THE PERCEPTION OF TECHNOLOGICAL TOOLS USEFULNESS TO DEVELOP MEDICAL CLINICAL SKILLS AMONG POSTGRADUATE MEDICAL STUDENTS

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Abstract: COVID-19 pandemic has forced postgraduate medical students to limit clinical practice. This demands clinical training centers to look at how to take advantage of digital resources available in the market to benefit a future doctor's training. Technological resources in healthcare learning and training clinical skills cover three aspects: learning through apps, virtual simulation, and social media. This study aimed to identify popular technological tools that doctors in training used in the Multicentric program at Tecnológico de Monterrey and analyze their valued opinions. An online questionnaire with 20 mixed questions, multiple-choice and open questions, was sent via email to all residents in the program. Answers were anonymous and voluntary of 60 responses received, 48 indicated that the use of digital apps increased during the pandemic. Application of clinical scales and updated information about diseases were the most common reasons to use the applications. 50% of residents mentioned using virtual simulation as a tool, while 20% identified it beneficial for developing clinical skills. It was surprising that most of them considered medical education content from social media such as You Tube® and Twitter® as good quality information. Apps have reached good popularity among residents, but simulation and social media are becoming popular and reliable. Attention has to be turned to these resources, for they may serve as aid tools for healthcare professionals.

Keywords: clinical learning, technology, tools, digital apps, virtual simulation, social media (4-6 words)

Introduction

The influence of technology on the clinical learning environment is around: learning through mobile apps, simulation, and social media. Downloadable applications through smartphones can support physicians in training for informed decision-making through updated information such as clinical guides and posology. Simulation can help train clinical skills through a controlled scenario and team feedback. Finally, social media nests a participatory approach to knowledge development (Bullock & Webb, Technology in postgraduate medical education: a dynamic influence on learning?, 2015)

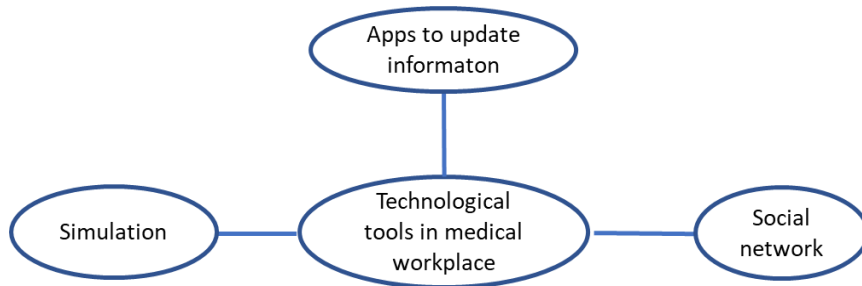*Corresponding Author's Email: *bca@tec.mx

Figure 1: Technological platforms available to teach postgraduate medical students.

Since the introduction of smartphones (portable multifunctional devices), their use has become an essential part of daily activities. These devices can store applications containing information such as textbooks, photos, and calculators. The popularity, of course, has arrived and benefited the medical community, including physicians and medical students. These programs have proven to be effective for the rapid access to information in any place. Also, they have changed the way of teaching and studying in the medical environment and have introduced a new way of learning using technological devices called mobile learning or "m-learning." **(Bullock & Webb, Technology in postgraduate medical education: a dynamic influence on learning?, 2015)**

It is a fact that mobile technology is now formalized in the current workspaces of health care workers (Ellaway, Fink, Graves, & Campbell, 2013). Attending physicians, postgraduate students, and undergraduate medical students require easy access and accurate information to diagnose and manage sick patients. Undergraduate and postgraduate students rely on these digital resources to obtain the information to proceed with a founded medical decision. Apps have improved clinical decisions, based on bibliography, by providing updated clinical practice guidelines, diagnostic clinical scales, specialized calculators for drugs, and many other tasks in a fast and precise way. (Payne, Wharrad, & Watts, 2012), (Bullock & Webb, Technology in postgraduate medical education: a dynamic influence on learning?, 2015), (Mohammad Mosa, Yoo, & Sheets, 2012).

