Hands-On Training in a Digital World: A Novel Simulation-Based Virtual Training Program for Placement and Removal of the Subdermal Contraceptive Implant


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ABSTRACT

Objective: The COVID-19 pandemic necessitated a shift from traditional in-person instruction for learning new technical skills to virtual delivery of medical education training. The objectives of this study were to develop and evaluate a virtual simulation-based training program for Canadian health care professionals (HCPs) on the insertion, localization, and removal of the etonogestrel subdermal contraceptive implant.

Methods: A scientific committee of Canadian family planning experts developed a 2-part virtual training program during the COVID-19 pandemic. Core educational content (part 1) was provided in an asynchronous, self-directed, online format. Part 2 consisted of synchronous, simulation-based training using web conferencing. The HCPs were provided with model arms and placebo applicators; the trainers demonstrated implant insertion and removal techniques, and trainees received individual feedback. All trainees were asked to complete an online evaluation upon completion of the program.

Results: Between September 22, 2020, and December 31, 2021, 83 trainers conducted 565 virtual training sessions. A total of 3162 HCPs completed part 1 of the training program, of whom 2740 had completed part 2 by December 31, 2021. Participants reported high levels of satisfaction with virtual simulation-based training; 96.5% of respondents (1570/1627) agreed that the virtual format was effective. Additional training prior to inserting the implant in clinical practice was requested by 4.5% of respondents (75/1671).

Conclusion: Virtual simulation-based learning provides effective education and technique training for etonogestrel implant insertion and removal. Online training for implant use can be scaled, as needed, to reach professionals in remote or underserved locations. This virtual training approach may be appropriate for other technical or minor surgical procedures.

RÉSUMÉ

Objectif : La pandémie de COVID-19 a imposé un virage dans l'enseignement de nouvelles compétences techniques en forçant la formation médicale en personne à passer en mode virtuel. Les objectifs de cette étude étaient d'élaborer et d'évaluer un programme de formation par simulation en mode virtuel destiné aux

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professionnels de la santé canadiens et portant sur l'insertion, la localisation et le retrait d'implants contraceptifs sous-cutanés d'étonogestrel.

Méthodologie : Un comité scientifique composé d'experts canadiens en planification familiale a mis au point un programme de formation virtuelle en deux volets pendant la pandémie de COVID-19. Le contenu formatif de base (volet 1) a été donné en ligne en mode asynchrone autodirigé. Le volet 2 consistait en une formation par simulation en mode synchrone par vidéoconférence. Les professionnels de la santé ont reçu un modèle de bras et des applicateurs placebo; les formateurs ont montré les techniques d'insertion et de retrait de l'implant, et les participants ont reçu des commentaires individuels. On a demandé à tous les participants de remplir une évaluation en ligne à la fin du programme.

Résultats : Entre le 22 septembre 2020 et le 31 décembre 2021, 83 formateurs ont donné 565 séances de formation virtuelle. Au total, 3162 professionnels de la santé ont suivi le volet 1 du programme de formation. Au 31 décembre 2021, 2740 d'entre eux avaient terminé le volet 2. Les participants ont déclaré un taux de satisfaction élevé à l'égard de la formation virtuelle par simulation; 96,5 % des répondants (1570/1627) ont jugé que le format virtuel était efficace. Dans l'ensemble, 4,5 % des répondants (75/1671) ont demandé une formation supplémentaire avant de mettre l'insertion d'implants en pratique.

Conclusion : L'apprentissage par simulation en mode virtuel est un moyen efficace pour la formation théorique et technique sur l'insertion et le retrait d'implants d'étonogestrel. La formation en ligne sur l'utilisation des implants peut être déployée, au besoin, pour atteindre les professionnels en région éloignée ou mal desservie. Cette approche de formation virtuelle peut être indiquée pour d'autres interventions techniques ou chirurgicales mineures.

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INTRODUCTION

Simulation-based education is ideal for the acquisition of new procedural skills and has been proposed to be superior to more traditional teaching modalities.[1] Medical educators and clinical experts have encouraged the use of simulation training for obstetrics and gynaecology.[2] Obstacles to providing and obtaining adequate and effective training for new procedures or technologies include the logistical challenges of location, timing, and availability of qualified trainers/teachers. Traditionally, training on new procedures and technologies has been conducted in face-to-face training sessions. However, rapid developments in Internet technology and virtual conferencing capabilities have created novel opportunities for continuing medical education and training.

