



Knowledge, attitudes and practices of telemedicine education and training of French medical students and residents

Journal of Telemedicine and Telecare
0(0) 1–9
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/1357633X20926829
journals.sagepub.com/home/jtt



Sarina Yaghobian¹ , Robin Ohannessian^{1,2,3} ,
Thomas Lampetro⁴, Isabelle Riom⁵, Nathalie Salles^{2,6},
Elisabeth Medeiros de Bustos^{3,7}, Thierry Moulin^{2,3,7} and
Alexandre Mathieu-Fritz^{2,8}

Abstract

Introduction: Telemedicine is a remote medical practice that is progressively expanding in France. In 2018, regulatory changes authorised telemedicine to become part of daily clinical practice. Telemedicine education and training (ET), however, has not been widespread, despite its integration in the medical curriculum since 2009. The objective of this study was to examine the self-perceived knowledge, attitudes and practices (KAP) and ET of telemedicine ET from medical students and residents in France.

Methods: A national survey was distributed online (15 December 2018 to 3 March 2019) to approximately 135,000 medical students and residents in medical schools ($n = 38$). The survey consisted of a total of 24 binary and Likert-scale questions covering telemedicine ET and KAP.

Results: In total, 3,312 medical students and residents completed the survey. Synchronous video consultation was the most well-known telemedicine activity (86.9%); asynchronous tele-expertise was the least recognised (40.3%). Most respondents (84.8%) stated they were not familiar with telemedicine regulations. The relevance of telemedicine for improving access to care was acknowledged by 82.8% of students and residents; 14% of respondents stated they had previously practised telemedicine during their studies; 14.5% stated they had received telemedicine ET; however, 97.9% stated they were not sufficiently trained.

Discussion: This is the first national scale study on telemedicine ET by medical students and residents, to date. Despite positive attitudes, participants were found to have limited telemedicine ET, knowledge and practices. The demand for telemedicine ET is increasing. Such studies that incorporate the perspectives of medical students and residents may strengthen the implementation of telemedicine ET in the future.

Keywords

Telemedicine, medical curriculum, medical education, residency training, telehealth

Date received: 1 November 2019; Date accepted: 25 April 2020

¹Télémedecine 360, TLM360, France

²Société Française de Télémedecine, France

³CIC-1431, Inserm, département de neurologie, CHRU Besançon, France; EA 481, Laboratoire de neurosciences intégratives et cliniques, université de Franche-Comté, France

⁴Association Nationale des Etudiants en Médecine de France, France

⁵InterSyndicale Nationale des Internes, France

⁶University of Bordeaux, INSERM UMR 1053 BaRITon, France; CHU Bordeaux, Pôle de Gérontologie Clinique, France

⁷Department of Neurology 2, CHRU, Besançon- EA 481- University of Bourgogne Franche-Comté, France

⁸Université Paris-Est Marne-la-Vallée, LATTs (UMR CNRS 8134) 5, France

Corresponding author:

Sarina Yaghobian, Télémedecine 360, TLM360, 55 Avenue Marceau, 75016 Paris, France

Email: contact@telemedecine-360.com

Introduction

Telemedicine is a remote medical practice that is progressively expanding across a range of medical specialities.¹ In the last 10 years, there has been a focus on including telemedicine in medical education.²⁻⁴ In France, telemedicine has been integrated nationally in the medical curriculum since 2009 and, more recently, in the residency programme in 2017.⁵

Implementation of telemedicine education and training (ET) within medical schools, however, has been limited, as shown by a study conducted among medical school deans and associate deans in 2017.⁵ This study found that telemedicine ET was not widespread in medical schools across France, despite positive knowledge, attitudes and practices (KAP) of medical school decision-makers. The need for telemedicine ET implementation as part of the medical curriculum is essential, not only to promote stronger adoption, but also to improve the quality and safety of its practice.^{6,7}

Reimbursement for teleconsultations and tele-expertise, initiated in 2018 by the national health insurance, *l'Assurance Maladie*, authorised telemedicine to play an increasing role in the daily clinical practice of doctors, including graduates of academic year 2018/2019.⁸ To date, there are no data on KAP and ET of telemedicine from medical students' or residents' perspectives. The objective of this study was therefore to examine self-perceived KAP and ET of telemedicine of French medical students and residents.

