

ImageMed HUSI: A Mobile Application for the Secure Capture of Clinical Images Integrated into the Electronic Medical Records in a Highly Complex University Hospital

ImageMed HUSI: una aplicación móvil para la captura segura de imágenes clínicas integrada a la historia clínica electrónica en un hospital universitario de alta complejidad

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ABSTRACT

The access to mobile equipment capable of taking high-quality photos and videos has facilitated the documentation of clinical images within daily medical practice. The indiscriminate use of some communication channels could compromise patient confidentiality. The purpose of this article is to describe the use of the ImageMed HUSI mobile application, which was designed for the safe capture of clinical images in a high-complexity university hospital. **Methods:** Prospective descriptive study. All physicians linked to Hospital Universitario San Ignacio who had downloaded and used the ImageMed HUSI application during the period from March 2021 to 31-Dec-2021 were included. 1015 clinical images have been uploaded to the mobile application by different medical-surgical specialties. **Conclusions:** ImageMed HUSI is a mobile application developed for the secure capture of clinical images integrated into the clinical history in a highly complex university hospital. Currently, it is available to HUSI care staff. The use of this tool guarantees the secure capture of clinical images, safeguarding the confidentiality of patients.

Keywords

mobile application; clinical images; medical record; confidentiality; mobile devices.

RESUMEN

El acceso a equipos móviles con capacidad para tomar fotografías y videos de alta calidad ha facilitado la documentación de imágenes clínicas dentro de la práctica médica cotidiana. Sin embargo, el uso indiscriminado de algunos canales de comunicación podría comprometer la confidencialidad de los pacientes. El propósito de este artículo es describir el uso de la aplicación móvil ImageMed HUSI, la cual fue diseñada para la captura segura de imágenes clínicas en un hospital universitario de alta complejidad. **Métodos:** Estudio descriptivo prospectivo. Se incluyeron a todos los médicos con vinculación al Hospital Universitario San Ignacio (HUSI) quienes hubiesen descargado y usado la aplicación ImageMed HUSI entre marzo de 2021 y el 31 de diciembre de 2021. Para el 31 de diciembre de 2021 se habían cargado 1015 imágenes clínicas a la aplicación móvil por diferentes especialidades médico-quirúrgicas. **Conclusiones:** ImageMed HUSI es una aplicación móvil desarrollada para la captura segura de imágenes clínicas integrada a la historia clínica en un hospital universitario de alta complejidad. Se encuentra disponible para el personal asistencial del HUSI. El uso de esta herramienta garantiza la captura segura de imágenes clínicas, pues salvaguarda la confidencialidad de los pacientes.

Palabras clave

aplicación móvil; imágenes clínicas; historia clínica; confidencialidad; dispositivos móviles.

Introduction

There is now free access to mobile equipment capable of taking high quality photographs and videos. This means that in routine clinical practice the use of clinical images—that is, photographs and videos taken in the context of clinical care, related to patients, their condition, the results of their examinations, diagnostic images and information from their medical history—has become an undeniably useful tool in daily medical practice (1-4). Clinical images allow a more detailed understanding of the patient's condition, because they often surpass words. Comparative photographs make it easier to evaluate the evolution of lesions, as there are subtle details that only an image can capture, such as certain lesions, changes following treatment, and even unusual clinical and anatomical findings, as well as surgical techniques.

Physicians have the possibility of documenting digital content of patients without barriers, with real-time transmission of images or videos,

which allows them to make timely decisions, as well as to request concepts from other colleagues, and exercise a teaching function, not to mention the great importance they can play in the diagnostic process. (2,3). Images and videos are very useful tools for medical practice, as they document, store and follow up clinical findings and conditions. In addition, clinical images facilitate discussion and decision-making among colleagues both synchronously and asynchronously, face-to-face and remotely, supplement communication among physicians and contribute to health sciences education and research processes.

Nevertheless, the indiscriminate use of some communication channels, such as social networks and instant messaging applications for the transmission of patients' digital content (5), as well as the storage of clinical images in devices for personal use, highlights major security issues capable of compromising their confidentiality and privacy (6-9). Likewise, the lack of adequate storage of images and videos in the electronic medical record makes it impossible to guarantee traceability and follow-up of the images taken.