When the etonogestrel subdermal contraceptive implant (Nexplanon) was approved by Health Canada in May 2020, the product monograph stipulated that insertion and removal of the implant should be performed by trained health care professionals (HCPs). Training programs for the insertion and removal of the implant in other countries had involved live face-to-face instruction with a trainer who provided didactic training and also demonstrated implant insertion and removal using a model arm with placebo training applicators. Participants then practised the procedures on the model arm under the supervision of the trainer and received feedback on their technique. Social distancing restrictions and limitations on face-to-face interactions necessitated by the COVID-19 pandemic resulted in the need to transition from a "hands-on" in-person training approach to a virtual training format to provide the required training on insertion and removal of the implant.

This paper describes the development, implementation, and evaluation of a virtual clinical training program for Canadian HCPs. The methodology of the training program was based in part on the principles of mastery learning,[3,4] in which learners acquire relevant knowledge and skills before advancing to the next learning stage, on studies supporting the effectiveness of simulation-based education in medicine,[5,6] and on optimal proposed frameworks for procedural skills training.[7] The training program included asynchronous didactic content delivery, as well as synchronous virtual simulation-based instruction for insertion and removal procedures using model arms and placebo implants/applicators. Trainee feedback from post-training program evaluations was used to evaluate the program's effectiveness.

METHODS

Training Program Development

The etonogestrel subdermal contraceptive implant clinical training program was initially designed as a single face-to-face session with didactic presentation and demonstration components. The onset of the COVID-19 pandemic necessitated the conversion of the initial in-person program to a 2-part online program. The program was developed by a scientific committee of family planning physicians. Members of the scientific committee also served as master trainers (i.e., trainers who trained additional trainers). Training was available in French and English.

Table 1. Physical and technical requirements for virtual simulated training of contraceptive implant insertion and removal

Item	Description
Adequate desk/table space	Depth and width need to be sufficient to accommodate all required equipment.
2 cameras for the trainer	• 1 (laptop) focused on the trainer (with flexibility to move this camera to the model arm in a single motion) • 1 (smartphone on tripod) focused on the model arm and technique demonstration
1 camera for the trainee	This allowed the trainer to visualize the simulated procedures on the model arm.
Third-party "producer"	This person managed the camera choice and speaker features on the video teleconference platform and toggled between trainer and trainee views, thereby allowing the participants to focus on the training, not the technology.

Part 1 of the training program consisted of asynchronous viewing of an expert-led core content presentation on the Canadian contraception landscape, unmet contraceptive needs, contraceptive options, and a review of standardized implant insertion and removal procedure videos.

Part 2 of the training program consisted of a 2-hour small-group (≤6 participants and a trainer) virtual "hands-on" training session via a teleconferencing platform. Internet access was required. The sessions were led by a trained trainer and participants took part virtually from their location of choice. In advance of the session, each participant received a training package with the requisite equipment for the simulated training, including a model arm, instruments, and placebo training applicators. To reinforce learning, a repetitive "learn, see, practise, prove, do" model, which has been proposed as an optimal framework for procedural skills training,[7] was used. The trainer demonstrated implant insertion and removal with the model arm and placebo applicators and then the group of trainees performed these steps simultaneously along with the trainer. Finally, each trainee was spotlighted within the web conference and individually demonstrated these procedures on a model arm. The trainer provided individual guidance and feedback while other trainees observed. Multiple attempts were allowed and encouraged until both trainer and trainee were satisfied with the trainee's technique. Trainees were required to attend the entire session to obtain a confirmation of attendance.

Proof of Concept for Virtual Simulation-Based Training

Prior to implementing the program nationally, the teleconferencing platform training experience was pilot tested to demonstrate the feasibility of the virtual training format. The initial pilot test identified essential physical/technical parameters for the virtual training sessions (Table 1). In particular, dual camera usage (1 camera directed at the presenter and 1 camera directed at the model arm, Figure 1) was necessary to provide a good user experience. A third-party "producer" was instrumental in managing camera choice and speaker features.

