions focused on the day's lecture topic. Similar to an in-person rotation, facilitators of these sessions rotated daily to provide flexibility for schedules and expose students to multiple faculty and residents. During these sessions, participants discussed surgical decision-making through problem-based learning (PBL) cases. PBLs were either written de novo or, when available, adapted from the AUA medical student case slides.⁵ Facilitators used Socratic teaching methods to approximate what is observed in our clinical environment during a surgical rotation. Learners also prepared a surgical SOAP note from PBL cases and presented a simulated patient to the group for feedback by faculty and fellow students. At the conclusion of the course, learners gave an evidence-based medicine capstone presentation on a urologic topic of interest to the entire Urology division in a Grand-Rounds-style presentation.

In accordance with our institution's grading guidelines for online courses, students were graded Pass/Fail based on completion of course requirements as outlined in Table 1.

Programmatic Evaluation

The Kirkpatrick model for programmatic evaluation was used.⁶ We focused our outcomes on Kirkpatrick Level 1 (participation) and Level 2a (attitudinal). To evaluate Level 2a outcomes, we developed a pre- and post-course questionnaire assessing participants' perceptions of Urology using a 5-point Likert scale (1 = poor/strongly disagree and 5 = excellent/strongly agree) (Supplemental 1). Areas for evaluation of student attitudes included self-perceived urologic knowledge, confidence in naming urologic conditions, comfort with performing urologic evaluations, and confidence placing consults for urologic conditions. Students also provided end-of-course open-ended comments.

Median scores with interquartile ranges of anonymized pre- and postcourse surveys were calculated. A paired Mann-Whitney U test compared pre- to postcourse responses for each item using RStudio software, v. 1.2.5033 (RStudio Inc, Boston, MA). A *P*-value <.05 was considered statistically significant.

Qualitative content analysis on open-ended answers was performed using conventional content analysis methodology.⁷ Thirty comments of written feedback were compiled, read in entirety, and analyzed inductively. Codes were then derived from prevailing themes captured among responses. Each comment was read word for word and assigned to its appropriate



Medical Student 1

May 6, 2020



When I was at CHOP for my EM rotation, we often had kids with really bad constipation that experienced urinary incontinence or UTI secondary to it. I remember one of the pediatricians saying that up to 70% of kids with constipation may experience urinary incontinence, with the thought that the back up of stool can press on the bladder, reducing the amount of urine it holds and weakening the pelvic floor muscles.

I was curious as to why we don't talk about constipation causing urinary incontinence in adults nearly as much as we do for children. I found this nice review article that summarizes the relationship of the two nicely. This review article quotes a study that found that in geriatric patients, treating constipation decreased the rates of urinary symptoms such as urgency, frequency, dysuria in patients. They also had a significant decrease in residual urine volumes. The article also highlighted a study that found that chronic constipation was the second strongest predictor of postpartum urinary incontinence. I know when I rotated with urogyn, they asked a ton about bowel habits, moreso screening for fecal incontinence, but should we also be asking about constipation?

https://www.scielo.br/scielo.php?pid=S1677-55382011000100003&script=sci_arttext

← Reply
👍 (4 likes)



Medical Student 2

May 6, 2020



Very interesting, especially the study "that found that chronic constipation was the second strongest predictor of postpartum urinary incontinence." In females I've learned the straining from constipation can also weaken the pelvic floor contributing to prolapse [1]-- which, if it's anterior prolapse actually improves their symptoms of SUI. Constipation seems to contribute to a lot of concomitant pelvic floor disorders. Things I've learned today: Kegels + fiber = happy pelvis

1. https://www.uptodate.com/contents/pelvic-organ-prolapse-in-women-epidemiology-risk-factors-clinical-manifestations-and-management?search=pelvic-organ-prolapse&source=search_result&selectedTitle=1~115&usage_type=default&display_rank=1

← Reply
👍 (2 likes)



Resident

May 6, 2020



This is a great point! I will say that often, in clinic, our attendings who see patients with urinary retention do recommend a bowel regimen. I'm sure one of the attendings can chime in, but the way I think about it is that constipation can lead to issues in both retention and prolapse populations due to 2 different mechanisms.

Constipation -> straining -> weakened pelvic floor -> prolapse (which can cause voiding issues of course)

Constipation -> pressure of the bladder in the kiddos with a small pelvic cavity and lots of organs smushed down there. We often say at CHOP, the bladder is a sensitive muscle, -> urinary retention. This is probably a similar etiology for the urinary symptoms in the geriatric population, whereas the constipation and pressure related issues likely exacerbate the incontinence, as above!

← Reply
👍 (3 likes)



Attending

May 7, 2020



Great points! Never forget that one organ system certainly affects the other.

We often see for neurogenic patients, like those with spina bifida, better bowel regimens lead to a lot of improvement in their urinary symptoms including continence and frequency of UTIs. Very important to not forget this can be a key part of everyone's management.