Along these lines, safe and efficient use of these tools is of utmost importance to guarantee the privacy and confidentiality of patients (9-13). Currently, in most hospitals, there are no standardized processes to capture and securely store this type of visual content. Some institutions in the United States have created and developed mobile applications for the secure capture and transfer of clinical images to electronic medical records, and in Europe, there is also evidence of the development of similar applications that guarantee the protection of personal data (14-17).

In 2015, Brigham and Women's Hospital (Boston, USA) developed the CliniCam mobile application for the secure capture and storage of clinical images. In their publication, they describe its implementation, use, and user perception in that hospital. The application is easy to use and very useful for routine clinical practice, as it captures clinical images safely and efficiently. It is also available for Apple iOS devices (iPhone and iPad) and allows the users to authenticate, select

the patient, capture the image, annotate it and store it in PDF format in the electronic medical record (15).

The PhoExam mobile application—compatible with the iOS operating system (iPhone, iPod Touch, and iPad)—was developed by the Mayo Clinic in the United States to capture clinical images. Users must download it, authenticate themselves, and then select the patient. With this application, it is possible to capture photographs and videos specifying the anatomical site, apart from including notes or comments of up to 256 characters. The images migrate to the patient's clinical history, and once sent, they are deleted from the user's device.

In Colombia and Latin America, there is no evidence of the development of any system or application for the capture and secure transfer of clinical images, despite the imperative need for this type of alternative that facilitates modern clinical practice. In the literature search for this research project, no publication was documented in Latin America related to mobile applications for the capture of clinical images. It appears that no such applications have been developed in other hospitals in Latin America, nor are there any previous documented experiences, only those reported in Europe and the United States.

The Hospital Universitario San Ignacio (HUSI) developed the ImageMed HUSI mobile application for the secure capture of clinical images integrated into the medical record and is a novel and pioneering project for routine healthcare practice in Colombia and Latin America. In this article, we describe the design of the mobile application, as well as findings regarding its use, from its implementation in the hospital until December 31, 2021 (approximately nine months).

Methods

This was a prospective descriptive study. It is an observational study that prospectively describes the implementation of the ImageMed HUSI mobile application and analyzes variables regarding its institutional use. The study included

healthcare personnel linked to the HUSI who had downloaded and used the ImageMed HUSI application during the period from its launch in March 2021 to December 31, 2021. By December 31, 2021, 1015 clinical images had been uploaded to the mobile application. Therefore, a sample calculation was not performed. The healthcare personnel was identified from the application's own information extraction system. The data extracted from the application were reviewed and taken for the description of the variables to be evaluated.

When the physician downloads and installs the application on his/her mobile device, he/she accepts the terms and conditions of use. Within these terms and conditions, it is explained that HUSI will be able to track the use (frequency, type, the number of images captured, the amount of videos captured, etc.) of the mobile application:

By downloading this mobile application, you agree to the terms and conditions of use. The application will be able to extract information regarding your use of the application, such as frequency of use, type of use, number of images captured and number of videos captured. In addition, information may be obtained from each access you make to the application, the hours of use, and all actions you perform within it. Hospital Universitario San Ignacio may use this information for healthcare and research purposes.

Once the mobile application was launched in March 2021, some socialization activities were carried out in the different services and units, to promote its implementation and use by the medical staff in their regular clinical practice. The ImageMed HUSI mobile application was developed to be used within the daily and routine practice of HUSI and to ensure patient privacy and confidentiality.

As mentioned, the mobile application has its own information extraction system for the variables that can be analyzed. Thus, the data extracted from the application were reviewed and used to describe these variables. For the description of quantitative variables, the mean and median were used as measures of central

tendency, and the standard deviation and range as measures of dispersion. Categorical variables were summarized using absolute and relative frequencies.

Description of the ImageMed HUSI mobile application

HUSI is a highly complex hospital and constitutes the academic environment for the training of students of the School of Medicine of the Pontificia Universidad Javeriana in Bogotá (Colombia). Currently, HUSI has more than 11 services and 17 units, consisting of 17 clinical specialties and 21 surgical specialties. Additionally, it is the training scenario for 31 specialization programs or medical residencies of the Pontificia Universidad Javeriana, which favors a high component of medical teaching.