After the pilot test, a full simulation for the synchronous virtual training was conducted and the recommended setup for trainers was determined (Figure 1). The proof-of-concept step verified the importance of having an optimized process, equipment, and technological setup to make the virtual training format as analogous to an in-person format as possible and to provide consistency across training sessions and trainers. An implementation guide was developed. For HCP trainees, the camera/computer and training equipment setup was optimized by sending them a "placemat" in advance of the session, which provided visual and written guidance on the training item placement.

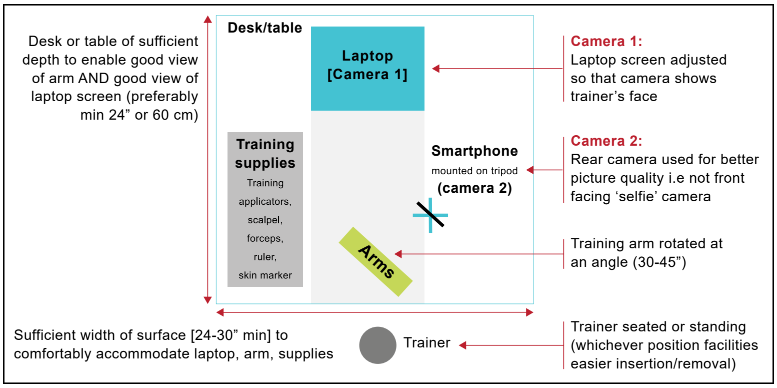
Participants were required to register online for the training program. Participants were required to complete part 1 prior to registration for part 2.

Program Evaluation

Upon completion of part 2, participants were asked to complete an anonymous evaluation of the training program using a three-point Likert scale (agree, neutral, or disagree). Trainees were also asked if they would like additional training (yes/no); if so, they were given the opportunity to provide contact information for follow-up. The link to this survey was sent the next business day after session completion by the program sponsor. Descriptive analyses of these data were performed.

As this study was a quality assurance and program evaluation activity, research ethics board review was not required.

Figure 1. Suggested simulation setup for (in this case, right-handed) trainer.



RESULTS

Training Program Enrollment and Evaluations

Between September 14, 2020 and June 2, 2021, six sessions were conducted to train 83 HCPs, including 5 scientific committee members, to be trainers for the part 2 virtual "hands-on" simulation training. The trainers were chosen based on considerations including geographic location and expertise. The trainers conducted 565 simulation training sessions between September 22, 2020 and December 31, 2021.

Between September 2, 2020 and December 31, 2021, 5540 HCPs registered for the training program; 3162 (57.1%) completed the part 1 asynchronous self-directed content viewing. Of the HCPs who completed part 1, 2740 (86.7%) had completed the part 2 synchronous simulated training session as of December 31, 2021.

Of the 2740 participants who completed the simulated training sessions, 60.1% (1646) were family physicians, 24.7% (677) were nurse practitioners (including a small number of registered nurses for whom this area was in their scope of practice), 12.7% (348) were obstetrician/gynaecologists, and 2.5% (69) listed other specialties, including postgraduate trainees (Table 2). There were participants from all Canadian provinces and territories. Ontario had the highest number of HCPs who completed part 2 (n = 913), followed by Québec (n = 588), British Columbia (n = 458), and Alberta (n = 440) (Table 2).

Of the 2740 HCPs who completed part 2, 1730 (63.1%) submitted a post-training evaluation (Table 3). Some respondents did not answer all questions. Most respondents (1570/1627 [96.5%]) reported that the virtual format of the "hands-on" training was effective. When asked "Would you like to request additional training on insertion and removal techniques?," 4.5% (75/1671) of respondents answered "yes."