Methods

A national, descriptive questionnaire-based survey was conducted from 15 December 2018 to 3 March 2019. The online survey was anonymous and voluntary.

Sample

There were approximately 135,000 medical students and residents in the 2018/2019 academic year in France. Respondents were required to be a student or resident at a medical school ($n = 38$), studying and/or completing their medical education in France. Survey participants that did not match these criteria were not included in the results.

Data were categorised according to whether participants were medical students or residents. In the 2018/2019 academic year, 59,753 students were enrolled in the first-year programme in France, known as PACES. First-year students were not included in the medical students' response rate. The rate including PACES would not have been representative of medical students and residents due to the programme's very high enrolment numbers. Completion of the residency programme in France, at the time of the survey, was

dependent on the years required to complete the medical training of a given speciality. For example, a general practitioner required 3 years' residency whereas a surgeon required 5 years. The sixth year of residency (TCEM6) was not integrated into the response rate under 'medical residents' because it is an elective year in medical studies and there were no national data available for residents completing the TCEM6 in France.

Survey recruitment

The survey was conducted using three national organisations in France: i) French Society of Telemedicine (SFTelemed), ii) National Association of French Medical Students (ANEMF), and iii) National Union of Medical Residents (ISNI). SFTelemed, ANEMF and ISNI participated in the preparation, organisation and distribution of the survey.

A nominative list of participants did not exist at both local and national levels at the time of the study, and thus could not be sent individually to each medical student and resident. The survey was distributed, upon availability of an email address provided by the national medical students' and residents' associations, school administration and corresponding official social media pages of the three national organisations.

Questionnaire

There were 24 questions in total. The survey consisted of 11 binary, 11 multiple choice and 2 Likert-scale questions. Four questions covered telemedicine ET and 20 questions related to KAP of telemedicine. Telemedicine was defined according to its legal definition in France. The types of telemedicine activity explored in the survey were i) synchronous video teleconsultations (TLC); ii) asynchronous tele-expertise (TLE), otherwise referred to as eConsult or store and forward; iii) remote patient monitoring (TLS); iv) tele-assistance (TLA); and v) medical regulation (MR), which is a type of telemedicine activity defined as emergency triage by phone. (See Appendix for further details on the questions.)

Knowledge items were defined as the self-perceived knowledge of telemedicine. Regarding telemedicine definitions, respondents were asked whether they knew the legal definitions of the types of telemedicine. The types of telemedicine ET were categorised under theoretical education, hospital training, and medical simulation.

Analysis

The analysis performed included descriptive rates for each question and comparisons where relevant by chi-square test. Data were collected and analysed

directly from the online software. Ethnicity was not collected in the survey to abide by French legislation. For this type of study to be conducted, ethical approval was not required according to French legislation.

Results

In total, 3,329 responses were retrieved, with 3,312 medical students and residents completing the survey. As shown in Table 1, 69.8% of respondents were medical students attending the first 6 years of medical school, and 30.2% were medical residents completing the six years of the residency programme.

The response rate was 5.3% for medical students, excluding first-year students (PACES) and 3.1% for residents, excluding TCEM6. The highest participation was from third-year medical students (549 students from 8533 officially registered; 6.4% response rate).

Population

The most prevalent participant age range was 20–25 years (55.3%). Respondent gender breakdown was female: 67.5%, male: 32.5%.

A proportion of medical students and residents from all medical schools in France ($n = 38$) participated in the survey. The medical schools with the highest participation rates were Caen, Montpellier, and Saint-Etienne, representing 9.2%, 8.4% and 5.9% of the total, respectively. The highest medical resident participation rates were from the specialties of general practice, psychiatry, and public health, at 43.9%, 13.1% and 7.4% respectively.

Knowledge of telemedicine definitions

The most well-known telemedicine activity definition was TLC (86.9% of medical students and 87% of residents) (see Table 2). The least recognised was TLE (39.9% of medical students and 41.2% of residents). Knowledge of TLC was significantly higher for both medical students and residents who had previously practised (95.2%). Knowledge of TLE was significantly higher for both medical students and residents who had practised (52.0%) and were trained (66.9%) in TLE. Knowledge of TLS was significantly higher for medical students overall (61.5%), and for both medical students and residents who had received training on it (79.0%).

