

به نام خداوند جان و خرد

کزین برتر اندیشه برنگذرد

Tele-Health

Mehdi Aarabi MD

Golestan University of Medical Sciences

Day 1401

Health

Good health of a population is synonymous with
equality of access to healthcare.

**Good health is fundamental for economic
development**



Evidence Based Telemedicine

- **84 years ago**, merchant mariners were treated by remote consultation delivered over “short waves”.
- VHF,
- INMARSAT based satellite communications etc.,

Anogianakis, G., Maglavera, S., Pomportsis, A., Bountzioukas, S., Beltrame, F. And Orsi, G.: Medical emergency aid through telematics: design, implementation guidelines and analysis of user requirements for the MERMAID project. Stud Health Technol Inform (1997) 43 Pt A: 74-8.

Anogianakis, G., Maglavera, S. and Pomportsis, A.: Relief for maritime medical emergencies through telematics. IEEE Trans Inf Technol Biomed (1998) 2:254-60.



Telehealth

Use of information and telecommunications technology in health care delivery for a specific patient involving a provider across distance or time.



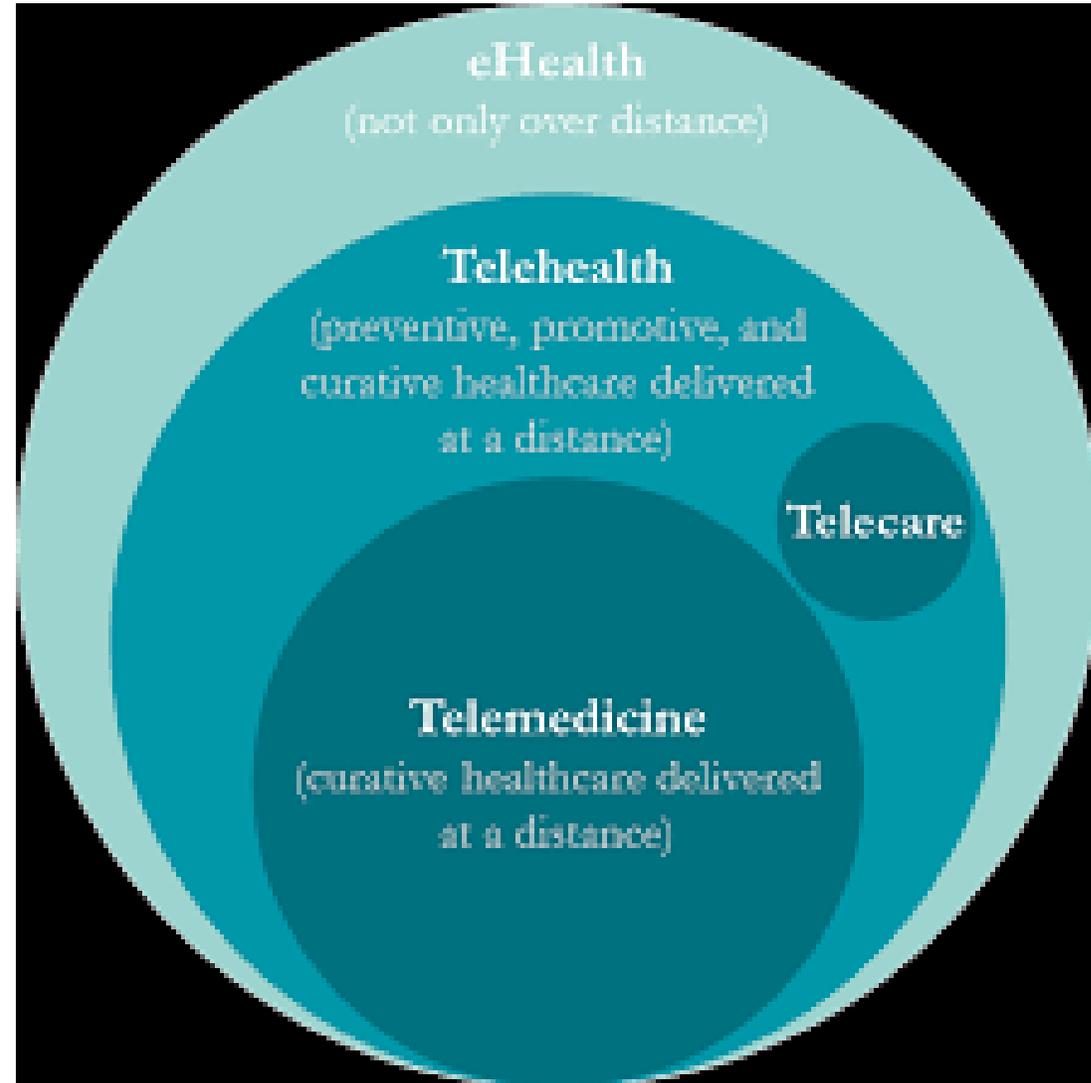
Totten AM, Womack DM, Eden KB, et al. Telehealth: Mapping the Evidence for Patient Outcomes From Systematic Reviews [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2016 Jun. (Technical Briefs, No. 26.) Available from: <https://www.ncbi.nlm.nih.gov/books/NBK379320/>