The ImageMed HUSI application was developed by this same hospital in Colombia's capital city, in conjunction with its Information Technology Office, in 2020. And after several adjustments and tests that ensured its proper functioning, its official launch to the hospital's healthcare staff took place in March 2021. The application can be downloaded from cell phones with Android and iOS operating systems, and is available to the public free of charge; however, its use is restricted to HUSI's active healthcare personnel.

The aforementioned arose after the HUSI saw the need for safe and correct use of clinical images; therefore, it made an economic and human resource effort in the development of the mobile application, which is undoubtedly extremely innovative in Colombia and Latin America. In this sense, the experience of its use is very striking and pioneering in the local environment, since, as we mentioned, the use of this type of mobile application has not been documented in Colombia or Latin America.

Once the mobile application was launched, training was given on the importance of the safe use of clinical images and, in this context, on the importance of using this new tool in the hospital. The advantages of being able to share images

securely in real-time and to request concepts from other services were explained. In general, it was well received by healthcare personnel, who quickly identified its advantages, and given the ease of downloading it to mobile devices, it quickly began to be used frequently.

During the first months, not all departments used ImageMed HUSI with the same frequency, so after approximately six months, some reinforcement socialization activities were carried out. In addition, interactive videos were also used to train healthcare personnel in the use of the mobile application. These videos are available on the hospital's website and are available to all healthcare personnel. The videos explain in detail what the mobile application consists of, how it can be downloaded for both iOS and Android devices and how the application itself works. However, the videos do not contain technical instructions on how to capture the images, since it is a very intuitive application.

To be able to access and use the mobile application, you must have the credentials (username and password) assigned directly by the HUSI Information Technology Office. These credentials coincide with the access credentials to the Integrated Hospital Administration System, which is the electronic medical records system. The application can only be used for patients who have active care within HUSI, i.e., it is not for patients who have been discharged or who do not have medical care, either emergency, inpatient, or outpatient at the time of use.

For the capture of images or videos, the patient must grant his/her written authorization in the same application, by means of a digital signature. For the capture of images or videos, the patient must grant his/her written authorization in the same application, through a digital signature (the patient signs on the cell phone screen with his finger or with the support of a stylus). The authorization includes an explanation of the use and destination of the digital content as well as the fact that it will not be anonymized but will be migrated to the patient's medical record. The authorization will be recorded in the mobile application and in the patient's electronic

medical record. In the event that the patient is unable to sign the authorization, the application allows for the signature of the legal representative or a family member to be recorded. In the case of pediatric patients, the application also includes the option of informed consent and the signature of a responsible person (a parent).

It is important to mention that the patient does not have direct access to the images, since the mobile application is for institutional use only and stores them in a secure and restricted manner in the patient's medical record and the application's repository; however, if he patient wishes to obtain a copy, he/she can request to the hospital (Medical Records Office) and it will provide him/her with the respective copy, as when a copy of the medical record is provided.

Once the patient has given his or her authorization, images (photographs or videos) are captured and migrated to the clinical history as part of a repository, which is of great help for the follow-up and traceability of clinical conditions. Additionally, they can be sent securely through the mobile application to a colleague to request his or her concept or opinion of the case (interconsultation).

As can be seen in Figure 1, the mobile application allows medical personnel to authenticate themselves, select the patient, capture the images (both videos and photos), make comments on the image, share it securely with a colleague, request a concept from a specialty, store the images securely in a central computer and, finally, automatically migrate them to the patient's medical record for follow-up and traceability.



Figure 1
ImageMed HUSI application

As we mentioned, there is no record of the development of other mobile applications for the secure capture of clinical images in Colombia or Latin America. This is why ImageMed HUSI is such an innovative tool in our environment. In addition, it has certain advantages over applications already available in the United States, such as CliniCam and PhotoExam, namely: is available for both iOS and Android devices, which facilitates free access to the application by hospital staff. Both CliniCam and PhotoExam are only available for Apple devices, which can create access barriers for downloading and using the application. Additionally, ImageMed HUSI captures both images and videos regardless of their duration; CliniCam does not capture videos and PhotoExam only allows short videos.

