Records (EHR) in 2016 [35]. All these initiatives have led to an increase in the use of telemedicine in fields like follow up and monitoring of asthma patients, diabetes care, psychiatric care and other areas [36-39].

With the advent of the COVID-19 pandemic and the burdens it had put on the health care sector globally, telemedicine has proved itself in the test of time to be safer, cheaper, easily accessible and affordable. Although these benefits were hugely influenced by the availability of specialists on telemedicine platforms and the ability of patients to access such facilities. Smartphones have indeed played a crucial role in delivery of efficient healthcare and remote monitoring during the country wide lockdown, while the Indian healthcare system was being massively overwhelmed by COVID-19 cases.

It would not be wise to consider that TM can address all the existing issues. However, it can address a range of issues associated with health care. Facilities like telehealth, teleeducation and telehome healthcare are like a boon. International TM programs are bridging the distance gap between a HCP and the patient and distance is now no longer an obstacle in availing quality healthcare. However, TM has not gained the momentum which it should have. Lack of awareness and acceptance of TM by HCPs as well as patients especially the rural populaces are holding it back. The governing bodies all across the globe are now taking an ardent interest in promoting and improving TM services thereby resulting in a gradual but steady improvement in its usage. Expectantly over the ensuing years, improvement in services of TM and its subsequent utilization will reach their real potential.

Aims and objectives

Primary objective: To assess knowledge, attitude and practices regarding utilization of telemedicine among health professionals (Medical doctors, residents and interns) involved in patient care in a tertiary care rural teaching hospital in central India.

Secondary objective: To examine correlations between genders, exposure, seeming interest in future use of TM for better healthcare by health professionals (medical doctors, residents, interns) involved in patient care in a tertiary care rural teaching hospital in central India.

MATERIALS AND METHODOLOGY

Ethical considerations

This web based survey study was started after seeking approval from the institutional ethics committee of the University. IEC approval letter ref. no. IEC/2021/319.

Study population

Health professionals (medical doctors, residents, interns) involved in patient care attending a 1250 bedded rural tertiary care teaching rural hospital in central India. All the health professionals like medical doctors, residents, interns (involved in patients care) affiliated with a rural tertiary care hospital of central India were recruited to participate in this cross sectional research study. For this study, we have used the World Health Organization (WHO) definition of telemedicine as, "The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities". We focused on telemedicine as direct verbal communication, direct messaging (*e.g.* text, email), patient directed web based applications (apps) and patient provider shared web based apps.

Sample size: Sample size was calculated using formula for cross sectional study. Power of test was kept at 80%; confidence interval at 95%. The sample size was calculated as 254 participants.

Duration of study: Two months.

Selection criteria

Inclusion criteria

- Health professionals like medical doctors, residents, interns involved in care of patient attending a rural tertiary care hospital in central India.
- Health professionals willing to participate in the study.

Exclusion criteria

Following people were excluded from the study owing to differences in settings and e-usage practices.

- Private medical practitioners involved in patient care.
- Health professionals not involved in patient care.
- Nurses and technical staff members.
- Health professionals not willing to participate in the study.

Data collection

In view of the COVID-19 pandemic scenario, instead of contacting the participants personally, whatsapp messages were sent to health care professionals (medical doctors, residents, interns) involved in health care of patients till agreement responses of 255 HCPs was achieved. Health professionals (medical doctors, residents, interns) involved in health care of patients were contacted *via* whatsapp. A message was then sent providing further information about the purpose of research study in detail, along with a link to access online survey. The survey was divided into three parts, with the part one being used to electronically obtain consent to participate in the study. Part two of the survey was used to collect demographic details like age, gender, specialty and designation. Part three of the survey included the questionnaire. Data was collected in one month period and reminder alerts were sent to all participants on whatsapp. Participation in the study was kept

entirely voluntary and participants had the choice to withdraw from the study at any time during the survey period. Responses to the questionnaire were collected separately from personal information and were kept strictly confidential.

Instruments used

In this study we used a previously validated questionnaire, as an online survey for assessing knowledge, attitude and practices regarding effective implementation of Telemedicine in rural Indian population (Annexure 1). The questionnaire broadly covered three domains. First domain consisted of ten components to assess the knowledge, attitude and perception regarding utility of Telemedicine for healthcare; wherein the participant had to choose any opinion ranging from "strongly disagree," to "somewhat disagree," "no opinion," "somewhat agree" or "strongly agree." The second and third domain had ten components each to assess the benefits and barriers respectively and had to be answered as either "yes" or "no." The average time to complete the questionnaire was approximately 5-8 minutes. The entire survey was conducted on the website zohosurvery.in and tools for processing of data as well tables and graphs were obtained from same website.

Quality control

Quality control was maintained strictly throughout the duration of the study by ensuring the following quality control measures:

- We will try to adhere to the protocol.
- Early involvement of institutional research assistance unit.
- Confidentiality will be strictly maintained.
- To ensure completion of preform, reminders will be sent to all the participants.

Consent and confidentiality

The participants provided their electronic consent to participate in this study before the questionnaire. The confidentiality was strictly maintained.

Statistical analysis

The thematic analysis of qualitative data was done in two steps. Answers were first obtained from the open ended questions and then analyzed for sets of common themes among them. Frequencies of common themes were calculated into percentages. The themes were then examined for trends and distributions against different influencing factors. We used *Chi-square* test to analyses the statistical significance of differences between the groups. Quantitative data analyses were performed using STATA version 12.0 software.