Telehealth

Preventive,
Promotive,
& Curative

Health care

delivered at a
distance.



Telehealth

van Dyk L.

A review of telehealth
service implementation
frameworks.

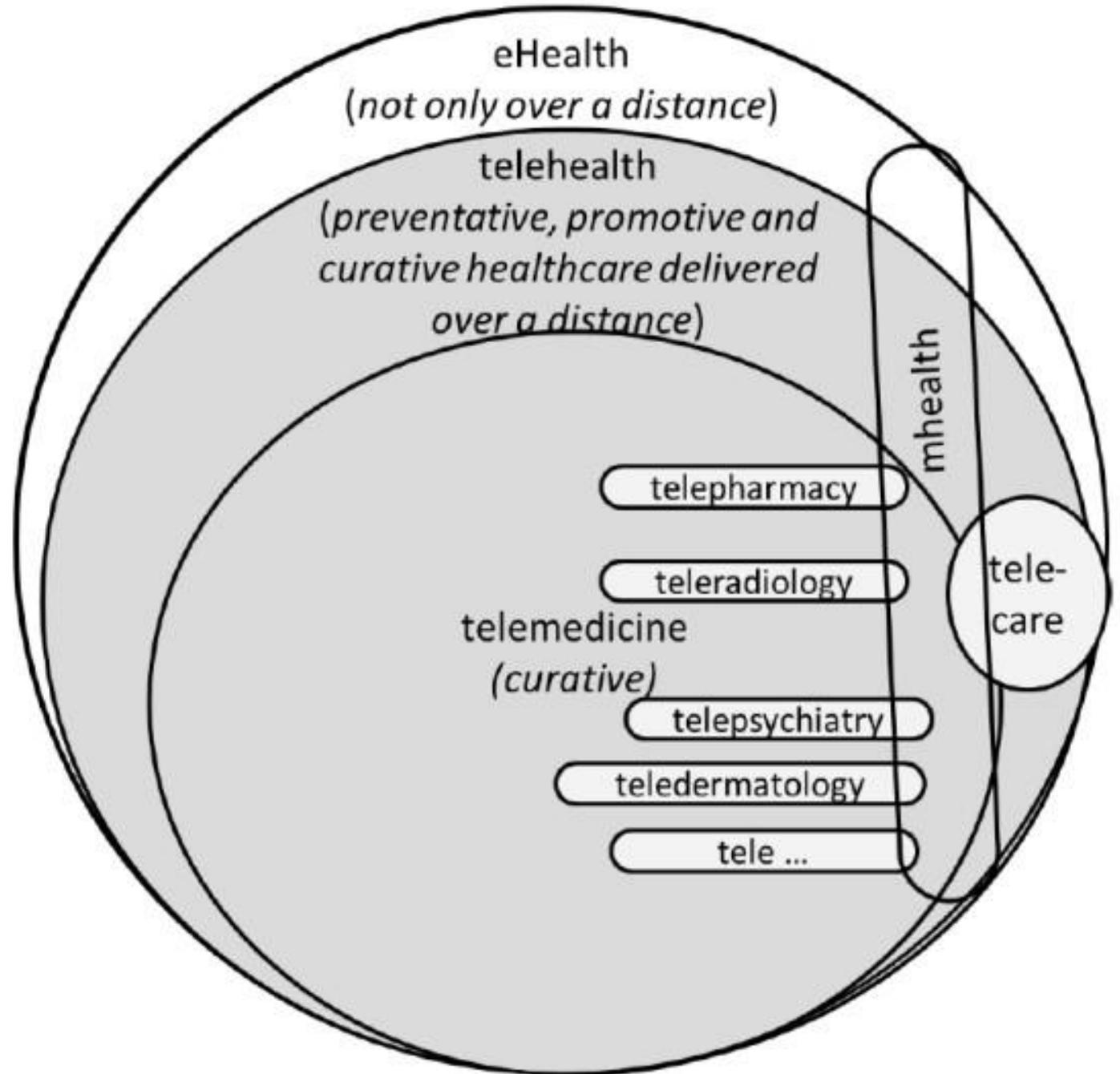
Int J Environ Res Public
Health.