In this order of ideas, ImageMed HUSI contributes to meeting the challenge of training residents and students in medical professionalism in the virtual era, as it leads them to apply the ethical principles that govern their virtual communication, to safeguard the confidentiality and privacy of the medical act, to recognize the autonomy of the patient and to adjust their behavior in social networks and any virtual media regarding the use of clinical images.

Use of the ImageMed HUSI mobile application

Use of the mobile application by specialty

By December 31, 2021, 1015 clinical images, or "requests" had been uploaded to the ImageMed HUSI mobile application, as shown in Figure 2. Among the specialties that used it the most were Dermatology, with 624 images, corresponding to 61.4%; Pediatrics, with 73 images; and Internal Medicine, with 57 images, as shown in Figure 3. However, 167 images were documented, corresponding to 16% uploaded by the nursing staff, which correspond mainly to the Wound Clinic.

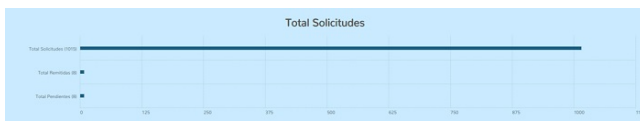


Figure 2
Total number of requests made in the ImageMed HUSI mobile application

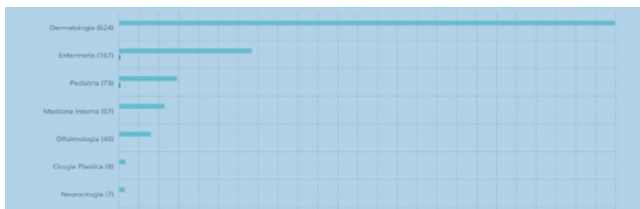


Figure 3
Use of the ImageMed HUSI mobile application by specialty

Use of the mobile application by days of the week and times of day

As shown in Figure 4, the mobile application was used most frequently on Tuesdays, Wednesdays, and Fridays, and the morning time slot was when the most images were uploaded or recorded in the mobile application.

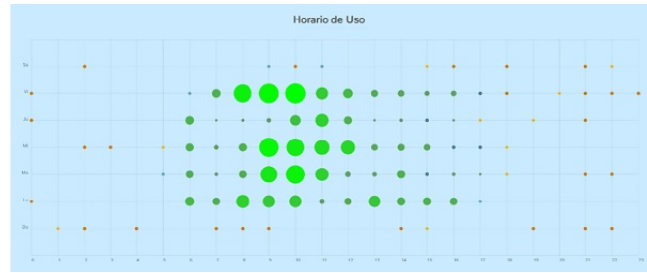


Figure 4
ImageMed HUSI mobile application use schedule

Use by gender, age and educational level

As can be seen in Figure 5, female personnel made more frequent use of the mobile application, with 915 images, corresponding to 90% of the total, compared to the male gender (100 images). However, when analyzing age, it was found that the mobile application is mostly used by personnel between 25 and 50 years of age (675 images, corresponding to 66%). Finally, the use of the application among doctors in training (residents) and specialist doctors (teachers) was very similar between the two groups.



Figure 5
Use by gender, age and educational level

Experience of Hospital Universitario San Ignacio

The use of the ImageMed HUSI mobile application quickly and positively changed how clinical images are used by healthcare personnel. We went from an indiscriminate use that puts patient confidentiality at risk, to rational, efficient, and safe use of clinical images. This has brought important benefits for patients, for whom image monitoring now

reduces interventions and facilitates the follow-up of certain conditions. In general, the mobile application has a positive impact on clinical practice. For example, dermatological pathologies have been better focused, even when there is no specialist available in person, since thanks to the application, the specialist's concept is requested remotely. Additionally, it is highlighted how the mobile application allows the postoperative follow-up of certain conditions, such as coverage defects, where through the images that are stored in the electronic medical record, the improvement of the defects can be evaluated. We cannot overlook the importance that ImageMed HUSI has had in the follow-up of ulcers in the Wound and Plastic Surgery Clinic.

The development of ImageMed HUSI involved an economic and human effort of almost 18 months; however, it was a positive experience that should be implemented in other hospitals. It was a novelty in Colombia and Latin America. Our own experience should motivate other institutions to develop these types of tools that ensure the confidentiality and well-being of patients.

