Mobile App for Laparoscopic Surgery Training

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Abstract

Background: Nowadays, information and communications technology is not only engaged in daily activities of people but it is directly utilized in patient care, making rapid online consultations, assessing and sharing paraclinical studies; these has changed the way people relate to each other, learn, work and even the way they care about their health. The Group of Investigators is interested in developing not only low-cost laparoscopic surgery simulators but an accessible and innovative mobile App for teaching and learning skills in laparoscopic surgery, it being the first in its kind.

Purpose: To present a mobile App for tablets and mobile phones (Smart Phones) for training and teaching laparoscopic surgery in low-cost simulators.

Material and Method: The author has created 2 prototypes of simulators or pelvitrainers for training laparoscopic surgery, one of them triangular prismatic standard and a new model created by the research team which has only 2 boards (the base board and the front or working board). The front board has a support and holes for fitting a mobile device (tablet or mobile phone) to use as visual interface. Training "kits" have been designed for these devices; exchangeable kits, a basic training kit and an advanced kit, which we have presented in the 67° Congreso Uruguayo de Cirugía (67° Uruguay Surgery Congress). Mainly, we have developed our mobile app for surgeons training, being the first in its kind published in Appstore and Playstore. The simulators and the app have been tested and used with great acceptance by general surgery residents, general surgeons from Montevideo and Maldonado, Uruguay, and by medical residents and general surgery and hepato-pancreato-biliary fellows from the Hospital Universitario Fundación Favaloro, and also by surgeons from Paraguay through the Paraguay Endoscopic Surgery Society.

Discussion: We have improved the original designs, by designing a personal and original simulator, with the lowest cost on the market, which is accessible, reproducible, portable and long-lasting, including the training exchangeable kits. We should further improve the design and add elements in order to make different and varied exercises. The mobile app accompanying this trainer has been revolutionary in its kind since it is not only novel in our field but also there is no app on the website with the dynamics or features of the one developed by our work group and has brought together surgeons from different geographical regions on the same system.

Conclusion: From the above, it is concluded that with the necessity of ex-vivo training, in order to reduce complications inherent to the learning curve of each surgeon, it was necessary to develop low-cost simulators for laparoscopic surgery in our environment. We were able to develop a one-of-a-kind, free and accessible mobile app for laparoscopic surgery training, which is currently generating a web community for discussion and training among different geographic zones; we will have to measure the impact of this tool which has been achieved without public or private financing.

Keywords: Mobile App; Laparoscopic Surgery Training

Introduction

The development and use of mobile devices in the medical practice together with the invention of mobile apps and the development of specialized software, constitute one of the options that allow facilitating work done in the field of medical assistance, allow management and supervision of the medical record information and improves access to medical information and clinical records helping in the communication and consultations, references and information collection, administration and monitoring of the patient; all of the above improves decision making and medical therapies, clinical decision making, medical education and training, etc (Ventola, 2014).