2014 Jan 23;11(2):1279-98.

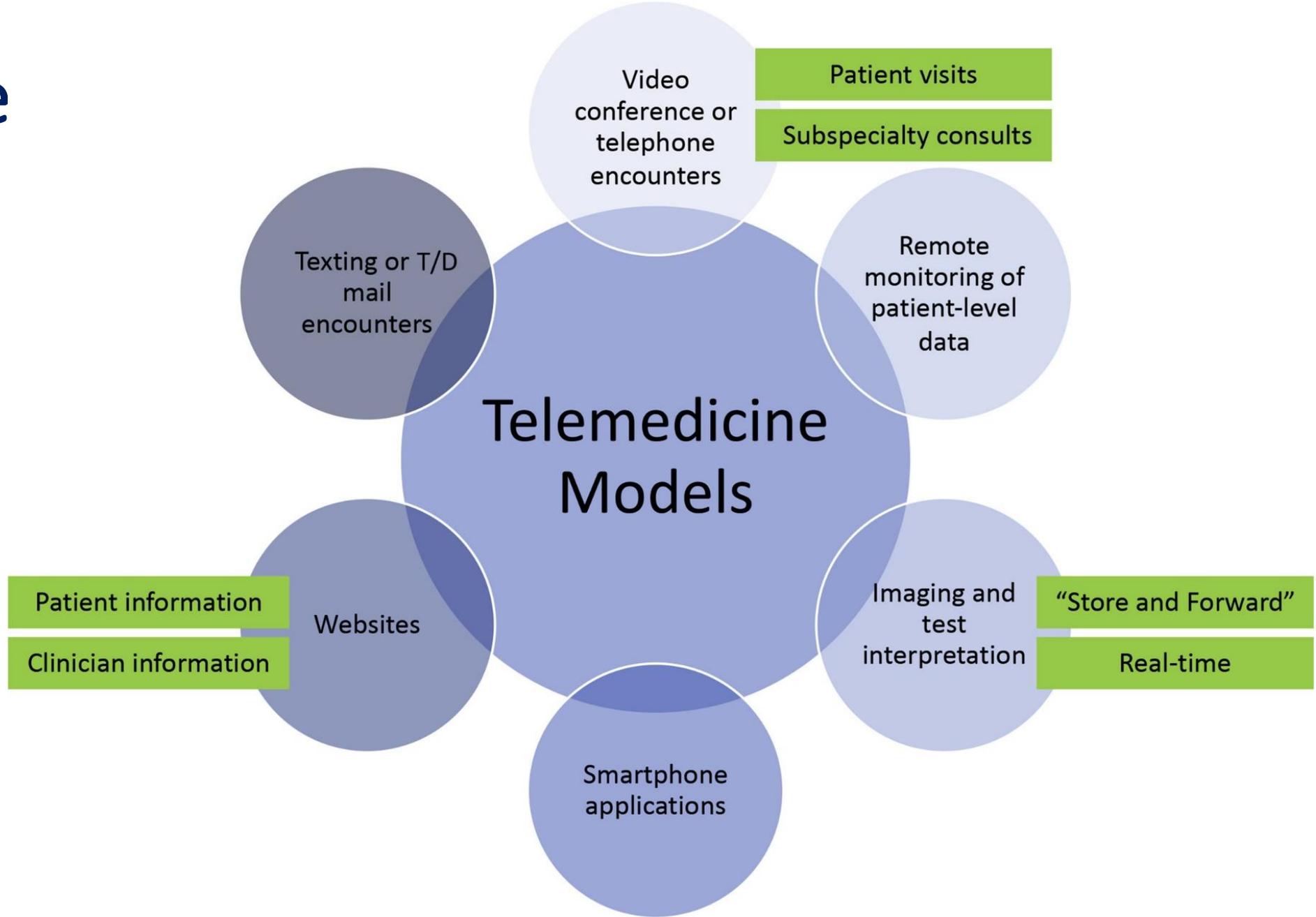
doi:

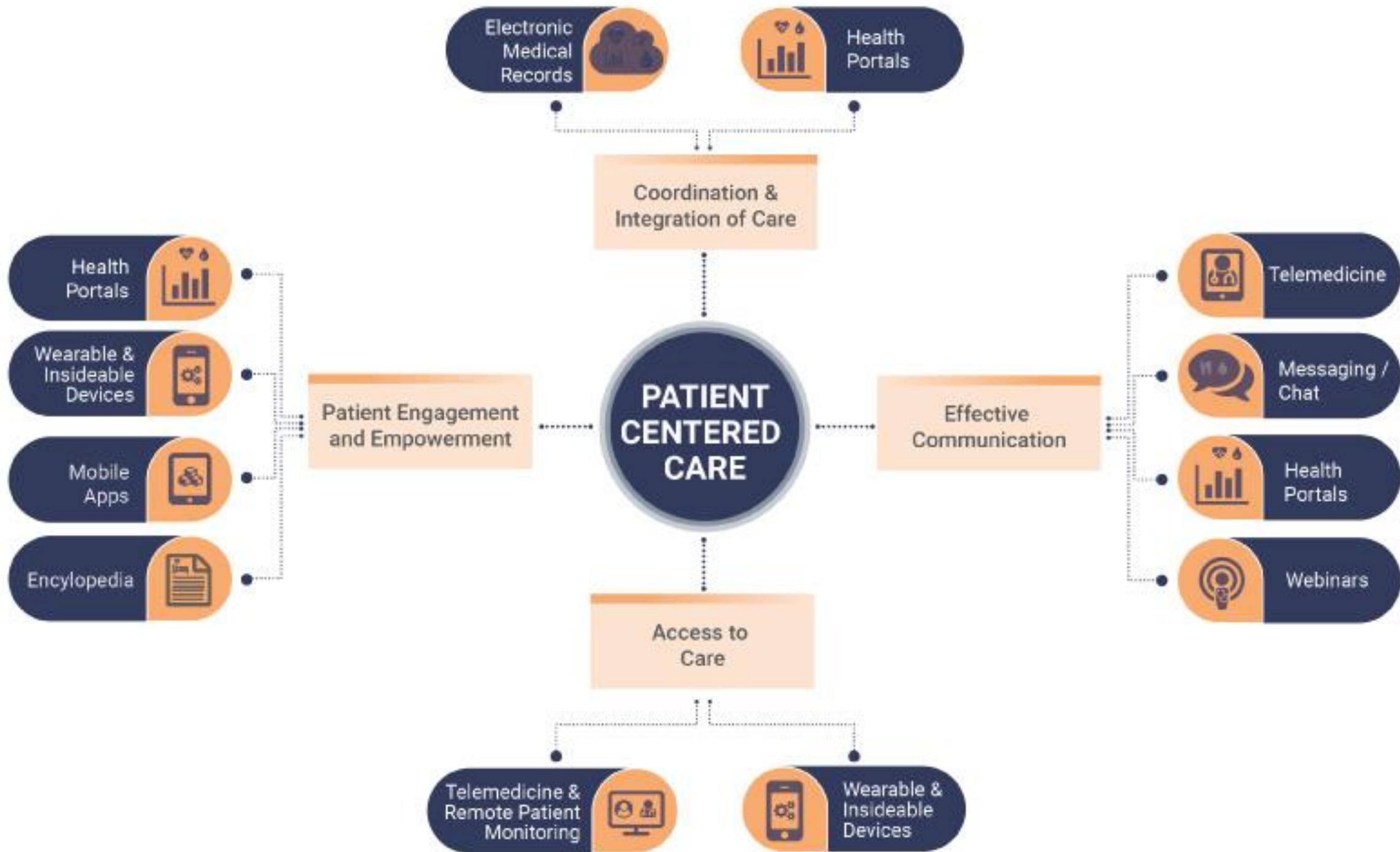
10.3390/ijerph110201279.

PMID: 24464237.