OBSERVATIONS AND RESULTS

About 321 whatsapp messages were sent to health care professionals (medical doctors, residents, interns) involved in health care of patients till agreement responses of 286 HCPs was achieved. Out of these responses, 255 participants completed the questionnaire with a response rate of 89%. The participants included 32 doctors (12.5%), 105 resident doctors (41.2%) and 118 (46.2%) medical interns with 136 (53.4%) female and 119 (46.5%) males. The age of the participants ranged between 19 to 36 years with the mean age of the male participants as 23.82 ± 2.78 SD and of the female participants as 23.79 ± 1.43 SD. The doctors and PG students that willingly participated in the study were mostly from medicine and radiology department.

Responses in domain 1 of questionnaire

All the participants in the study completed the online questionnaire. First domain consisted of ten components to assess the knowledge, attitude and perception regarding utility of telemedicine for health care (Figure 1). Majority of the participants somewhat agreed that the implementation of telemedicine will help in easy access to healthcare for rural patients (60.94%), saves travel time and costs (64.06%) as well as helping save patients' time (73.44%) and expenses (60.94%) and should be implemented in all hospitals with internet facility (60.94%). Almost one third of the participants (34.38%) were neutral but less than one third (29.69%) somewhat agreed that telemedicine will be beneficial only for urban population, more than one third (37.50%) somewhat agreed telemedicine can never replace face to face consultation, while almost half of the participants (43.75%) were neutral to the reliability of telemedicine consultations. Views of the participants on the ability of telemedicine to prevent the worsening of patients' medical condition, were equally divided between somewhat agree (42.19%) and neutral (42.19%). More than half of the participants (53.13%) somewhat agreed that doctors will approve telemedicine only after its benefits have been statistically evaluated. The data examined for trends and distributions about KAP against gender has been depicted (Table 1). Overall, no significant association was observed in gender as well as level of expertise of HCPs (such as interns, PGs and doctors) regarding knowledge, attitude and practices about TM except about TM in helping the easy access of healthcare services for rural patients (Figure 1).

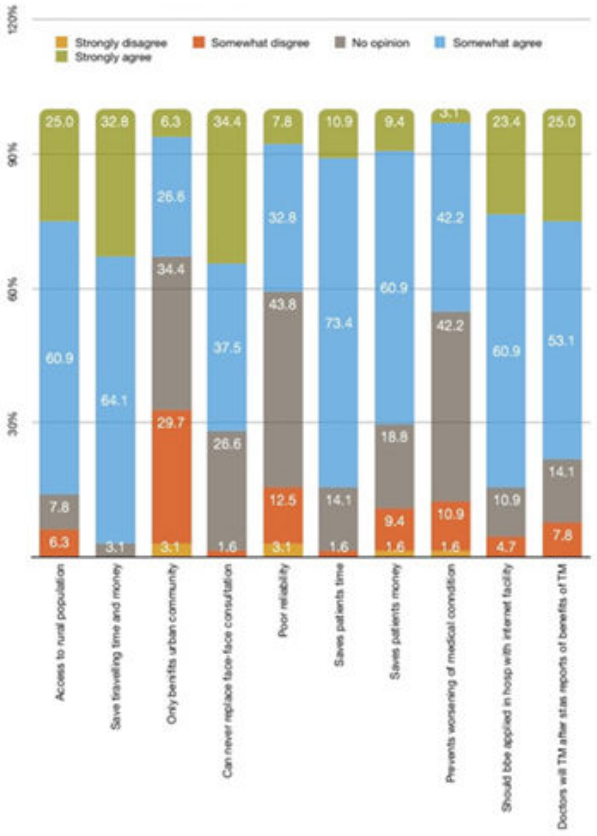

Figure 1: Knowledge attitude and practice regarding telemedicine (domain 1 of questionnaire) among HCPs in rural set up.

Table 1: Knowledge attitude and practices regarding telemedicine (domain 1 of questionnaire) among HCPs in a rural set up with regards to gender and level of expertise of HCPs.