So far, in the case of surgery this technology has failed to achieve generating the benefit observed in other medical specialties. This is because the surgeon makes two tasks: the first being clinical surgery where the surgeon could consult web bibliography and even mobile apps with written content, surgical consensuses and authors' references; this consultation is already an everyday thing and a tool, particularly for younger surgeons and surgery residents. The second main task for every surgeon is carried out in the surgical block and is to "operate", a medical act that involves different manual, eye-hand coordination skills, involves superior cognitive skills, prompt decision making and defining surgical tactics in the same intraoperative period always based on experience, training and prior knowledge. In our local environment and in many centers in the region, the surgery resident usually has little prior training outside the operating room before facing their first surgeries, since there is no other formal place for training and learning the surgical technique in young practitioners starting their road in surgery, except for the Surgery Basic Department where some basic skills in surgical pathology and technique begin to develop. The opportunity for young surgery residents from different specialties to train in laparoscopic surgery - a technique requiring a different training with a specialized team and which is extremely expensive in our environment and also in the region - is even more difficult to find. The author already presented in prior scientific communications the development of a low-cost pelvitrainer for laparoscopic surgery training, which we have publicized and sought to promote even in the surgery service of the Medicine Faculty. It is in their interest to develop in this communication the design of the first Uruguayan Mobile App for laparoscopic surgery teaching, which is novel in our environment and we were not able to find in the indexed literature nor on the Internet stores Appstore and Playstore, respectively, an app with the features of our app, functioning not only as a reference manual in surgical technique, but also functioning as pelvitrainer visual interface, that is, as a display of the laparoscopy tower once uploaded on a Tablet or a Smartphone, and allows recording and sharing by mobile apps (Whatsapp, Facebook, e-mail and others) the training sessions so that reference professors or colleagues make their comments or correct the different exercises. This tool is completely novel and currently in use, even with a Whatsapp group of the mobile app where clinical cases are being discussed; so this has gone beyond the author's expectations. We should publicize and measure the impact of this app in the field of laparoscopic surgery teaching.

Background

Nowadays, information and communications technology is not only engaged in daily activities of people but it is directly utilized in patient care, making rapid online consultations, assessing and sharing paraclinical studies; these has changed the way people relate to each other, learn, work and even the way they care about their health [1-3].

Medicine and particularly surgery have benefitted from technological developments from patient organization and management and also surgery, by technological mobile apps that allow surgeries where the patient and the specialist are in different geographical places, to a myriad of tools which facilitate care, teaching or investigation [3-6].

UNESCO (2013) states that for the first time in history there are more mobile phones and laptops than people in the world, recognizing utility, comfort and low-cost which help broadening educational opportunities of students in different contexts. According to the director of the Competitive Intelligence Unit (CIU) technology users are increasing exponentially in the world. All prior background mentioned above require mobile technology to be implemented in educational institutions, that the use of mobile tools be promoted in classrooms and in different spaces where the student has access to a mobile technology that facilitates learning, and that mobile technology leads to the development of the institution, as faculty of the intellect in the student. This approach is called Mobile Learning (M-learning).

Much of this advanced technology is high-cost and not very accessible in our environment, thus the authors are interested in adapting the existing technology to be used in daily learning and surgeon and surgery monitoring.

The challenge for surgery professors is to adapt low-cost mobile technologies for teaching and learning processes; consequently, the authors have tried to include these everyday tools for surgery teaching, particularly laparoscopy surgery teaching.

In prior communications we have introduced initial and novel prototypes of low-cost simulators for laparoscopy training, manufactured by the authors, based on pre-existing designs from a long time ago, improving their design and creating a simple pelvitrainer, which is an easy to use, portable, reproducible and low-cost device.

These are currently used for training surgeons and residents from different public and private centers from Uruguay and the region; these use a tablet or mobile phone as interface, which acts as laparoscopy camera. That is why we have focused on developing a mobile app used in tablets and smartphones during training with pelvitrainers developed by the author or in different ones using these mobile devices (tablets and mobile phones) also as visual interface.

At present we could not find dynamic educational apps which can be used in this type of pelvitrainer and, if they do exist, these are not accessible to the general surgical public. The existing mobile apps are generally static and with preloaded content, and of very low diffusion, which do not allow for an active interaction, that is, these do not have truly dynamic video interfaces and these are usually not for free. In our research, we could not find apps with the features of the app introduced by us on the Appstore or Playstore.

Consequently, the author is interested in developing not only low-cost simulators but an educational mobile app, for the teaching and learning of laparoscopic surgery skills to be accessible, objectifiable, and a tool for laparoscopic training, not only in an educational field but also for solo training.

Purpose of the Study

To present a mobile App for tablets and mobile phones (Smart Phones) for training and teaching laparoscopic surgery in low-cost pelvitrainers.