For patients with OAB, it can be difficult to improve the condition with any medications or regimens until their constipation is managed. Should be part of the initial work-up. And remember, antimuscarinics unfortunately don't help the situation...

← Reply
👍

Figure 2. Example of discussion board thread.

Medical students were instructed to post a brief comment on a topic of interest from each day's lectures. Canvas discussion board threads allowed for asynchronous interactions among medical students, residents, and faculty.

Table 2. Median scores in learner attitudes

Topic	Median Baseline Score (IQR)	Median Post-course Score (IQR)	P
Overall knowledge of urology	3 (2-3)	4 (4-4)	0.01
Naming urologic conditions confidence	3 (2-3.75)	4.5 (4-5)	0.01
Urologic evaluation confidence	2 (2-2.75)	3.5 (3-4)	0.02
Urology consult confidence	3 (2.25-4)	5 (4.25-5)	0.01

5-point scale: 1 poor, 5 excellent.
n = 10.

theme. Coding was performed separately by 2 investigators, C.W. and O.F., to minimize subjectivity. Disagreement among investigators regarding theme titles was resolved by discussion between the 2 coders. This study was considered quality improvement by the University of Pennsylvania Institutional Review Board, and informed consent was waived.

RESULTS

Kirkpatrick Level 1 outcomes (participation) were a total of 10 senior medical students over 2 separate 2-week subinternship iterations occurring during May 2020. Participant's specialty of interest was recorded at the start of class and included Urology (3), General Surgery (1), OB/GYN (3), Emergency Medicine (1), Orthopedic Surgery (1), and Plastic Surgery (1). Twenty of 26 (77%) division faculty participated in lectures, discussion boards and/or discussion groups. Faculty reported that the creation of lecture material and participation in the discussion board on average was a cumulative 2.5 hours (Table 1). Faculty participation in synchronous learning activities, including discussion sessions and final capstone presentations, was a total of 3.5 hours.

Kirkpatrick Level 2a outcomes include learner attitudes. Prior to taking the course, median student scores for all items ranged from 2 to 3 (Table 2). By the end of the curriculum, median scores significantly improved to greater than 3 in every topic area ($P < .05$). At the completion of the course, 2 students reported a shift of specialty commitment to Urology.

In qualitative content analysis of 30 end-of course feedback comments, themes included that the course had high perceived educational value, and that the course increased appreciation of Urology among students who were not previously considering the field. A representative comment stated that "[the] surgical patient presentations and capstone project were fun! It allowed me to think critically about a patient and get real time feedback on my surgical decision making." Student feedback also highlighted the theme that discussion sessions that were didactic in nature were less favored than sessions that took a question and answer format. An additional theme was the convenience and appreciation of pre-recorded lectures and varied interaction with faculty members. One student remarked, "The flexibility of the course was great! The prerecorded lectures were succinct but with all the high yield facts I needed. I really liked that I could watch them on my own time." Another student reported, "the daily discussion groups were my favorite part of the course. It was nice interacting with all of the Urology team."

Feedback volunteered by facilitators revealed that faculty and residents enjoyed the opportunity to continue teaching medical students during social distancing, and they appreciated the practicality of now having pre-recorded lectures for other teaching opportunities.

COMMENTS

We provide a framework that allows for resuming urologic education for medical students while social distancing. Although there is no replacement for in-person, direct patient care for senior medical students, a virtual surgical subinternship is an effective and feasible alternative that has been recently explored in other surgical specialties.^{8,9} Our approach is unique in recreating an online version of the interpersonal aspects of clinical learning. These initial programmatic outcomes demonstrated an improved perception of urologic knowledge during the rotation. Although this was a temporizing innovation during the COVID-19 pandemic, this curriculum has the potential for lasting improvement of the future of urologic undergraduate medical education. Considering the AAMC recommendation to suspend visiting student rotations, the Society of Academic Urologists has encouraged Urology programs nationally to develop online virtual rotations.¹⁰ Unfortunately, no best practices yet exist. Our curriculum can model this adaptation for other Urology and surgery residency programs.

Beyond the pandemic period, virtual course materials may augment or replace traditional curricula. An organized virtual platform is well-suited to expose "visiting" students to more programs by providing flexible scheduling and reducing the cost of visiting rotations. For students uncertain about their interest in a specialty, a virtual format with synchronous and asynchronous learning methods may allow them to learn about the specialty and its culture before deciding on a traditional rotation.¹¹ Additionally, with the incorporation of students into outpatient telemedicine visits, there is potential for virtual subinternships to include patient care. The use of live video streaming of cases from the operating room may allow students to experience surgical decision making and operative techniques in real-time.¹² Finally, this format could correct the pervasive lack of Urology (and surgical subspecialties) within pre-clinical curriculums.¹³ Prerecorded lectures and case modules created for virtual subinternships and stored on open-access Canvas sites are easily scalable and adaptable for a broader preclinical audience with minimal additional educator time. Furthermore, the learner-driven discussion board can become a portal to activate wider learning by empowering students to ask specific questions and learn from each other.