Q. no	Questions in domain 1 of questionnaire	Participants responses					P-value Chi^2 value
		Strongly agree	Somewhat agree	No opinion	Somewhat disagree	Strongly disagree	
Q. 1	TM will help in easy access of healthcare services for rural patients	Male: 14.29% Female: 33.33%	Male: 64.29% Female: 58.33%	Male: 10.71% Female: 5.56%	Male: 10.71% Female: 2.78%	Male: 14.29% Female: 33.33%	P=0.212 Chi2=4.501
		Interns: 25.81% PGs: 25.81% Doctors: 0.71%	Interns: 64.51% PGs: 61.29% Doctors:0.00	Interns: 6.45% PGs: 3.23% Doctors:100%	Interns:6.45% PGs: 6.45% Doctors: 0	Interns: 0 PGs: 0 Doctors: 0	P=0.00 Chi2=24.59
Q. 2	TM will save travelling time and money for availing expert opinion	Male: 21.43% Female: 41.67%	Male: 71.43% Female: 58.33%	Male: 7.14% Female: 0%	Male: 0% Female: 0%	Male: 0% Female: 0%	P=0.084 Chi2=4.959
		Interns: 38.71% PGs: 29.71% Doctors: 0	Interns: 67.74% PGs: 58.06% Doctors:100%	Interns: 3.23% PGs: 3.23% Doctors: 0%	Interns: 0% PGs: 0% Doctors: 0%	Interns: 0% PGs: 0% Doctors: 0%	P=0.768 Chi2=1.827
Q. 3	TM will benefit only the urban community	Male: 3.57% Female: 8.33%	Male: 35.71% Female: 19.44%	Male: 39.29% Female: 30.56%	Male: 14.29% Female: 41.67%	Male: 7.14% Female: 0%	P=0.06 Chi2=9.039
		Interns: 12.9% PGs: 0 Doctors: 0	Interns: 25.81% PGs: 29.03% Doctors: 0	Interns: 35.48% PGs: 32.26% Doctors:50%	Interns: 22.58% PGs: 35.48% Doctors:50%	Interns: 3.23% PGs: 3.23% Doctors: 0	P=0.616 Chi2=6.281
Q. 4	TM can never replace face to face consultation	Male: 42.86% Female: 27.78%	Male: 32.14% Female: 41.67%	Male: 25% Female: 27.78%	Male: 0% Female: 2.78%	Male: 0% Female: 0%	P=0.523 Chi2=2.246
		Interns: 29.03% PGs: 38.71% Doctors: 50%	Interns: 32.26% PGs: 41.94% Doctors:50%	Interns: 29.03% PGs: 25.81% Doctors: 0	Interns: 0 PGs: 3.23% Doctors: 0	Interns: 0 PGs: 0 Doctors: 0	P=0.844 Chi2=2.715

Q. 5	Reliability of consultation by TM will be poor	Male: 7.14% Female: 8.33%	Male: 42.86% Female: 25%	Male: 39.29% Female: 47.22%	Male: 10.71% Female: 13.89%	Male: 0% Female: 5.56%	P=0.483 Chi2=3.465
		Interns: 12.90% PGs: 3.23% Doctors: 0	Interns: 25.81% PGs: 38,71% Doctors: 50%	Interns: 41,94% PGs: 45.16% Doctors: 50%	Interns: 16.13% PGs: 9.68% Doctors: 0	Interns: 3.23% PGs: 3.23% Doctors: 0	P=0.867 Chi2=3.885
Q. 6	TM will help to save patients' time	Male: 3.57% Female: 16.67	Male: 82.14% Female: 66.67	Male: 14.29% Female: 13.89%	Male: 0% Female: 2.78%	Male: 0%% Female: 0%	P=0.288 Chi2=3.762
		Interns: 12.90% PGs: 9.68% Doctors: 0	Interns: 70.97% PGs: 77.42% Doctors: 50%	Interns: 12.90% PGs: 12.90% Doctors: 50%	Interns: 3.23% PGs: 00% Doctors: 00%	Interns: 00% PGs: 00% Doctors: 0%	P=0.734 Chi2=3.576
Q. 7	TM will help to save patients' money	Male: 3.57% Female: 13.89%	Male: 60.71% Female: 61.11%	Male: 25% Female: 13.89	Male: 7.14% Female: 11.11%	Male: 3.57% Female: 0%	P=0.357 Chi2=4.376
		Interns: 9.68% PGs: 9.68% Doctors: 0	Interns: 61.29% PGs: 61.29% Doctors:50%	Interns: 12.58% PGs: 16.13% Doctors: 0	Interns: 12.90% PGs: 3.23% Doctors: 50%	Interns: 3.23% PGs: 0% Doctors: 0%	P=0.514 Chi2=7.212
Q. 8	TM prevents from worsening of the medical condition of the patient	Male: 0% Female: 5.56%	Male: 28.57% Female: 52.78%	Male: 57.14% Female: 30.56%	Male: 10.71% Female: 11.11%	Male: 3.57% Female: 0%	P=0.104 Chi2=7.670
		Interns: 6.45% PGs: 0 Doctors: 0	Interns: 58.06% PGs: 29.03% Doctors: 0	Interns: 25.81% PGs: 54.84% Doctors:100%	Interns: 6.45% PGs: 16.13% Doctors: 0	Interns: 3.23% PGs: 0 Doctors: 0	P=0.097 Chi2=13.446
Q. 9	TM should be applied in all the hospitals equipped with internet facility	Male: 17.86% Female: 27.78%	Male: 57.14% Female: 63.89%	Male: 21.43% Female: 2.78%	Male: 3.57% Female: 5.56%	Male: 0% Female: 0%	P=0.116 Chi2=5.920
		Interns: 29.03% PGs: 19.35% Doctors: 0	Interns: 54.84% PGs: 67.74% Doctors:50%	Interns: 12.90% PGs: 6.45% Doctors:50%	Interns: 3.23% PGs: 6.45% Doctors: 0%	Interns: 0 PGs: 0 Doctors: 0	P=0.484 Chi2=5.478
Q. 10	Doctors will approve of telemedicine only after getting the statistical reports of the benefits of TM	Male: 21.43% Female: 27.78%	Male: 57.14% Female: 50%	Male: 14.29% Female: 13.89%	Male: 7.14% Female: 8.33%	Male: 0% Female: 0%	P=0.933 Chi2=0.435
		Interns: 25.81% PGs: 25.81% Doctors: 0	Interns: 51.61% PGs: 54.84% Doctors:50%	Interns: 19.35% PGs: 9.68% Doctors: 0	Interns: 3.23% PGs: 9.68% Doctors:50%	Interns: 0 PGs: 0 Doctors: 0	P=0.285 Chi2=7.401