Materials and Methods

For our simulator prototype we used 2 models, one of them a standard triangular prismatic prototype and a new model created by the research team which has only 2 boards (a base and a front or work board (Figures 1 and 2)); it was manufactured with MDF lacquered boards, in order to obtain a simulator by using less materials, making the simulator more economic, foldable and reproducible. Simulators have 2 or 4 ports according to the model, where laparoscopy tools are inserted, the front board has a support and holes for fitting a mobile device (tablet or mobile phone) to use as visual interface (Figure 3). Simulators are approximately 3 kg, the angle between the front board and the base can vary from 90 to 70 degrees, the distance between ports and trocars varies from 14 to 24 cm and are adapted for simulating the distance of trocars in adult and pediatric surgery.

Figure 1 and 2: Original prototype (Designed by J Sanguinetti, Surgeon).

Figure 3: Front view of the simulator with the tablet as interface and with the app on camera mode, recording training session.

The different parts are joined together by hinges so that this device can be folded and easily movable. Training "kits" have been designed for these devices, with the support of the Surgery Basic Department of the Medicine Faculty, which have been discussed with the Research Team of the General Surgery Service from Hospital Universitario Fundación Favaloro. The basic training kit (Figure 4) is developed to begin incorporating initial skills in laparoscopy with element mobilization and fitting, basic handling in two dimensions, endoloops, initial handling of laparoscopic strings and knots; these are versatile models where up to 5 different exercises can be made on the same kit. The intermediate and advanced training kit (Figure 5) has elements for making laparoscopic knots and sutures, in a material similar to the living tissue (EVA foam), as well as structure cuts and cannulation exercises. In the pictures of the first prototypes can be noted how tablets act as a "display" or visual interface for training and making the different exercises.

Figure 4: Basic training kit.

Figure 5: Advanced training kit.

When using the mobile devices' camera, we faced the problem that the devices turn off for being inactive during several minutes, since these are used only as displays; with our mobile app, called "EASYLAP", we managed to avoid the device from turning off, then the device is active even when we do not touch it, thus our display will not turn off in the middle of a training practice. As surgeons and with basic computing knowledge we had to learn and understand the details of mobile app programming and development, with the help of professionals and friends who selflessly supported this project regarding content, such as Surgeon Marcelo Viola who helped with the App manual development.

We have developed a mobile app (registered authorship: J Sanguinetti, Surgeon) together with a computing engineer who contributed to the work, Gastón Caldeiro, Engineer, adapting the prototype for Android and also for IOS; the author has optimized this specific interface for training surgeons. It can be used on Android and IOS devices (tablets or mobile phones).

It has an app in camera mode which does not turn off automatically even when the device has low battery, it can record and save training sessions, and it has also a visible and adjustable chronometer to control the training time and the exercise time. It has double display; a camera mode showing a work area and another adjustable display where pre-recorded videos can be saved and downloaded from the Internet or You-Tube®; in this way exercises before starting can be immediately viewed. On this second display, basic techniques of the procedures can be saved in order to read them quickly before training.

The app display has a zoom and image settings both on the main display and the second display. Training sessions are recorded for their subsequent correction by professors, as well as for assessing the student evolution in the different exercises.

The simulators and the app have been tested and used with great acceptance by general surgery medical residents, and different general surgeons from Montevideo and Maldonado, Uruguay, and by medical residents and general surgery and hepato-pancreato-biliary fellows from the Hospital Universitario Fundación Favaloro (Figures 6 and 7).