DISCUSSION

Canada was the first country to initially use a completely remote virtual training program for the contraceptive implant. Converting from face-to-face to virtual training environments required careful development to ensure Canadian training met previously established global standards. Best practices for teaching procedural skills and to improve patient safety were used, including demonstrating and organizing procedures into steps[8] and the repetitive framework of "learn, see, practise, prove, do, maintain."[7] The program incorporated principles of simulation-based mastery learning that emphasize tailoring education to the learner's pace and the use of feedback to enhance skill acquisition.[4,5] Simulation-based mastery learning initiatives have been found to result in substantial retention of knowledge[9] and may improve patient care practices and outcomes.[6] The majority of our survey respondents found that the program was clinically relevant, useful, and effective for their training needs.

Learnings From the Virtual Simulation Training Program

The virtual adaptation of part 1, a prerecorded session reviewing core content, required technology (voice over slides) and infrastructure (web platforms capable of hosting prerecorded slide presentations) that were available prepandemic. Ongoing engagement with the training program was high between part 1 and part 2. At the time of this analysis, not all participants who completed part 1 had registered for or completed part 2. Others may have been interested in learning about a new contraceptive option for patient counselling purposes but did not plan to do implant insertions or removals themselves.

Table 2. Professional status and geographic distribution of health care professionals who completed the contraceptive implant virtual training program (n = 2740)

	No. of participants (%)
Professional status	
Family physician	1646 (60.1)
Nurse practitioner/RN	677 (24.7)
Obstetrician/gynaecologist	349 (12.7)
Other specialty	69 (2.5)
Geographic location	
Yukon	2 (0.1)
Prince Edward Island	9 (0.3)
Nunavut	20 (0.7)
Northwest Territories	25 (0.9)
New Brunswick	32 (1.2)
Newfoundland	40 (1.5)
Manitoba	66 (2.4)
Saskatchewan	66 (2.4)
Nova Scotia	81 (3.0)
Alberta	440 (16.1)
British Columbia	458 (16.7)
Quebéc	588 (21.5)
Ontario	913 (33.3)

RN: registered nurse.

The virtual synchronous simulated training sessions in part 2 required adaptations and use of web-based conferencing platforms to optimize the trainer/trainee experience. Essential features for success of the virtual simulation-based training were identified. These included clearly outlined procedures for both the trainer and the trainee, as well as a list of requirements for trainee setup (e.g., proper equipment, Internet connection, training models, placebo applicators, lighting). This allowed training to be standardized and replicated across different trainers and sessions (Figures 1 and 2A) and ensured all trainees had the same optimized view of the model arm (Figure 2B). This may have been an improvement over live training, where trainees often have partially blocked views or different angles. A technology dry run with the trainer (dual camera, audio, etc.) prior to initiating the training sessions was critical for trainer confidence with the technology and to troubleshoot in advance.

Unexpected issues can arise during any training program, but virtual learning is particularly sensitive to technology or equipment failures. Technical requirements should be confirmed in advance, so trainees have the fidelity needed for participation. Important logistical considerations included coordination of shipping for materials in advance of scheduled simulation sessions and time zone considerations. Solutions included early shipment (as much in advance of the synchronous training session date as feasible) and confirmation of receipt of materials by the HCP. Conducting synchronous training sessions across different time zones resulted in some HCPs not attending their session at the scheduled time and/or inadvertently having clinical obligations during scheduled training sessions. Highlighting time zones in messages and including calendar options during registration to ensure meeting times were automatically switched to the trainee's time zone helped address these issues.

A major tenet of adult learning principles is active involvement in the learning process.[10] Simulation-based medical education has advantages over traditional clinical skill training,[1] including opportunities to offer support and guidance in a less stressful environment.[11] Providing each trainee with a model arm and placebo training applicators was essential so they could view the procedure being performed remotely by an expert and then practise it and receive real-time expert feedback on technique. Gynaecology has many potential applications for simulation-based training. A recent Danish survey identified >30 procedures suitable for simulation-based education and OB/GYN training program curricula, including the insertion of contraceptive devices.[12] The need for this form of "hands-on" training took on greater urgency during the COVID-19 pandemic.[13] Although the impetus for our virtual training program was the pandemic, the lessons learned would extend beyond this unique period. Virtual simulation-based training programs may allow widespread access to knowledge and skill acquisition for other medical procedures. This type of medical training satisfies important needs by providing (1) an active HCP user experience to improve performance in medical procedures, (2) remote education that removes geographic- and resource-based constraints for attending the training, and (3) the opportunity to network/interact with other HCPs across geographies. A lack of HCP training has been identified as a key barrier to the use of long-acting contraceptive methods.[14–16] Remote education is a challenge that can be addressed by programs like the one we have described. Web-based programs can reach anywhere with Internet access or cellular networks, including remote geographic locations and regions that may not have sufficient experts to guide training.