Discussion

Clinical images are an undeniably useful tool for daily medical practice. However, the dissemination of this type of content through instant messaging programs puts patient confidentiality and privacy at risk (18). Clinical images are an unquestionably useful tool for daily medical practice. However, the dissemination of this type of content through instant messaging programs puts patient confidentiality and privacy at risk (18).

The ImageMed HUSI mobile application is a novel tool of great importance in the routine clinical practice of HUSI staff in Bogota because it securely captures clinical images and integrates them into the clinical history to safeguard patient confidentiality. Additionally, it allows requesting concepts (interconsultations) to other colleagues and this favors multidisciplinary. Finally, it

benefits the teaching processes for doctors in training in a highly complex university hospital.

Since its launch in March 2021 and until December 31, 2021, it was observed that it has been used by clinical specialties, surgical specialties, and nursing staff. Undoubtedly, dermatology and nursing have made the most use of it. It is striking that its use is not significant both on holidays and at night, considering that specialists are less available during these periods. At the time the mobile application was designed, it was expected to be used more during the time slots corresponding to rest hours since it should facilitate real-time and remote consultations or concepts. Nevertheless, their use was higher in the morning, which would correspond to the outpatient/outpatient setting.

Landman et al. (15) described the preliminary use of the ClinCam mobile application for secure clinical image capture. They selected the specialties of emergency medicine, internal medicine, and dermatology within their hospital to use it for one month and then completed a survey to learn their perceptions. We do not agree with these authors in the selection of specialties, because in this study we allowed all hospital staff to use the mobile application, including the nursing staff, for whom it has been a great tool, mainly in the Wound Clinic. However, in the present study we did not carry out a survey to determine the perception of the healthcare personnel, and this became one of our limitations, insofar as no doubt knowing and evaluating the perception of the use of the application would allow us to propose improvement actions.

Li et al. (17), in their article on the safe transfer of clinical images based on mobile devices, explain the importance of clinical images in medical practice, in their particular case for orthopedics. A single photograph can avoid unwarranted repetition of the physical examination of a wound, considering that repetition would promote wound contamination. In addition, clinical images allow the follow-up of wounds and fractures over time. In this sense, we fully agree with the statement made in their article: "a picture is worth a thousand words."

Finally, we agree with the authors that the use of mobile devices favors the capture of clinical images. In the past, each hospital had to have its own cameras to take clinical images; this limited the use of photographs by healthcare personnel, since they often could not have access to their own or professional cameras to document clinical findings. In this new era, barrier-free access to mobile devices has revolutionized the use of clinical imaging.

One of the limitations of this study is that the implementation of the mobile application within the HUSI is relatively recent, so it is not widely known in all services. It is possible that with the passage of time and with the help of socialization activities in the different specialties, the use of this tool may become greater and more habitual in clinical practice.

Conclusions

ImageMed HUSI is a mobile application developed for the secure capture of clinical images integrated into the medical record in a high-complexity university hospital. It is currently available to HUSI healthcare staff, who can access it from their iOS and Android devices. Its development and implementation have been not only novel but also innovative in Colombia and Latin America. Since its launch, its use within the hospital's healthcare personnel has been significant, because it has involved surgical specialties as well as clinical specialties and nursing personnel.

The implementation of this tool is relatively recent and surely with time its use will be increasing and the entry of images into the application will become routine within the hospital's clinical practice. Undoubtedly, the implementation of this mobile application has changed how clinical images were made available to the hospital. There is now appropriate and safe use of this type of content and this has positively influenced routine clinical practice.

So far, no disadvantages have been identified in its use. In addition, its operation, backup and migration of images has not presented any type

of failure. At present, we do not know the users' perception of the mobile application, and this is a limitation of the present study. In the near future, we hope to conduct a survey to ascertain the perception of the healthcare personnel, which will allow us to identify barriers, limitations and opportunities for improvement.

A study on user perception of the mobile application is expected to be conducted soon to identify opportunities for improvement. We hope that other institutions will in the future develop their own tools for the secure capture of clinical images to favor patient confidentiality, the safe use of clinical images, multidisciplinary, and teaching processes for medical personnel.

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Conflicts of interest

The authors declare no conflicts of interest.

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