Figure 6: *Test sessions by fellow from Hospital Universitario Fundación Favaloro, Buenos Aires, Argentina.*
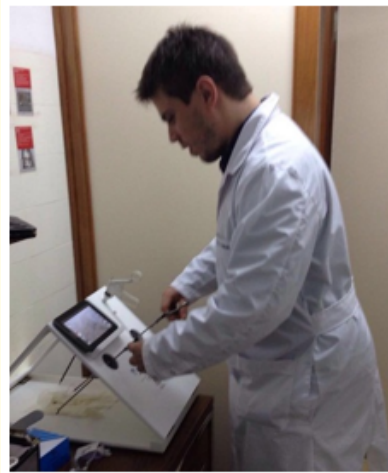
Figure 7: *Test session by general surgery resident from Hospital Pasteur, Montevideo, Uruguay.*

Mobile app profile

This is a basic app of medium complexity which functions as an active prototype. It is compatible with Android (Samsung and other trademarks) and IOS (Ipad and Iphone). At present, the app is available for free in both mobile platforms.

It has been downloaded approximately 180 times until the development of this work, we did not promote the app for its specific download, so it has been transmitted by word of mouth among surgeons.

It has different screens.

Home screen; where there are explanatory pictures of the simulators and training kit taken in Fundación Favaloro in Argentina.

Under these pictures, there are instructive video gallery, which has a selection of laparoscopic knots and sutures training videos for general surgeons. There are also basic exercises for laparoscopic urology surgery. Instead of creating new videos, the author has decided to utilize the best videos without copyright found in Youtube. Why creating videos if we already have excellent accessible educational material? Thus, we have gathered videos considered to be of better use by the app users, and we have also created some videos we consider necessary together with Fundación Favaloro in Argentina, created by Santiago Rubio, Research Fellow of this Institution. This video gallery is novel since it is open, that is, more videos can be added and videos can be edited generating a true video gallery constantly reviewed and edited.

Under the photo gallery there is the session gallery in the home screen, so we can access the training sessions previously recorded.

There is a taskbar in the lower section of the app with the following icons: Home, manuals, sessions and videos.

To access from the main screen to these secondary screens.

Home icon; leads to the home screen mentioned above with explanatory pictures and video and session gallery.

Manual icon: leads to the screen with different technique manuals loaded, currently with different chapters:

1- Pneumoperitoneum and approaches.

2- Knots and sutures.

3- Right colectomy.

4- Materials and instrumentation.

5- Rectum anterior resection.

This screen, like the ones above, is open to changes, so it is dynamic, further chapters and manuals will be loaded, and the existing ones can be edited.

The session icon leads us to the training sessions recording screen, activating the camera from the mobile device, allowing timing the session, activating the flash if more light is necessary for the pelvitrainer; this mode remains active with the display on, which is a major improvement because otherwise the tablet or phone would turn off after a few minutes, since these devices are programmed to save battery. After the session is recorded, it remains in the session gallery so it can be subsequently revised and also shared online by different mobile apps (Whatsapp, e-mail, and other social networks); this is not only an important and almost free educational tool but it is also novel, thus generating a feedback between the app user and a reference professor who can receive the pre-recorded sessions being on a different geographic place.

The video icon leads us to the video gallery pre-loaded from Youtube, knots and sutures technique videos, basic training in laparoscopic surgery and also advanced exercises; this is also a dynamic and editable screen.

Thus, we consider that with this app precepts of "classic surgery" where you first read the technique, then you observe (help) and finally you make, can be fulfilled.