Responses in domain 2 of questionnaire

The second domain had ten components to assess the benefits and had to be answered as either “yes” or “no.” Figure 2 clearly outlines that the benefits of telemedicine that can be availed even at rural centers, although there are some limitations (Figure 2). Most of the participants acknowledge the use of telemedicine as helpful in obtaining laboratory results via internet (96.88%), helping in transmission of medical data like x-rays (96.88%), providing health education (96.88%), video consultations between healthcare professionals (95.31%), getting second opinions (95.31%), making outpatients appointments online (93.75%) and referring patients to tertiary care centers (90.63%). However, a lesser percentage agreed that telemedicine is useful in rural areas for monitoring and follow-ups of patient at home (84.38%), teleconferencing via telephone (76.56%) and for pre-operative services (67.19%).

The data examined for trends and distributions about benefits of telemedicine as perceived by HCPs against gender and level of expertise of HCPs has been depicted (Table 2). Overall, no significant association was observed in gender as well as level of expertise (HCPs such as interns, PGs and doctors) regarding benefits of TM in health care (Figure 2).

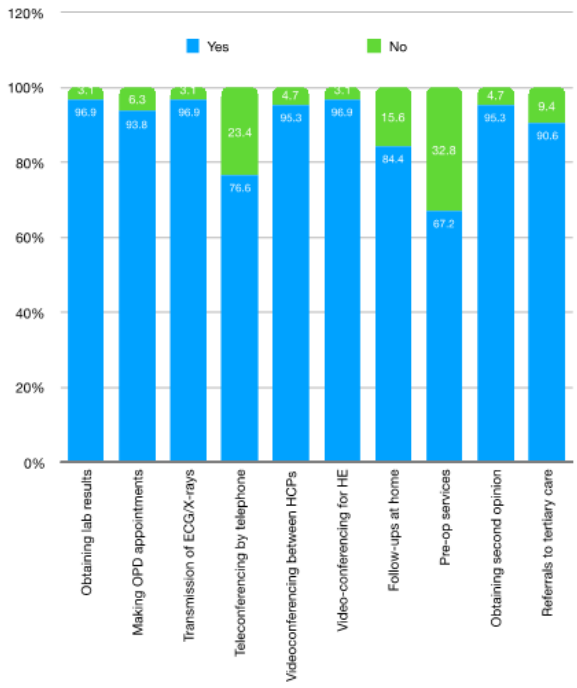

Figure 2: Responses regarding benefits of telemedicine (domain 2 of questionnaire) among HCPs in rural set up.

Table 2: Responses regarding benefits of telemedicine (domain 2 of questionnaire) among HCPs in a rural set up with regards to gender and level of expertise of HCPs.

Q. no	Questions in domain 2 of questionnaire	Responses		P-value Chi^2 value
		Yes (%)	No (%)	
Q. 11	Obtaining laboratory results via internet	Male: 100 Female: 94.44	Male: 0 Female: 5.56	P=0.205 Chi2=1.605
		Interns: 100 PGs: 93.55 Doctors:100	Interns: 0 PGs: 6.45 Doctors: 0	P=0.333 Chi2=2.197
Q. 12	Making outpatient appointments using internet	Male: 89.29 Female: 97.22	Male: 10.71 Female: 2.78	P=0.193 Chi2=1.693
		Interns: 93.55 PGs: 93.55 Doctors:100	Interns: 6.45 PGs: 6.45 Doctors: 0	P=0.933 Chi2=0.137
Q. 13	Transmission of electrocardiograms, x-rays, still images	Male: 100 Female: 94.44	Male: 0 Female: 5.56	P=0.205 Chi2=1.605
		Interns: 96.77 PGs: 96.77 Doctors: 100	Interns: 3.23 PGs: 3.23 Doctors: 0	P=0.967 Chi2=0.066
Q. 14	Teleconferencing with patients by telephone	Male: 67.86 Female: 83.33	Male: 32.14 Female: 16.67	P=0.147 Chi2=2.102
		Interns: 83.87 PGs: 70.97 Doctors:50	Interns: 16.13 PGs: 29.03 Doctors:50	P=0.325 Chi2=2.249
Q. 15	Videoconferencing of a consultation between health care professionals	Male: 92.86 Female: 97.22	Male: 7.14 Female: 2.78	P=0.412 Chi2=0.671
		Interns: 93.55 PGs: 97.66 Doctors:100	Interns: 6.45 PGs: 3.23 Doctors: 0	P=0.794 Chi2=0.462
Q. 16	Videoconferencing a meeting for health education	Male: 96.43 Female: 97.22	Male: 3.57 Female: 2.78	P=0.856 Chi2=0.032