Limitations

Because no in-person training program existed for Canadian HCPs during the pandemic, it was not possible to do a direct comparison to in-person learning opportunities or

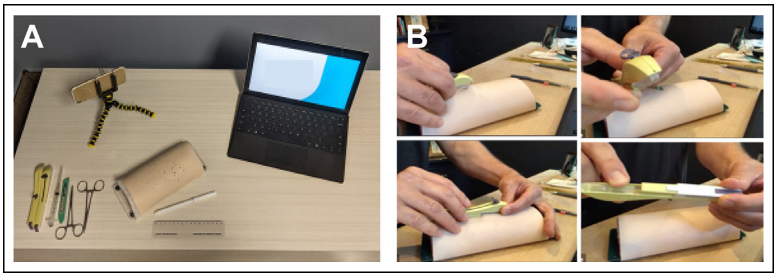
Table 3. Post-training evaluations from HCPs who completed part 2 of the training program

		No. of respondents (%)		
Question	n	Agree	Neutral	Disagree
The "hands-on" training was clinically useful and relevant.	1667	1651 (99.0)	10 (0.6)	6 (0.4)
The "hands-on" training was presented clearly and effectively.	1670	1652 (98.9)	13 (0.8)	5 (0.3)
The virtual format of the "hands-on" training was effective.	1627	1570 (96.5)	47 (2.9)	10 (0.6)
The picture quality and clarity for the "hands-on" training were adequate.	1632	1599 (98.0)	28 (1.7)	5 (0.3)
The length of the "hands-on" training was appropriate.	1667	1577 (94.6)	69 (4.1)	21 (1.3)
The number of participants was appropriate.	1666	1644 (98.7)	18 (1.1)	5 (0.3)
There was ample opportunity for questions and discussion during the "hands-on" training.	1665	1647 (98.9)	12 (0.7)	6 (0.4)

Total answers may not equal 100% because of rounding. n = 1730 respondents; not all respondents answered every question.

HCP: health care professional.

Figure 2. Visualization of the contraceptive implant virtual training program. (A) Live setup from the trainer perspective. (B) View from the trainee perspective as the trainer demonstrates steps involved in inserting the contraceptive implant.



to conduct a cost-effectiveness comparison, which is an important consideration in the provision of access to training across the country. We aimed to provide training for the contraceptive implant in Canada similar to what had been successfully used in other countries, thus we did not explore additional options for simulation-based medical education, including virtual reality or screen-based simulators.[17] These alternatives may be helpful in further expanding outreach and enhancing the training experience. Lastly, the program evaluations were completed by 1730 participants who completed the program (response rate 63.1%), leading to a potential response bias.

Virtual web-based training offers many advantages, but it is important to acknowledge potential drawbacks. Virtual training programs have the potential to be highly cost-effective, but programs that require individual training materials will need additional resources for shipping and logistical support. Most conventional live training programs offer on-site support from experts (e.g., "staying behind for questions") and although additional 1:1 time (both at the end and at a later time) was available in our program to support learners as needed, not all who would have wanted to may have taken advantage of this. Adequate wireless (wi-fi) or cellular data networks are required, and these may not be available in more remote locations. However, it is possible that some aspects of the training could be conducted with lower resolution, which may help expand virtual training outreach.

CONCLUSION

The creation of a virtual simulation training program that can be delivered remotely takes initial time and effort to develop consistent training across different trainers and sessions and to ensure an optimal training experience. Once achieved, this program can be continually replicated and allow for greater access to training opportunities, particularly in more remote geographic locations. Virtual, simulation-based training on web-based platforms may be a valuable continuing medical education modality that provides greater flexibility for learners. Although our program was specific for the contraceptive implant, it may provide a template or procedures in other areas of medicine in the future.

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