Telemedicine





Telehealth

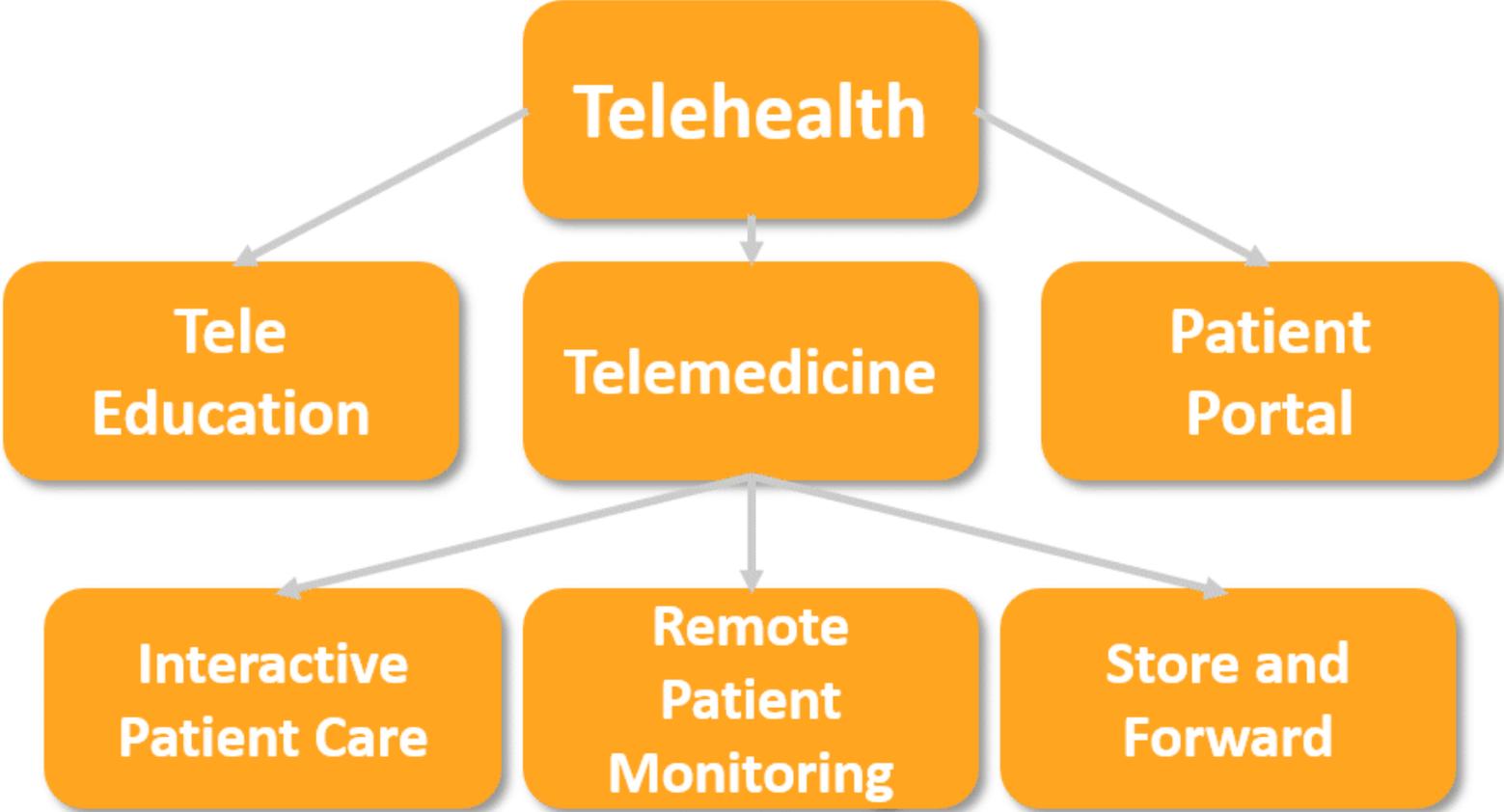
Potential to **improve access** to care for specific patient populations of particular concern, including

- people living in **rural areas**
- those with **transportation barriers**
- those facing **provider shortages**