		Interns: 96.77 PGs: 96.77 Doctors:100	Interns: 3.23 PGs: 3.23 Doctors: 0	P=0.967 Chi2=0.0666
Q. 17	Monitoring patient at home (follow up)	Male: 85.71 Female: 83.33	Male: 14.29 Female: 16.67	P=0.795 Chi2=0.0670
		Interns: 87.10 PGs: 80.65 Doctors: 0	Interns: 19.35 PGs: 12.90 Doctors: 0	P=0.647 Chi2=0.871
Q. 18	Preoperative services	Male: 64.29 Female: 69.44	Male: 35.71 Female: 30.56	P=0.663 Chi2=0.190
		Interns: 74.19 PGs: 58.06 Doctors:100	Interns: 25.81 PGs: 41.94 Doctors: 0	P=0.242 Chi2=2.837
Q. 19	Obtaining second opinion	Male: 92.86 Female: 97.22	Male: 7.14 Female: 2.78	P=0.412 Chi2=0.671
		Interns: 96.77 PGs: 93.55 Doctors:100	Interns: 3.23 PGs: 6.45 Doctors: 0	P=0.794 Chi2=0.462
Q. 20	Referrals of patients to tertiary Care Centers	Male: 89.29 Female: 91.67	Male:10.71 Female: 8.33	P=0.746 Chi2=0.105
		Interns: 93.55 PGs: 87.10 Doctors: 100	Interns: 6.45 PGs: 12.97 Doctors: 0	P=0.615 Chi2=0.973

Responses in domain 3 of questionnaire

The third domain had ten components to assess the barriers and had to be answered as either “yes” or “no” (Figure 2). It delineates the participants’ opinion on barriers faced in implementation of telemedicine in rural areas. Majority candidates asserted that the biggest hurdle in telemedicine practice in rural areas is the legal responsibility (88.14%) that entails its use, followed by the loss of effective communication between the doctors and patients due to distance (86.44%) and the lack of suitable training for equipment use (83.05%). More than three fourth of the participants considered the lack of consultation between IT experts and doctors (79.66%), lack of perceived clinical usefulness (76.27%), lack of user friendly software (72.88%), negative attitude of staff (72.88%) and concerns regarding patients’ privacy (71.19%) as other potential obstacles in the success of telemedicine in rural areas. Only two third of the participants viewed perceived increase in workload (66.10%) while using telemedicine as a barrier. Around half of the responses concluded that the high cost of equipment (59.32%) is yet a barrier in developing successful telemedicine models for rural India. The data examined for trends and distributions about barriers to effective use of telemedicine as perceived by HCPs against gender and level of expertise of HCPs has been depicted (Table 3). Overall, no significant association was observed in gender as well as level of expertise (HCPs such as interns, PGs and doctors) regarding barriers in using of TM in health care (Figure 3).

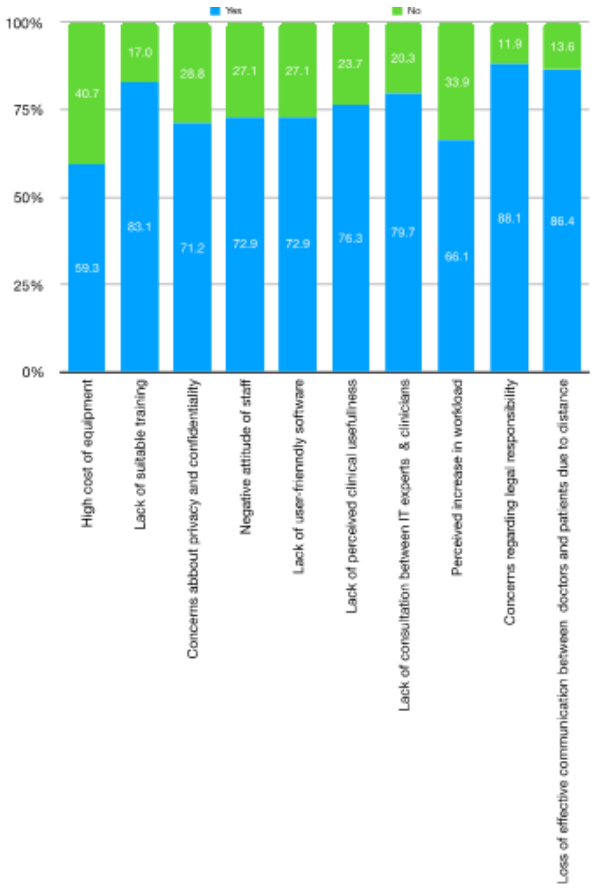

Figure 3: Responses regarding benefits of telemedicine (domain 3 of questionnaire) among HCPs in rural set up.

Table 3: Responses regarding barriers to the use of telemedicine (domain 3 of questionnaire) among HCPs in a rural set up with regards to gender and level of expertise of HCPs.