Table 1: Medical applications

Purpose	Applications
Self-learning	Medscape
	Up to Date
	Amboss
	Evernote
	ANKI
	VIsual Dx
Clinical Guides	Dynamed Plus
	PEPID
	LC
	QXMD

Management doses and calculation	Medscape
	UptoDate
	MedCalc X
	MDCALC+
	Micromedex Drug Info IBM

The most popular apps, based on different articles, provide pharmacologic formulations and dosage calculations. The ones medical students use the most are shown in Table 1. Medscape and UptoDate, in contrast with the others, not only display drug information and function as a constantly updated database that provides clinical guidelines, disease information, and much more practical information for the health care professionals. An emerging app called DynaMed Plus is similar to these, whose information is evidence and expert opinion based. MDCALC has clinical diagnostic scales. Lastly, MedCalc X, which has risen in popularity in previous years, has the one inconvenience that it only works on iOS devices (Payne, Wharrad, & Watts, 2012).

Social media: Collaborative learning

Social media, which consists of Web-based technologies, facilitates sharing of knowledge and opinions through collaboration, interaction, and discussion. Platforms, including wikis, social networking sites (e.g. Facebook), microblogs (i.e. Twitter), and blogs, offer a venue through which trainees communicate, exchange ideas, learn evidence-based medicine, and promote their scholarship (Sterling, Leung, Wright, & Bishop, 2017). Social media has the potential for aiding in knowledge translation, or implementation science, which seeks to close the gaps between knowledge and practice and focuses on novel forms of dissemination. Despite using social media in health care, little evidence exists on using it for education and training (Hamm, et al., 2013).

Simulation: learn skills

Simulation in the health area is increasingly approved, as well as applied; all this to have health professionals more prepared and trained to carry out their work, whether it be how to approach a consultation, surgical techniques, technical skills, etc. The advantage of simulation is that students can make mistakes and learn from them to avoid harming a patient in the future; likewise, it has been found that these activities develop clinical competencies at the undergraduate and postgraduate levels (Karunathilake, 2018).

Simulation offers the possibility to teach a range of higher-level competencies expected by a postgraduate trainee, including critical thinking, analytical skills, specialized procedures, leadership, decision-making, interpersonal skills, and professionalism. Regarding team learning, it has allowed establishing team self-correction as a strategy, consisting of feedback from the members and discussions designed to point out the good and bad processes carried out (Karunathilake, 2018).

Table 2: Simulation platforms

Purpose	Simulation Platforms
Simulated clinical cases	Insimu https://insimu.com
	Full Code https://full-code.com
	MedSims by Medscape https://www.medscape.org/simulation
	Dr. SIM https://drsim.accuratesolutions.eu
Interactive simulated clinical cases	MedicActiv https://www.medicactiv.com/en/
	SimX https://www.simxvr.com
	USC Standardized Patients https://www.standardpatient.org
	ACADICUS https://acadicus.com

Methods

A 20-question-long survey was created using the google forms program from Google®. The survey included multiple choice and open answer questions with various sections focused on: mobile medical apps, web pages, simulation, and social media. Multiple-choice questions had a 5-point Likert scale. With the authorization of the multicentric residency program of Tecnológico de Monterrey, the link to the survey was sent via institutional email to all the residents engaged in the program. The participation was voluntary and supported anonymity.

Results and Discussion

Demographics

In total, 60 answers were received from medical residents at the Multicentric Program of Tecnológico de Monterrey School of Medicine. 50% of participants were coursing their first year of medical residency, with the other half studying between the 2nd and 4th year of residency. The highest answers were received from Internal Medicine (8 answers), followed by Anesthesiology (7 replies), Ophthalmology, and General Surgery, both with 6 answers each (Table 3).

Table 3: Distribution of answered questionnaires within the different residency programs.

Medical Residency	Number of answers received
Internal Medicine	8
Anesthesiology	7
General Surgery	6
Ophthalmology	6
Radiology	5
Psychiatry	5

Pediatrics	5
Cardiology	4
OBGYN	4
Quality in Clinical Care	4
Geriatrics	3
Urology	2
Neonatology	1
Pathology	1

Mobile medical apps

The tendency to use apps because of COVID-19 pandemia was asked to medical residents. As seen in Table 4, most residents changed the frequency of app usage, with only 20% not reporting a change in their use.