The user of the app may read manuals, watch pre-loaded videos and then "make", that is, select session mode to start making exercises at pelvitrainer, complying with these logical steps for learning new techniques, plus the possibility of recording the training so that a feedback thereof can be made.
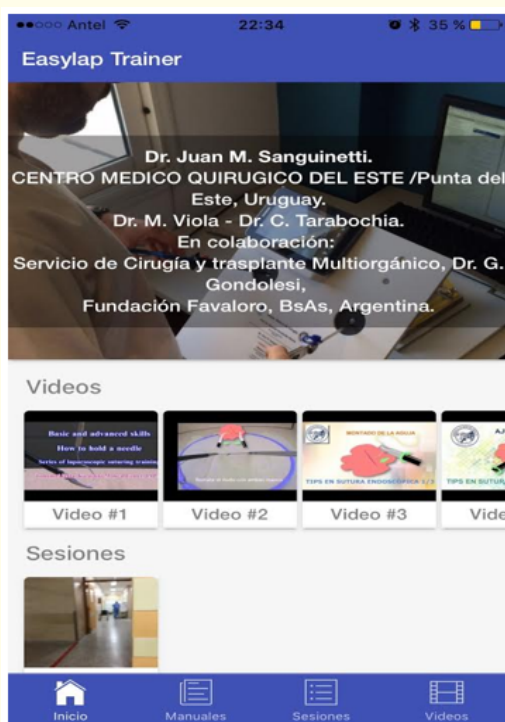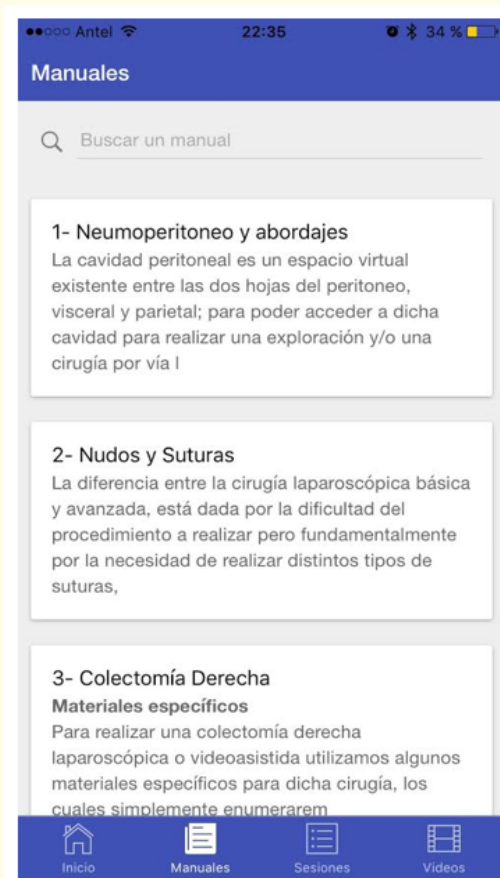

Figure 8: Easylap App Home Screen.

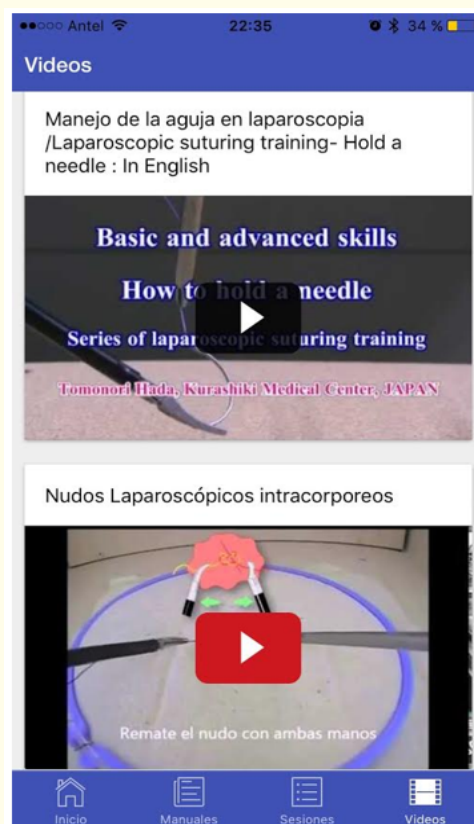*Figure 9: Easylap app manual screen.*

Figure 10: Easylap app video gallery screen.

Results and Discussion

We briefly describe our pelvitrainers and mainly our mobile app for laparoscopic surgery training. We introduced a novel idea not only for our field, which we consider will be the starting point for authors to continue developing simulator models and improving the training mobile app. At present the author has ongoing projects with the Team of Hospital Universitario Fundación Favaloro and the Surgery Basic Department to develop and standardize training exercises and the order thereof for training surgery residents. We have improved the design of the pre-existing simulators such as the Lap box from Inst. Lubeck (Brasil) where we saw the design for the first time, the original patent is not from these authors and there are already several authors who have made similar models for more than 10 years [7-12].