Q. no	Questions in domain 3 of questionnaire	Responses to questions		P-value *Chi*^{2} value
		Yes (%)	No (%)	
Q. 21	High cost of equipment	Male: 53.85 Female: 63.64	Male: 46.15 Female: 36.36	P=0.447 *Chi*2=0.577
		Interns: 53.57 PGs: 68.97 Doctors: 0	Interns: 46.43 PGs: 31.03 Doctors: 100	P=0.110 *Chi*2=4.418
Q. 22	Lack of suitable training in the use of equipment	Male: 80.77 Female: 84.85	Male: 19.23 Female: 15.15	P=0.678 *Chi*2=0.171
		Interns: 78.57 PGs: 86.21 Doctors:100	Interns: 21.43 PGs: 13.79 Doctors: 0	P=0.603 *Chi*2=1.012
Q. 23	Concerns about patient privacy and confidentiality	Male: 69.23 Female: 72.73	Male: 30.77 Female: 27.27	P=0.768 *Chi*2=0.086
		Interns: 67.86 PGs: 72.41 Doctors: 100	Interns: 32.14 PGs: 27.59 Doctors: 0	P=0.612 *Chi*2=0.982
Q. 24	Negative attitude of staff involved	Male: 69.23 Female: 75.76	Male: 30.77 Female: 24.24	P=0.576 *Chi*2=0.313
		Interns: 78.57 PGs: 72.41 Doctors: 0	Interns: 21.43 PGs: 27.59 Doctors:100	P=0.054 *Chi*2=5.836
Q. 25	Lack of user friendly software	Male: 69.23 Female: 75.76	Male: 30.77 Female: 24.24	P=0.576 *Chi*2=0.313
		Interns: 78.57 PGs: 68.97 Doctors:50	Interns: 21.43 PGs: 31.03 Doctors:50	P=0.545 *Chi*2=1.213
Q. 26	Lack of perceived clinical usefulness	Male: 73.08 Female:78.79	Male: 26.92 Female: 21.21	P=0.609 *Chi*2=0.262
		Interns: 75 PGs: 79.31 Doctors:50	Interns: 25 PGs: 20.69 Doctors:50	P=0.626 *Chi*2=0.935
Q. 27	Lack of consultation between information technology experts and clinicians	Male: 80.77 Female: 78.79	Male: 19.23 Female: 21.21	P=0.851 *Chi*2=0.035
		Interns: 82.14 PGs: 79.31 Doctors:50	Interns: 17.86 PGs: 20.69 Doctors: 50	P=0.550 *Chi*2=1.194
Q. 28	Perceived increase in workload	Male: 69.23 Female: 63.64	Male: 30.77 Female: 36.36	P=0.652 *Chi*2=0.2031
		Interns: 67.86 PGs: 68.97 Doctors: 0	Interns: 32.14 PGs: 31.03 Doctors: 100	P=0.132 *Chi*2=4.044
Q. 29	Concerns regarding legal responsibility	Male: 84.62 Female: 90.91	Male: 15.38 Female: 9.09	P=0.458 *Chi*2=0.551

		Interns: 92.86	Interns: 7.14	P=0.434
		PGs: 82.76	PGs: 17.24	*Chi*2=1.668
		Doctors: 100	Doctors: 0	
Q. 30	Concerns regarding loss of effective communication between the doctors and patients due to distance between the two	Male: 88.46	Male: 11.54	P=0.687
		Female: 84.85	Female: 15.15	*Chi*2=0.162
		Interns: 89.29	Interns: 10.71	P=0.292
		PGs: 86.21	PGs: 13.79	*Chi*2=2.46
		Doctors: 50	Doctors: 50	

DISCUSSION

This study assessed the knowledge, attitude and practices regarding utilization of TM among HCPs (medical doctors, residents, interns) involved in patient care in a tertiary care rural teaching hospital in central India and observed that though the HCPs perceived that telemedicine has a lot of utilities and benefits but also several barriers that limits its use in resource poor settings.

Telemedicine being a relatively new intervention methodology needs tremendous amounts of research and statistical analysis to be effectively applied in resource poor settings. Success of any implementation model largely depends on the input costs, electronic infrastructure, patient awareness and quality of service. Global and national initiatives along with appropriate execution models can enormously escalate the standards of healthcare in low income population using telemedicine. Recent technological advances in the development of telemedicine in developing countries seem promising. The declining costs of electronic gadgets, increasing computing speeds, high speed internet band width, the falling costs of digital storage and storage options, all have cumulatively driven telemedicine to its widespread use today. Cost effectiveness studies have showed that TM can cut the cost, but not all. Lack of randomized control trials and paucity of quality data limit the economic evaluations of TM.

Telemedicine helps rural health centers to provide quality health services at lower costs, which helps rural patients by reducing cost travel to access specialty health care services.

Infrastructure plays a crucial role in realizing the true potentials of any healthcare service. Telemedicine heavily relies on the ICT infrastructure available in different regions and the level of communicability between them. Unfortunately, in most developing countries infrastructure is not adequate enough to utilize most recent technologies. Coupled with this is the limited penetration of computers or other electronic devices into the remote locations, significantly impacting the adoption of TM in such areas. In India, the problem of unstable electric power supply, lack of high speed internet connectivity beyond metropolitan cities and tropical climate are other unfavorable factors which impose further limitations in designing efficient telemedicine models for rural India. Internet congestion can cause a delay in receipt of images or poor resolution of images that may hinder diagnosis and treatment thereof. Slow bandwidth can restrict effective video conference. At places where basic infrastructure exists, there is a lack of inter-operability standards for software and equipment or possibility of computer system failure [40].

Due to the impact of COVID-19 pandemic, there has been an unprecedented increase in the use of TM in almost all of the medical specialties [41,42]. Telehealth rose as a fore most mode of delivering health care services during the COVID-19 pandemic, when patients as well as healthcare providers tried to decrease person to person contact through routine visits. To increase an access to TM and augment flexibility of HCPs, laws, compensation strategies and protocols were momentarily altered through emergency regulations. There are chances that these regulations might become permanent. Assessment of the knowledge and usage of TM will aid in drafting appropriate policy sanctions for enhancing effective and efficient TM use in a rural setup.