Table 4: Use of apps after COVID-19 pandemia

Year in residency	Changed	Did not change	Total
1st year	23	7	30
2nd year	18	1	19
3rd year	5	2	7
4th year	2	2	4
Total	48	12	60

Important to note that most of the change was seen in the first and second year residents which could explain increased incorporation of technological resources in their daily lives from Millenials. Clinical training time was limited due to COVID-19, so medical residents had more time to self-study and explore digital resources. Also, worldwide, more applications became available to provide the latest information regarding the care and prevention related to COVID (Kondylakis, et al., 2020).

It would be interesting to increase our 4th year students' group and make a comparable differentiation between 1st and 4th year students due that the first are centennials (born between 1995 and 2010) and the later are millennials (born between 1980 and 1995). 73 % of millennials consider teleworking as the perfect alternative to provide life-work balance and 51% use social media during working hours. (Chivers, 2021). Centennials, on the other hand, consider smartphones indispensable in their daily lives and spend an average three hours and thirty minutes online on their smartphones.

In order to go further into the popularity of m-learning, use of technological devices was asked. According to EDUCASE review by Chen et al 86% higher education students owned a smartphone

(Chen, Seilhamer, Bennet, & Bauer, 2015). And even though this study was conducted in Mexico, the most common devices used were smartphones and mobile apps, as expected due that the majority of our study group are centennials.

Table 5: Technological devices frequently used

Device	Mean	Standard deviation
Smartphone	4.69	0.66
Laptop	4.53	0.74
Tablet	2.69	1.50

The reason for the use of these mobile programs was also asked, and popular choices among postgraduate medical students were provided such as posology, clinical scales, diagnostic approach, update about diseases and prep quizzes. A 5-point Likert scale was given upon each choice, and a mean with SD was calculated.

Table 6. Reasons to use medical applications

Reasons to use	Mean	Standard deviation
Clinical Scales	4.04	1.17
Update about diseases	3.82	1.07
Posology	3.80	1.46
Diagnostic approach	3.69	1.33
Prep quizzes	2.83	1.32

The majority agree that the apps focused on posology and the ones providing access to disease-centered clinical guidelines are among the most popular as of today (Payne, Wharrad, & Watts, 2012), as it can be seen in table 6. Also, specialties like Anesthesiology, General Surgery, and Ophthalmology that focus on training procedures might explain the need to apply scales in order to proceed in diverse maneuvers. Easily accessible information is needed by medical apps to aid medical clinical learning and offer supported decision-making they provide during their clinical training in any kind of specialty. On the other end, the most infrequent reason for usage was the prep quizzes apps which could be explained by the high percentage of first-year residents who answered the survey. First years tend not to focus on board exam preparation but on gaining practice in their specialty field.

Table 7: Five most frequent mobile apps used

Medical Applications	Number out of 60 total	Description
Medscape®	56	<u>Free</u>. Offers updated medical information, point-of-care drug and disease information.
UptoDate®	56	Paid. Offers clinical decision information powered by renowned physicians. Offers patient education leaflets.
MD+Calc®	37	<u>Free</u>. Provides point-of-care clinical decision-support tools, including medical calculators, scoring systems, and algorithms
QXMD®	29	<u>Free</u>. Convert medical evidence, guidelines, and protocols into practical tools.
MedCalcX®	28	<u>Paid.</u> Is a tool that enables medical professionals to easily use complicated medical formulas, scores and classifications.

The popularity of different available apps was measured. The choice provided was based on current published popularity rates among web pages and app stores. Out of the twelve provided, the five enlisted in table 7 were among the most used due to free access and the subscription our university has to UptoDate®. Interestingly, the two highest used are the oldest, which probably could also mean they are the most known to compare with the rest.

Simulation: improving clinical skills

Studies conducted worldwide within the postgraduate specialties have demonstrated that simulation is effective in teaching patient safety and practical procedures, leading to improved clinical practice. As discussed before, one of the tendencies in medical education is the use of simulation within the new curriculum. Simulation can be virtual or performed in a center with different mannequins and setups (Karunathilake, 2018).