Knowledge of telemedicine regulations

Only 1% of medical students and residents stated they had a good knowledge of telemedicine regulations; 14.1% stated they had a little knowledge of telemedicine regulations (Table 3). Most respondents stated they were not at all familiar with the regulations (84.8%); more specifically, this broke down as 77.0% of those who had previously practised telemedicine and 67.9% of those who had telemedicine ET.

Attitudes

Attitudes towards the relevance of telemedicine improving patient care were positive (60.8%), where medical students and residents agreed and completely agreed to this statement (69.6% of participants who had practised previously and 78.1% of those who had received telemedicine ET).

Table 1. Response rate and participation for the knowledge, attitudes and practices of telemedicine education and training of medical students and residents in France.

Year type	Year number	Year name	Registered (N)	Response (N)	Response rate (%)	Survey participation (%)
Medical student	1st	PACES	59,753	265	0.4	8
	2nd	DFGSM2	9,007	465	5.2	14
	3rd	DFGSM3	8,533	549	6.4	16.6
	4th	DFASMI	8,492	335	3.9	10.1
	5th	DFASM2	8,489	322	3.8	9.7
	6th	DFASM3	8,500	375	4.4	11.3
Total medical students			43,021 (excluding PACES)	2,311	5.3	69.8
Resident	7th	TCEM1	8,646	221	2.6	6.7
	8th	TCEM2	8,065	218	2.7	6.6
	9th	TCEM3	8,122	284	3.5	8.6
	10th	TCEM4	5,494	159	2.9	4.8
	11th	TCEM5	2,302	64	2.8	1.9
	12th	TCEM6	N/A	55		1.7
Total residents			32,629 (excluding TCEM6)	1,001	3.1	30.2
Total				3,312		100

Table 2. Self-perceived knowledge of telemedicine definitions per activity type in France, by medical students and residents in 2019.

Category	Teleconsultation (TLC) (%)	Tele-expertise (TLE) (%)	Remote patient monitoring (TLS) (%)	Tele-assistance (TLA) (%)	Medical regulation (MR) (%)
Medical student	86.9	39.9	61.5*	54.1*	42.9*
Medical resident	87.0	41.2	48.8	42.1	70.6
Practised	95.2*	52.0*	60.2	51.0	80.9*
Not practised	85.5	38.4	57.2	50.4	46.5
Trained	88.4	66.9*	79.0*	68.8*	55.2
Not trained	86.7	35.8	54.0	47.4	50.6
Total	86.9	40.3	57.6	50.5	51.3

* $p < 0.01$.**Table 3.** Self-perceived knowledge of telemedicine regulations in France by medical students and residents in 2019.

Category	I know the telemedicine regulations well (%)	I know the telemedicine regulations a little (%)	I do not know the telemedicine regulations (%)
Medical student	0.7	13.7	85.6
Medical resident	1.7	15.2	83.1
Practised	2.2	20.9	77.0
Not practised	0.8	13.0	86.2
Trained	0.8	31.2	67.9
Not trained	1.1	11.2	87.7
Total	1.0	14.1	84.8

Respondents who agreed or completely agreed on the relevance of telemedicine to improving access to care amounted to 82.8% (Table 4). However, 30.7% of respondents regarded telemedicine as a threat to medical practice (19.8% of those that had practised and 23.3% for those that had previous telemedicine ET). More than half regarded telemedicine as an opportunity to improve medical practice (64.3% of those that had practised and 68.1% of those that had previous ET).

A combined 36.6% of medical students and residents agreed or completely agreed that they would want to practise telemedicine in the future (47.4% of those that had practised and 44.3% of those that had previous ET). Over half the respondents agreed or completely agreed (50.7%) that patients were in favour of telemedicine.

Practices

14% of respondents stated they had practised telemedicine previously: 7% of medical students and 30% of residents ($n=455$). There was an increasing trend towards the practice of telemedicine by academic year in medical schools and/or residency programmes (Figure 1). The most practised telemedicine activity was MR (34.2%) followed by TLE (29.3%) and TLC

(24.1%). The two least practised telemedicine activities among medical students and residents in France were TLS (6.5%) and TLA (5.8%).