The study has several strengths as well as limitations. This study adds to the limited and inconclusive evidence base on knowledge, attitude and practices regarding usage of TM for accessing healthcare, especially in an Indian rural setup. The participants comprised doctors, PG students as well as interns. However; due to time restrictions, wide variety of HCPs such as nurses, private practitioners, dentists, physiotherapists, etc. were not included. This study can be replicated on a larger scale with variety of HCPs involved in providing health care to the patients.

Further investigation of the knowledge, ease of access and cost of utilization of TM would help to deliver tailor made policy recommendations for Indian requirements thus enhancing effective and efficient use of TM in rural health care setup. Quality randomized controlled trials with adequate sample sizes are required to address the knowledge gap regarding use of TM in rural setups.

CONCLUSION

This study assessed the knowledge, attitude and practices regarding utilization of TM among HCPs (Medical doctors, residents, interns) involved in patient care in a tertiary care rural teaching hospital in central India and observed that though the HCPs perceived that

TM has a lot of utilities and benefits, it has several barriers that limits its use in resource poor settings.

TM can help in providing better health care services to the patients residing in rural areas However, proper access to these patients needs to be ensured. Results of this study can help in designing and implementing future strategies aimed at improving the utilization of TM practices among HCPs in a rural hospital.

SUMMARY

Telemedicine (TM) is referred to as 'healing at a distance'. It can play a pivotal role in improving people live through healthcare delivery, diagnosis of diseases; follow up, transmission of medical data research and training of the Health Care Professionals (HCPs). However, people residing in remote areas all across the globe usually have poor access to quality healthcare and TM has the potential to bridge this distance and facilitate healthcare in these remote areas. Despite the ever increasing usage of ICT for innumerable purposes, the precise know how and application of TM for health care services is limited. Hence, we conducted this study to assess Knowledge, attitude and practice regarding TM among HCPs in treating patient attending a rural tertiary care hospital in central India.

This cross sectional study was started after seeking approval from the IEC. Health professionals (Medical doctors, residents, interns) involved in patient care participated in study. The participants were contacted via whatsapp. They were informed about the nature and purpose of research study and were requested to fill the online questionnaire. The entire survey was conducted on the website zohosurvery.in. The questionnaire broadly covered three domains, each with 10 questions. First domain consisted of ten components to assess the knowledge, attitude and perception regarding utility of Telemedicine for healthcare. The second and third domain had ten components each to assess the benefits and barriers respectively. Answers were analyzed for sets of common themes among them. Frequencies of common themes were calculated into percentages. The themes were then examined for trends and distributions against different influencing factors.

A total of 255 HCPs comprising of 32 doctors (12.5%), 105 residents (41.2%) and 118 (46.2%) medical interns with 136 (53.4%) female and 119 (46.5%) males. The age of the participants ranged between 19 to 36 years. It was observed that though the HCPs perceived that telemedicine has a lot of utilities and benefits, it has several barriers that limits its use inn resource poor settings.

Telemedicine being a relatively new intervention methodology needs tremendous amounts of research and statistical analysis to be effectively applied in resource poor settings. Success of any implementation model largely depends on the input costs, electronic infrastructure, patient awareness and quality of service. Due to the impact of COVID-19 pandemic, there has been an unprecedented increase in the use of TM in almost all of the medical specialties. Telehealth rose as a fore most mode of delivering health care services during the COVID-19 pandemic, when patients as well as health care providers tried to decrease person to person contact through routine visits. Further investigation of the knowledge, ease of access and cost of utilization of TM would help to delivery policy tailor made recommendations for Indian requirements for enhancing effective and efficient use of TM in rural health care set up.

The study found that though the HCPs perceived that TM has a lot of utilities and benefits, it has several barriers that limits its use in resource-poor settings.

REFERENCES

1. Dasgupta A, Deb S. Telemedicine: A new horizon in public health in India. Indian J Community Med Off Publ Indian Assoc Prev Soc Med 2008; 33:3–8.
2. Katzmarzyk PT, Mason C. The physical activity transition. J Phys Act Health 2009; 6:269–280.
3. Lucas H. Information and communications technology for future health systems in developing countries. Soc Sci Med 2008; 66:2122–2132.
4. World Health Organisation (WHO). Telemedicine: Opportunities and Developments in Member States: Report on the Second Global Survey on eHealth. Global Observatory for eHealth Series 2009; 2.
5. Nemecek R, Huber P, Schur S, et al. Telemedically augment palliative care. Wien Klin Wochenschr 2019; 131:620–626.
6. Pfaeffli Dale L, Whittaker R, Jiang Y, et al. Text message and internet support for coronary heart disease self-management: Results from the Text 4 Heart randomized controlled trial. J Med Internet Res 2015; 17:e237.
7. Thabrew H, Stasiak K, Hetrick SE, et al. E-health interventions for anxiety and depression in children and adolescents with long-term physical conditions. Cochrane Database Syst Rev 2018; 8:CD012489.
8. Nair U, Armfield NR, Chatfield MD, et al. The effectiveness of telemedicine interventions to address maternal depression: A systematic review and meta-analysis. J Telemed Telecare 2018; 24:639–650.
9. Sproch LE, Anderson KP. Clinician delivered teletherapy for eating disorders. Psychiatr Clin North Am 2019; 42:243–252.
10. Anderson KE, Byrne CE, Crosby RD, et al. Utilizing telehealth to deliver family based treatment for adolescent anorexia nervosa. Int J Eat Disord 2017; 50:1235–1238.
11. Prior AL, Woodward D, Hoefkens T, et al. Telephone helplines as a source of support for eating disorders: Service user, career and health professional perspectives. Eat Disord 2018; 26:164-184.