Table 8: View of usefulness in simulation

Answer choice	Do not use	Use to improve diagnosis accuracy	Use to improve clinical skills
Number	40	12	8

Surprisingly, half of the residents reported not using simulation as a learning tool. Taking into account the fact that simulation has been found to be an effective way of learning skills this teaching modality should be promoted specifically in medical postgraduate programs. This is an opportunity area to

analyze and develop and incorporate into the different programs. It might reflect a deficiency in faculty development into simulation and knowledge of how to set up scenarios to teach through simulation. There is a wide spectrum of ways to incorporate simulation: role play, standardized patients, virtual reality, augmented reality, and low and high-fidelity mannequin-based (Herrera-Aliaga & Estrada, 2022).

In situ simulation is gaining importance for training in real environments and to encourage teamwork, which must be contrasted with its real effectiveness. The validation of simulation programs is increasingly important, as well as the knowledge of how it impacts patient care. The simulation also provides a unique opportunity for learners to understand their reactions under stressful circumstances. This allows a process of systematically reflecting upon experiences with the objective of improvement (Herrera-Aliaga & Estrada, 2022).

It is quite fundamental to incorporate virtual simulation into their clinical learning due that centennials, nowadays, the generation of postgraduate students, have 41% tried Virtual Reality and 12% use it on a daily basis and 74% have used Augmented Reality, and 15% use it on a daily basis (Karr, 2021). This data emphasizes that postgraduate learners, which are native immigrants, are used to learning on technological mobile devices that go beyond social communication and web surfing (Manez, 2022).

Social media: Dissemination of expert opinions

Lastly, an emerging way by which medical clinical students acquire knowledge is through social media. Social media has the potential of aiding in knowledge translation and health care has slowly been incorporating its use (Hamm, et al, 2013). Adapting social media into educational programs can help students stay connected with teachers, enhance engagement and promote remote learning (Greenhow & Galvin, 2020). As these facts have made their way into postgraduate education, various studies have been conducted to assess their effectiveness. By these means, it included the last section to acknowledge the use of social media among medical residents in our multicentric program and consider the opinion about the quality of information.

Table 9: Frequency distribution of use between diverse social media platforms.

App Name	Number of students reporting usage
You Tube	28
Twitter	27
Websites	17
Facebook	16
Spotify/Podcasts	15
Instagram	13

LinkedIn	1
Research Gate	1

The majority of students reported using You Tube® and Twitter®. Although less popular and not excluded as good sources of information were websites, Facebook®, Spotify®/podcasts, and Instagram® in descending order of frequency (Table 9). The quality content on a 5-point Likert scale was considered good (n=30) and very good (11) becoming a reliable source accordingly. Also searching strategies used to navigate social media were found: following a renowned expert (n=35) and open a browser (n=33).

Centennials consider technology not as an element of consumption but as a tool that facilitates access to communication, exchange, education, and entertainment (Editorial, 2016). Sterling and colleagues found Twitter® and podcasts to be effective in engaging learners and enhancing education, while You Tube® served as a technical skill teaching tool for graduate medical students. (Sterling, Leung, Wright, & Bishop, 2017). In medical education, learners have reported high levels of satisfaction with the brief and concise nature of educational videos, ease of access and use, and ability to view videos in a variety of settings to supplement clinical experiences and consolidate their learning provided by You Tube®. Several studies did report high levels of learner satisfaction, increased levels of confidence, and increased knowledge. But still remains studies to evaluate the educational effectiveness of You Tube® videos as an educational resource in medical education (Curran, et al., 2020).

Twitter® is an effective tool that gives the user access to current information for as much or little time that a clinician can spare, A 2011 survey of physicians found that 24% of respondents used social media daily and 61% weekly to explore online medical information (Melvin & Chan, 2014). But like You Tube® its educational effectiveness should be evaluated.

Conclusions

COVID-19 pandemic has called for a change in education programs all across the world, many of them were forced to adapt to available technological tools. As vulnerable as others, medical clinical learners were impacted by this worldwide health risk and learning opportunities involving peer and patient interaction and clinical skills were reduced. Digital natives such as millennials and centennials have described differences in how they adopt digital technology in their workplace and for education which should be researched more in detail.

Digital resources such as mobile apps, simulation platforms, and social media are the mainstays of educational aid nowadays. The simulation was not as popular as social media platforms among residents. Simulation and social media platforms are emerging learning modalities that seem to be

successful in clinical skill acquisition and evidence-based medicine practice, respectively. Technology plays an important role in medical postgraduate education nowadays and its constant evolution will keep providing tools to provide much better and more effective attention to their patients.

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