Thus, we have improved the original designs, making a personal and novel simulator, with the lowest cost on the market, which is accessible, reproducible, portable and long-lasting, including in this novel design the innovative training exchangeable kits which are totally novel and with personal design and low-cost, even its replaceable materials by elements that could be found in the emergency rooms of hospitals. Donations of these simulators have been made to private and public centers with which we had a labor relationship: Hospital Pasteur, Sanatorio Cantegril, Comero Rocha and the head of the Surgical Block of Sanatorio Mautone (Uruguay) and even abroad (HU Fundación Favaloro, Buenos Aires - Argentina), apart from being used presently with great acceptance by a relevant number of surgeons from Uruguay.

We intended to design a trainer accessible to the resident and the surgeon not only in the hospital or facility but also at home in order to extend training time. We should further improve the design and add elements in order to make different and varied exercises. The app accompanying this trainer is not only novel in our field but also there is no app on the website with the dynamics or features of the one developed by our work team, which could make it a fundamental tool created with a very low budget. These and other tools will surely change the training of residents in our environment, and the team is interested in these intervening in the training of colleagues from the region. We managed to make the simulators and the app in less than a year with an almost solo work, with no external financial support from private or public entities, only with the educational interest from the designer and contributors.

Conclusion

From the above it is concluded that with the necessity of ex-vivo training, in order to reduce complications inherent to the learning curve of each surgeon, it is necessary to develop low-cost simulators for laparoscopic surgery in our environment. It was possible to develop a mobile app for laparoscopic surgery training. The next objective is to demonstrate, by a prospective, longitudinal and comparative study, the method's usefulness and applicability, in order to standardize its use both in Uruguay and Argentina.

Bibliography

1. Santos SE. "La perspectiva histórica de las relaciones Ciencia-Tecnología-Sociedad y su papel en la enseñanza de las ciencias". *Revista Electrónica de Enseñanza de las Ciencias* 2.3 (2003): 240-246.

2. Adell J. "Tendencias en educación en la sociedad de las tecnologías de la información". *Edutec* 7 (1997): 24.

3. Dadle L., *et al*. "Telemedicine in Surgery". *British Journal in Surgery* 90.6 (2003): 647-658.

4. Di Lucca J., *et al*. "Fortalecimiento de Servicios Esenciales de Salud en Latinoamérica mediante el uso de las Tecnologías de la Información y Comunicación.

5. "Proyecto de demostración basado en Plataforma para la e-Salud en Código Abierto (PESCA)". *Revistae Salud* 3.12 (2007): 4.

6. Jamison DT. "Accomplishments, Challenges, and Priorities". In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB. Priorities in Health. Washington, DC: The Work Bank (2006): 1-22.

7. Rodríguez-Covarrubias F., *et al*. "Simulador computarizado de inmersión virtual, como modelo de inicio de entrenamiento de laparoscopia urológica". *Actas Urológicas Españolas* 30.8 (2006): 819-823.

8. Traxer O., *et al*. "The impact of intense laparoscopic skills training on the operative performance of urology residents". *Journal of Urology* 166.5 (2001): 1658-1661.

9. Fichera A and Prachand V. "Physical reality simulation for training of laparoscopists in the 21st century. A multispecialty study". *Journal of the Society of Laparoendscopic Surgeons* 9.2 (2005): 125-129.

10. Kneebone R. "Simulation in surgical training: educational issues and practical implications". *Medical Education* 37.3 (2003): 267-277.

11. Gregoire R., *et al.* "Mise a point et validation d`un modele d`entrainement à domicil à la laparoscopie". *Progrès en Urologie* 16.3 (2006): 352-355.

12. Pineda E and Alvarado B. Metodología de la investigación (1998): 167-177.

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