12. Huskamp HA, Busch AB, Souza J, et al. How is telemedicine being used in opioid and other substance use disorder treatment? Health Aff Proj Hope 2018; 37:1940–1947.
13. Barash D. Telemedicine in substance use disorder treatment. Health Aff 2019; 38:331.
14. Lin LA, Casteel D, Shigekawa E, et al. Telemedicine delivered treatment interventions for substance use disorders: A systematic review. J Subst Abuse Treat 2019; 101:38–49.
15. Molfenter T, Brown R, O'Neill A, et al. Use of telemedicine in addiction treatment: Current practices and organizational implementation characteristics. Int J Telemed Appl 2018; 2018:3932643.
16. Chellaiyan VG, Nirupama AY, Taneja N. Telemedicine in India: Where do we stand? J Fam Med Prim Care 2019; 8:1872–1876.
17. World Health Organization (WHO). Telemedicine: Opportunities and developments in member states: Report on the second global survey on e-Health. Geneva, Switzerland, 2009.
18. Bohr A, Memarzadeh K. The rise of artificial intelligence in healthcare applications. Elsevier 2020; 25–60.
19. Hamet P, Tremblay J. Artificial intelligence in medicine. Metabolism 2017; 69:S36–S40.
20. Handelman GS, Kok HK, Chandra RV, et al. eDoctor: Machine learning and the future of medicine. J Intern Med 2018; 284:603–619.
21. Deo RC. Machine learning in medicine. Circulation 2015; 132:1920–1930.
22. Chan HP, Samala RK, Hadjiiski LM, et al. Deep learning in medical image analysis. Adv Exp Med Biol 2020; 1213:3–21.
23. Bizopoulos P, Koutsouris D. Deep learning in cardiology. IEEE Rev Biomed Eng 2019; 12:168–193.
24. Singh RP, Javaid M, Haleem A, et al. Internet of Things (IOT) applications to fight against COVID-19 pandemic. Diabetes Metab Syndr 2020; 14:521–524.
25. Kelly JT, Campbell KL, Gong E, et al. The internet of things: Impact and implications for health care delivery. J Med Internet Res 2020; 22:e20135.
26. Baatar T, Suldsuren N, Bayanbileg S, et al. Telemedicine support of maternal and newborn health to remote provinces of Mongolia. Stud Health Technol Inform 2012; 182:27–35.
27. Portillo B, Garcia-Cervigon P, Figueras P, et al. Telemedicine, prison and illness associated with HIV. Rev Espanola Quimioter Publicacion of Soc Espanola Quimioter 2019; 32:539–544.
28. Omboni S, Caserini M, Coronetti C. Telemedicine and M-health in hypertension management: Technologies, applications and clinical evidence. High Blood Press Cardiovasc Prev Off J Ital Soc Hypertens 2016; 23:187–196.
29. Augusterfer EF, O'Neal CR, Martin SW, et al. The role of telemental health, teleconsultation and telesupervision in post disaster and low resource settings. Curr Psychiatry Rep 2020; 22:85.
30. Le T, Toscani M, Colaizzi J. Telepharmacy: A new paradigm for our profession. JPharm Pract 2020; 33:176–182.
31. Fatehi F, Jahedi F, Kanagasingam Y, et al. Teleophthalmology for the elderly population: A review of the literature. Int J Med Inf 2020; 136:104089.
32. Grisolia ABD, Abalem MF, Lu Y, et al. Teleophthalmology: Where are we now? Arq Bras Oftalmol 2017; 80:401–406.
33. Hanna TN, Steenburg SD, Rosenkrantz AB, et al. Emerging challenges and opportunities in the evolution of teleradiology. AJR Am J Roentgenol 2020; 215:1411–1416.
34. Bradley WG. Teleradiology. Neuroimaging Clin N Am 2012; 22:511–517.
35. Ministry of Health and Family Welfare (MOHFW). Electronic Health Records (EHR) standards for India. Department of Health and Family Welfare. 2016.
36. Jain S, Thakur C, Kumar P, et al. Telemedicine for asthma follow up in children during COVID-19 pandemic. Indian J Pediatr 2021; 88:1050.
37. Ghosh A, Gupta R, Misra A. Telemedicine for diabetes care in India during COVID-19 pandemic and national lockdown period: Guidelines for physicians. Diabetes Metab Syndr 2020; 14:273–276.
38. Ramalho R, Adiukwu F, Gashi Bytyci D, et al. Telepsychiatry and healthcare access inequities during the COVID-19 pandemic. Asian J Psychiatry 2020; 53:102234.
39. Ateriya N, Saraf A, Meshram VP, et al. Telemedicine and virtual consultation: The Indian perspective. Natl Med J India 2018; 31:215–218.
40. Combi C, Pozzani G, Pozzi G. Telemedicine for developing countries. Appl Clin Inform 2016; 7:1025–1050.
41. Lukas H, Xu C, Yu Y, et al. Emerging telemedicine tools for remote COVID-19 diagnosing, monitoring and management. ACS Nano 2020; 14:16180–16193.
42. Colbert GB, Venegas Vera AV, et al. Utility of telemedicine in the COVID-19 era. Rev Cardiovasc Med 2020; 21:583–587.