A combined 77.4% of respondents were satisfied or very satisfied with the practice of telemedicine (see Figure 2). Some 60.2% stated having practised telemedicine on fewer than 5 occasions; 20.6% of respondents stated having practised telemedicine on between 5 and 20 occasions and 19.2% stated they had practised telemedicine more than 20 times; no significant differences were found between medical student and resident experiences.

Most respondents (82.6% in total: 84.7% of medical students and 76.4% of residents) who had not practised telemedicine stated they would like to before the end of their studies. 6.7% of medical students and residents stated they had used telemedicine as a patient (8.4% medical students and 2.7% residents).

The channels for non-secured remote medical practice included telephone, text, email and video during hospital rotations. The primary form of professional communication was telephone, with 70.3% using this to communicate with a healthcare professional (HCP), and 60.4% to communicate with a patient (Figure 3). Only 0.8% of medical students and residents had previously used video with patients as a channel of non-secured remote medical practice.

Table 4. Survey results for the attitudes of medical students and residents on telemedicine in France.

Category	Completely agree (%)	Agree (%)	Do not know (%)	Disagree (%)	Completely disagree (%)
Relevance for patient	16.5	44.3	6.9	25.6	6.7
Medical student	16.4	44.1	6.9	25.7	6.9
Resident	16.5	45.0	7.0	25.3	6.3
Practised	21.9	47.7	4.9	20	5.4
Not practised	15.6	43.8	7.3	26.5	6.9
Trained	26.2	51.9	3.3	15.6	2.9
Not trained	14.8	43.0	7.6	27.3	7.3
Improved access to care	31.8	51.0	3.3	10.9	3.0
Medical student	30.9	51.6	3.7	10.9	2.9
Resident	33.9	49.8	2.3	11.0	3.1
Practised	40.0	45.4	1.9	9.0	3.7
Not practised	30.5	51.9	3.5	11.2	2.8
Trained	42.1	45.2	1.5	9.4	1.9
Not trained	30.0	52.0	3.6	11.2	3.1
Threat to medical practice	9.2	21.5	9.2	46.2	13.9
Medical student	10.9	23.8	10.2	43.5	11.5
Resident	5.2	16.2	6.9	52.2	19.5
Practised	6.0	13.8	8.8	51.8	19.6
Not practised	9.7	22.8	9.3	45.2	13.0
Trained	7.5	15.8	6.9	52.1	17.7
Not trained	9.5	22.5	9.6	45.2	13.3
Opportunity to improve medical practice	11.9	45.2	10.3	25.1	7.5
Student	10.9	45.6	10.9	24.7	7.9
Resident	14.1	44.3	9.0	26.1	6.6
Practised	16.6	47.7	9.5	20.9	5.4
Not practised	11.1	44.8	10.4	25.8	7.8
Trained	16.2	51.9	7.3	20.2	4.4
Not trained	11.2	44.1	10.8	26.2	8.0
Would like to practise in the future	8.4	28.4	21.6	27.1	14.6
Student	7.1	28.9	22.3	26.9	14.7
Resident	11.4	27.3	19.8	27.4	14.2
Practised	16.6	30.8	20.2	23	9.5
Not practised	7.1	28.1	21.8	27.7	15.4
Trained	8.3	36	18.8	26.7	10.2
Not trained	8.4	27.2	22.0	27.1	15.3
Patients in favour of telemedicine	9.9	40.8	18.2	25.8	5.3
Student	9.6	38.3	18.7	27.4	6.0
Resident	10.7	46.6	17.0	22.0	3.8
Practised	14.0	48.2	15.1	18.9	3.9
Not practised	9.2	39.6	18.7	26.9	5.6
Trained	10.4	41.0	18.8	24.0	5.8
Not trained	9.8	40.8	18.1	26.1	5.3

Education and Training

In total, 14.5% of medical students and residents stated they had received previous telemedicine training (16.9% of medical students and 7% of residents). Training was shown to be most prominent during the first 4 years of medical studies (Figure 1). Among those that received telemedicine training, 92.3% were medical students and those that were trained in the first year of their studies (67.9%).