We acknowledge limitations with this reported experience. Our programmatic evaluation is based on 2

course-sessions with a relatively small number of participants. Additionally, 2 students involved with curriculum design participated in one iteration of this study, introducing potential bias of the evaluations. Areas for improving of the course include more interaction with residents and more exposure to actual patients. In addition to accruing more participants, future directions include a postcurriculum exam assessing knowledge acquisition of urological principles (Kirkpatrick level 2b) and longitudinal follow-up to determine student's choice to enter Urology residency (Kirkpatrick level 4).

CONCLUSION

Urology has always been on the forefront of healthcare innovation, and here we apply this same spirit to medical education. By integrating didactic lectures, problem-based cases, and discussion sessions, we provide a model for recapitulating the interpersonal relationships of a subinternship experience in the virtual environment. With continued healthcare and educational innovation, we have an opportunity to embrace online learning with virtual subinternships and continue to push our collective mission of educating the next generation of Urologists during these unprecedented times.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at <https://doi.org/10.1016/j.urology.2020.08.071>.

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EDITORIAL COMMENT



The COVID-19 pandemic has necessitated and enabled a reimagining of not only how to deliver effective clinical learning in a virtual environment, but also how to foster interest in a specialty often unfamiliar to students before an in-person rotation captures their enthusiasm. The authors designed and implemented a virtual subinternship for medical students consisting of recorded lectures, live sessions, and an interactive discussion board, which was intended to mimic the didactic experience of an in-person subinternship, despite being unable to replace the operative component vital to these rotations. The inclusion of current medical students in the leadership and planning of the curriculum was a notable strength of the authors' approach—the result was not just *for* students, but *by* and *with* them, as well.

A virtual curriculum does have inherent limitations. Many facets of what makes the field of urology exciting and empowering to students are challenging to simulate or recreate in an online platform. For instance, hands-on operative experience is essential to attracting future surgeons and facilitating students' decisions about whether urology is the right fit. In both the education literature and the anecdotes of generations of surgeons, active participation in the operating room is one of the most important factors when students decide to pursue a surgical career.^{1,2} This appears to be especially true in specialized surgical fields like urology.³ Just as watching surgical videos from home is not a replacement for the operative experience of residency training, there is something fundamental, even transformative, about what students learn in the operating room. Successfully recapitulation in a virtual setting will require further study and innovation.

The proliferation of virtual subinternships like the one presented here ahead of the 2021 residency recruitment cycle has notable implications. Urology subinternships have traditionally formed the basis of student evaluations, culminating in letters of recommendation that accompany residency applications. As the perceived competitiveness of the urology residency match has markedly increased,⁴ the majority of recent candidates have completed one or more "away" subinternships—external to the medical schools they attend—in pursuit of these letters. Are

virtual subinternships an appropriate mechanism through which candidates should obtain letters of recommendation, and how should evaluators consider impressions of a student formed entirely through remote or asynchronous learning formats? The qualities of a “good resident” extend beyond e-learning modules and message boards and include certain intangibles, such as work ethic and team cohesiveness that may be challenging to observe remotely. Another concern is that the substantial economic cost of away subinternships, including travel and accommodations, disadvantages certain kinds of students, such as those who have families or significant educational debt. Virtual subinternships are a potential solution, but will they further stratify these students once in-person rotations resume?

Amidst the ongoing challenges of the COVID-19 pandemic, the education community in urology should welcome continued innovation in undergraduate medical education and, in equal measure, critically assess the impact on student interest, objective candidate evaluation, and fair resident selection.

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future colleagues. Traditional metrics of performance as judged during in-person away rotations and from letters of recommendation penned by well trusted colleagues will be replaced at many institutions by a more holistic application review process.¹ While this represents a deviation from our standard practice, this new paradigm may offer significant opportunity for growth as a specialty. With the paucity of data regarding the value of our standard metrics and the significant potential for bias in any of the tools we use, perhaps a re-imagining of the system comes at just the right time for us all.

The innovative quality of urologists has always made our field exciting, attracting talented individuals of all backgrounds and mindsets. We are immensely encouraged by the creative energy from urologists across the globe to make urologic education even more accessible through didactics, surgical work-shops, town halls, and mentoring sessions during the pandemic. To this day, these resources have continued to positively augment the educational program for medical students returning to service at our institution.

We urologists recognize the core place of the operating room in our specialty and its irreplaceable value in the surgical educational process. We hope that our virtual subinternship model, which encourages active learning and participation, and those like it will ultimately serve as a valuable addition (not replacement) to the more traditional teaching methods that have made our specialty so unique.

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AUTHOR REPLY



This year’s application cycle has challenged us all to rethink the way we evaluate the medical students looking to become our