Telehealth

A Telehealth Taxonomy



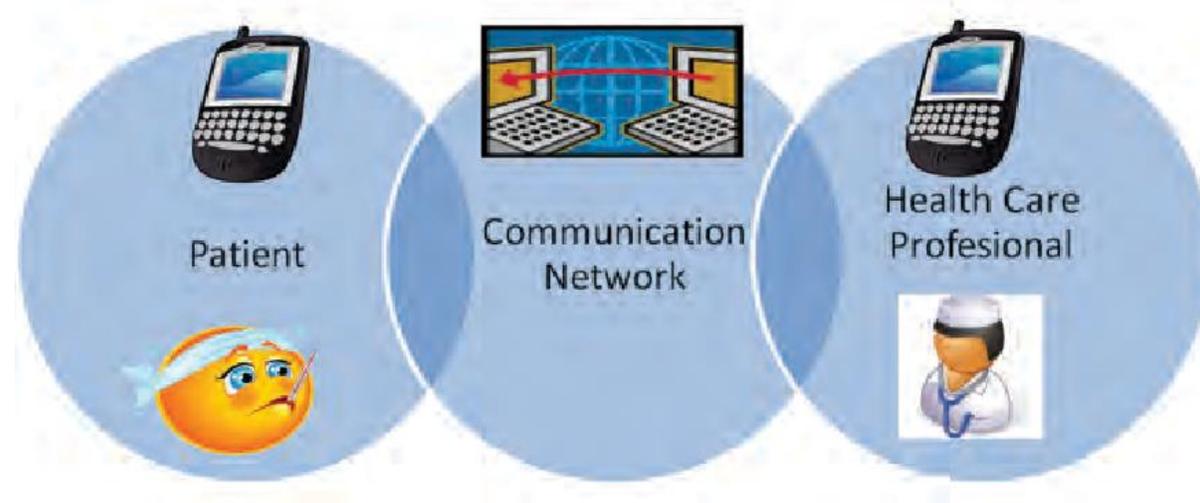
Virtual Communities in Health Care

- The utilization of advanced technologies enabling interactions and exchange of information between members who may not physically meet at any point in time.



Virtual Disease management

- Utilization of information technologies such as the Internet to allow patients suffering from chronic conditions to stay at home and be involved in the care delivery process.
- Such technologies can link home care with hospital and ambulatory care, and facilitate information exchange and communication between patients, family members, and care providers.



Virtual Disease management

Home Asthma Telemonitoring (HAT) system

- Early detection and timely intervention
- Daily routine of asthma care with personalized interventions
- Alerts health care providers in cases that require immediate attention.



Finkelstein J., O'Connor G., and Friedmann R. H. 2001. **“Development and implementation of the home asthma telemonitoring (HAT) system to facilitate asthma self-care.”** In MedInfo 2001, edited by V. Patel, R. Rogers and R. Haux, 810-4. Amsterdam, Washington, DC: IOS Press.

Virtual Disease management

Diabetes

- The Center for Health Services Research, Henry Ford Health System in **Detroit**, Michigan, developed a **web-based Diabetes Care Management Support System (DCMSS)** to support care delivery to diabetic patients.



Baker A. M., Lafata J. E., Ward R. E., Whitehouse F., and Divine G. **2001.** "A Webbased diabetes care management support system." Jt Comm J Qual Improv 27(4):179- 90.

Virtual Disease management

TeleHomeCare Project

at the

University of Minnesota

- congestive heart failure,
- chronic obstructive pulmonary disease
 - wound care,

to interact with health care providers at the agency.



- Demiris G., Finkelstein S. M., and Speedie S. M. 2001b. "Considerations for the design of a Web-based clinical monitoring and educational system for elderly patients." JAMIA 8(5):468-72.

The Current State Of Telehealth Evidence: A Rapid Review

Key findings of included systematic reviews and meta-analyses of telehealth, by clinical area

Clinical area	Equivalence to in-person care
Telemental health	Generally equivalent to in-person care for a variety of mental health conditions
Telerehabilitation	Generally equivalent to or yields better outcomes than in-person care
Teledermatology	Diagnosis and treatment concordance ranges from “acceptable”/ “good” to equivalent compared to in-person care
Teleconsultation	Potential alternative to in-person care, but equivalence is unclear as teleconsultation encompasses widely varied conditions

The Current State Of Telehealth Evidence: A Rapid Review

- **Twenty systematic reviews** and associated **meta-analyses** are included in this review, covering clinical areas such as **mental health and rehabilitation.**
- **Broadly, telehealth interventions appear generally equivalent to in-person care.**



The Current State Of Telehealth Evidence: A Rapid Review

- **Telehealth for nutrition** management in older adults living at home was likely to yield clinical improvements compared to usual care.
- **Diabetes:** Telehealth was effective for diagnosing **foot ulcers.**
- **Teledermatology:** management, they reported **equivalent overall accuracy** between teledermatology and in-person dermatology.