The main form of telemedicine ET was theoretical education (79.8%), followed by hospital training and medical simulation, 13.1% and 2.4% respectively. Knowledge about the integration of telemedicine ET into the medical curriculum was low, at 5.7% for ET delivered in the first 6 years of medical school and 9.9% during the residency programme. Most respondents (97.9%) stated they had not received sufficient telemedicine ET. A total of 77.4% stated that they would like telemedicine ET to be increased at their medical school.

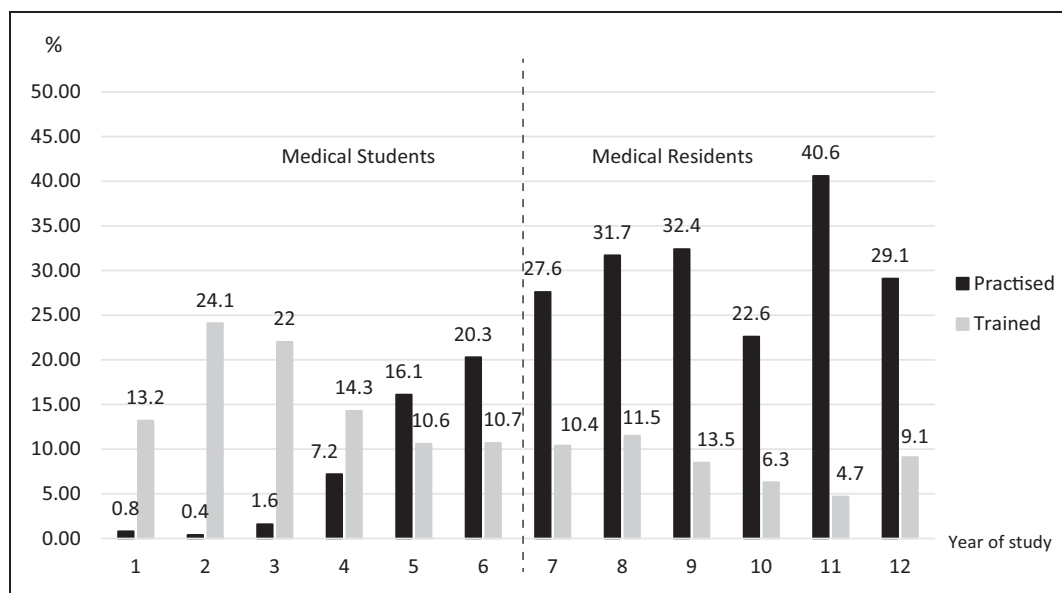


Figure 1. Percentage (%) of medical students and residents that had telemedicine training and practices during the 12-year period of their medical education and residency programme in France.

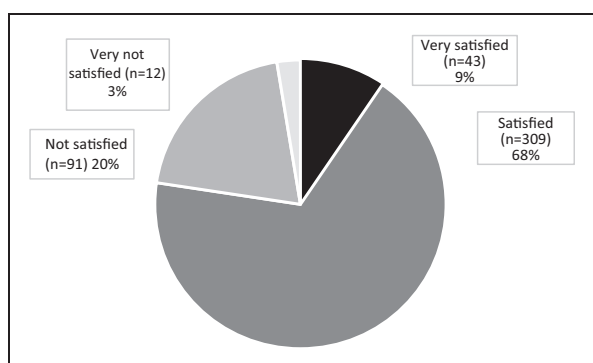


Figure 2. Satisfaction rates (%) for telemedicine practice of French medical students and residents in 2019.

Discussion

This was the first national-scale study on telemedicine ET of medical students and residents. KAP of medical students and residents was evaluated to better understand the telemedicine ET landscape and its accessibility in medical schools.

Knowledge

In this study, self-perceived medical student and resident knowledge of telemedicine varied among the types of telemedicine activity. The high familiarity observed for TLC among medical students and residents may have occurred due to the extensive national medical

and non-medical media discussions that took place before and during the release of the survey. Limited professional and public communication about TLE, as well as limited practice amongst students may have contributed to the lack of knowledge of this activity type.

Self-perceived knowledge of telemedicine regulations including ET was extremely low and should be a matter of concern for future practice in France if not rectified. Similar results were observed in the United States, where the complex legislative landscape contributed to a poor understanding of telemedicine regulations.⁹ The significant differences found between students and residents that were trained and/or had practised telemedicine previously may indicate the impact of telemedicine ET on the knowledge of its practice by doctors, as shown in Table 2. These results demonstrate the necessity of including terminology, definitions and regulations in the core components of telemedicine ET in the medical curriculum.⁹⁻¹¹

Attitudes

Positive attitudes towards telemedicine, particularly in relation to improving 'patients' access to care' were observed in this study. However, 50.7% of French students and residents were in favour of telemedicine, whereas in the 2017 study of deans, associate deans and medical school decision-makers, 97.7% were in favour. Almost a third (30.7%) of medical students and residents considered telemedicine a threat to

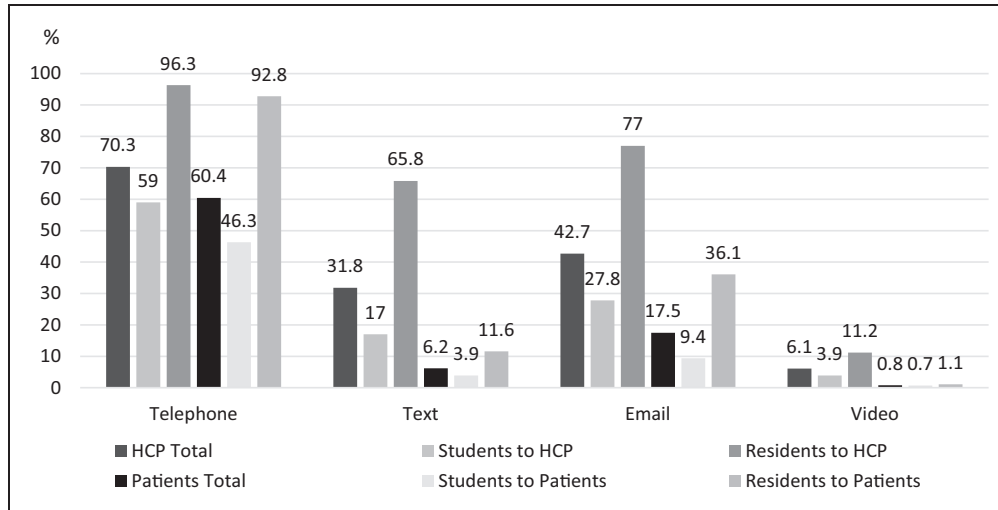


Figure 3. Percentage (%) of non-secured channels used for remote medical practice (via telephone, text, email and video) of French medical students and residents during hospital rotations to communicate professionally with patients and/or healthcare professionals (HCPs) in 2019.

medical practice, compared with 18.8% of medical school decision-makers in the 2017 survey. These differences in attitudes towards telemedicine may represent the low experience with and use of telemedicine (14%) compared with the more senior academic respondents (56.2%) of the 2017 study.

Practices

Telemedicine practice by medical students and residents was limited, however there was a trend indicating its use increased consecutively per medical school year, with an overall high satisfaction rate (Figure 2). The low rate of telemedicine practice from first- to third-year medical students may have occurred because in the preclinical settings in the initial years of medical school, greater focus is placed on theoretical education and there are limited clinical roles in the second and third years of hospital rotations. Conversely, increased telemedicine practice from the fourth to the sixth year of studies, could similarly be explained by the increase in clinical activities during hospital-based training rotations.

The most practised telemedicine activity was MR, and experience in medical emergency rotations may have contributed to this. A low rate of practice for TLS was observed. The initiation of TLS as a telemedicine practice at university hospitals and clinical management in France by senior HCPs may have contributed these results (Table 4).

Non-secured medical practice was investigated in the survey because of its common usage amongst the ‘digitally native’ generation. This study showed that the telephone remained the most common form of non-

secured professional practice between medical students and residents to HCPs or patients. Professional use of video was very low compared with texts and emails, and texts and emails were used more frequently by medical students and residents with HCPs than with patients (Figure 3). Similar results for non-secured communication between HCPs were also found in the 2017 study.⁵ These findings may indicate the need to promote tele-expertise with secure care-coordination software solutions in the future.

Education and training

Both medical students and residents declared very little training experience in telemedicine. However, the increasing trend by academic year may reflect the increased implementation of telemedicine ET since the introduction of the legislation in 2009. In a recent study in the United States, the rate of telemedicine ET adoption by medical schools during the preclinical and clerkship phases was higher than in France.¹² The low rate of training for residents in our study, could have been due to the low participation of medical specialties with declared telemedicine training and the higher participation of residents with medical specialties that did not have implemented telemedicine training. In addition, the ET type mostly remained, as theoretical education with limited medical simulation and hospital-based training on telemedicine, which should be encouraged in the future.¹³

Differences between the results of medical school decision-makers and medical students in the last 3 years of medical school were found. These differences may have been influenced by the nature of the

questions in the respective surveys. Questions regarding training for medical students asked whether respondents 'had previously trained in telemedicine', whereas in the 2017 study, medical school decision-makers were asked whether 'telemedicine training was available per year in the medical curriculum'. Students from the initial years of medical school, who practised more and were trained less, were found to have received more training than residents. The gradual and progressive expansion of telemedicine ET in medical schools, which parallels the implementation of telemedicine practices in daily hospital activities, may explain these findings.

Awareness of telemedicine ET in the medical curriculum was very low. However, the majority of medical students and residents were aware that they were not trained enough and would like to see telemedicine ET increased. Similar results were found in a study published in the United States in 2016, where students acknowledged the relevance of and need for telemedicine ET in the undergraduate medical curriculum.¹⁴ The high demand shown by medical students and residents in the current survey, which matched the results of medical school decision-makers, may encourage further implementation of telemedicine ET in medical schools in France; it is possible that the low implementation observed may have been due to organisational rather than motivational factors. Similarly, in Australia, eHealth and, telehealth ET was identified as a priority by medical schools but was not implemented due to other priorities and organisational matters.¹⁵ Studies on telehealth use was, however, explored in primary school settings in Australia.¹⁶ External support from organisations such as SFTeamed, the *Conférence des Doyens des facultés de Médecine*, ANEMF, ISNI, and the Ministry of Health may provide assistance in designing, preparing, and implementing nationally standardised and evidence-based telemedicine ET, adapted to each year of medical school and per medical speciality.

Limitations

Participation rates were a limitation in this study. A lack of priority for telemedicine ET compared with the context of multiple medical curriculum reforms in France may have influenced the low participation. Furthermore, a national database of all students and residents with accompanying contact information, did not exist at the time of the study; this should be addressed to improve the quality of national-scale studies in the future.

In conclusion, despite the very low participation rate and a possible participation bias due to the over representation of informed students, this study remains the

largest medical student and residents survey on telemedicine ET published, to date.¹⁰ This study could be conducted in all countries and for all HCPs to increase understanding of telemedicine ET.

In France, such studies could be applied in dentistry and midwifery, as the practice of tele-dentistry was similarly legally endorsed in 2009; however its adoption has remained very limited in comparison to telemedicine.¹⁷ Furthermore, the adoption of a new health law in 2019, allowing telecare practices for professionals such as nurses, pharmacists and physiotherapists may also present an opportunity for future research.¹⁸

Acknowledgements

The authors would like to thank SFTeamed (subsequently renamed the French Society of Digital Health, SFSD), ANEMF, ISNI, and all other individuals and organisations that assisted in publicising and distributing the survey. The authors would also like to thank the French Ministry of Health for their support in providing administrative data.



Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article other than their affiliation with their organisations.

Funding

The authors received no financial support for the research, authorship and/or publication of this article.

ORCID iDs

Sarina Yaghobian  <https://orcid.org/0000-0002-7307-9472>
Robin Ohannessian  <https://orcid.org/0000-0003-1999-7683>

References

1. Simon P and Williate L. The French decree on telemedicine: a guarantee for doctors. *Eur Res Telemed* 2012;1:70–75
2. Lee MS and Nambudiri V. Integrating telemedicine into training: adding value to graduate medical education through electronic consultations. *J Grad Med Educ* 2019;11:251–254.
3. O'Shea J, Berger R, Samra C, et al. Telemedicine in education: bridging the gap. *Educ Health* 2015;28:64–67.
4. Kuhn S and Jungmann F. Medizin im digitalen Zeitalter: Telemedizin in der studentischen Lehre [Medicine in the digital age: telemedicine in medical school education]. *Radiologe* 2018;58:236–240.
5. Yaghobian S, Ohannessian R, Mathieu-Fritz A, et al. National survey of telemedicine education and training in medical schools in France. *J Telemed Telecare*. Epub ahead of print 2 Jan 2019. DOI: 10.1177/1357633X18820374:1357633X18820374.

6. Blignault I and Kennedy C. Training for telemedicine. *J Telemed Telecare* 1999;5:S112–S114.
7. Scott Kruse C, Karem P, Shifflett K, et al. Evaluating barriers to adopting telemedicine worldwide: a systematic review. *J Telemed Telecare* 2018;24:4–12.
8. Ministère des Solidarités et de la Santé. Arrêté du 1er août 2018 portant approbation de l'avenant n° 6 à la convention nationale organisant les rapports entre les médecins libéraux et l'assurance maladie signée le 25 août 2016. Journal officiel de la République Française n°0183 du 10 août 2018.
9. Lehrer M, Murray S, Adler C, et al. Telemedicine education for undergraduate medical students. *Meeting of Keck School of Medicine of the University of Southern California*. Los Angeles, CA: University of Southern California, 2016.
10. Edirippulige S and Armfield NR. Education and training to support the use of clinical telehealth: a review of the literature. *J Telemed Telecare* 2017;23:273–282.
11. Demiris G. Integration of telemedicine in graduate medical informatics education. *J Am Med Inform Assoc* 2003;10:310–314.
12. Waseh S and Dicker AP. Telemedicine training in undergraduate medical education: mixed-methods review. *JMIR Med Educ* 2019;5:e12515.
13. Wang JJ, Lavigueur O, Sheridan M, et al. Implementation of a simulation-based telemedicine curriculum. *Med Educ* 2017;51:1178–1179.
14. Pathipati AS, Azad TD and Jethwani K. Telemedical education: training digital natives in telemedicine. *J Med Internet Res* 2016;18:e193.
15. Edirippulige S, Brooks P, Carati C, et al. It's important, but not important enough: eHealth as a curriculum priority in medical education in Australia. *J Telemed Telecare* 2018;24:697–702.
16. Langbecker DH, Caffery L, Taylor M, et al. Impact of school-based allied health therapy via telehealth on children's speech and language, class participation and educational outcomes. *J Telemed Telecare* 2019;25:559–565.
17. Giraudeau N, Inquimbert C, Delafoy R, et al. Teledentistry, new oral care tool for prisoners. *Int J Prison Health* 2017;13:124–134.
18. Loi n° 2019-774 du 24 juillet 2019 relative à l'organisation et à la transformation du système de santé. *JORF* n°0172 du 26 Juillet 2019, <https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000038821260&categorieLien=id> (2019, accessed 25 October 2019).

Appendix

Question topic	Question type	Other information
Questions for the self-perceived knowledge of telemedicine definitions by activity type (Table 2)	Binary questions	Types of telemedicine activity investigated were i) synchronous video teleconsultations (TLC); ii) asynchronous tele-expertise (TLE), otherwise referred to as eConsult or store and forward; iii) remote patient monitoring (TMS); iv) tele-assistance (TLA); and v) medical regulation (MR), which is a type of telemedicine activity defined as emergency triage by phone
Questions about the self-perceived knowledge of telemedicine regulations (Table 3)	Likert-scale multiple choice	Questions were categorised under I know the telemedicine regulations well, a little, or have no knowledge
Questions relating to the attitudes of medical students and residents (Table 4)	Likert-scale multiple choice	Questions were categorised under i) relevance for patient, ii) improved access to care, iii) threat to medical practice, iv) would like to practise in the future, and v) patients in favour of telemedicine
Questions on telemedicine training and practices during medical school and residency programme (Figure 1)	Binary questions	–
Satisfaction rates for telemedicine practices of medical students and residents (Figure 2)	Likert-scale multiple choice	–

(continued)

Continued.

Question topic	Question type	Other information
Rate for the use of non-secured channels for remote medical practice by medical students and residents during hospital rotations to communicate professionally with patients and/or healthcare professionals (HCPs)	Binary questions	Questions were categorised as medical student to HCP or patient, and resident to HCP or patient. Non-secured channels of remote medical practice were via telephone, text, email and video