Telehealth: Mapping the Evidence for Patient Outcomes From Systematic Reviews

- **58 systematic reviews:**
- Organization of these results by **clinical focus areas** (a hybrid of conditions, body systems, and type of health care)

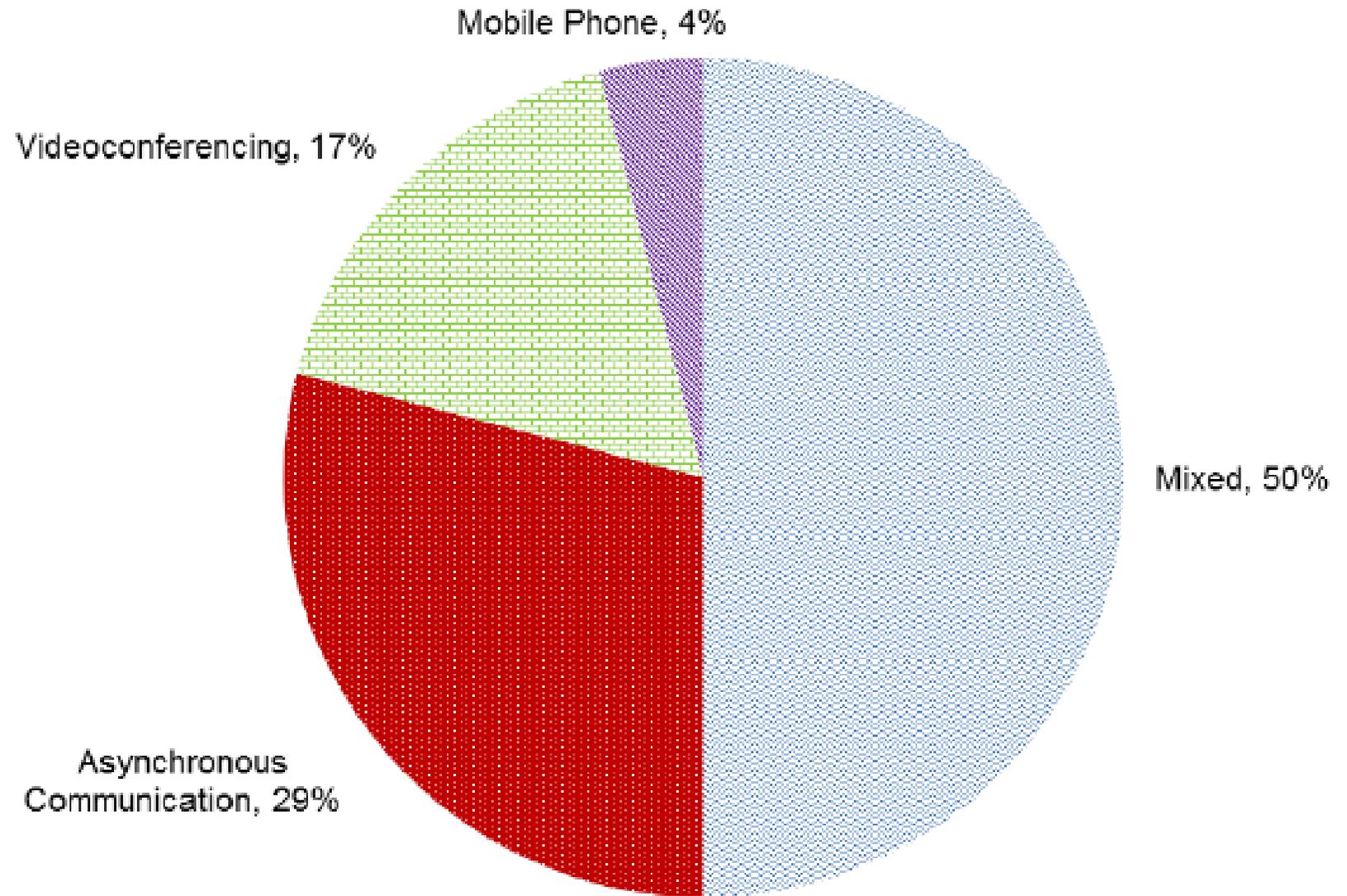


Telehealth: Mapping the Evidence for Patient Outcomes From Systematic Reviews

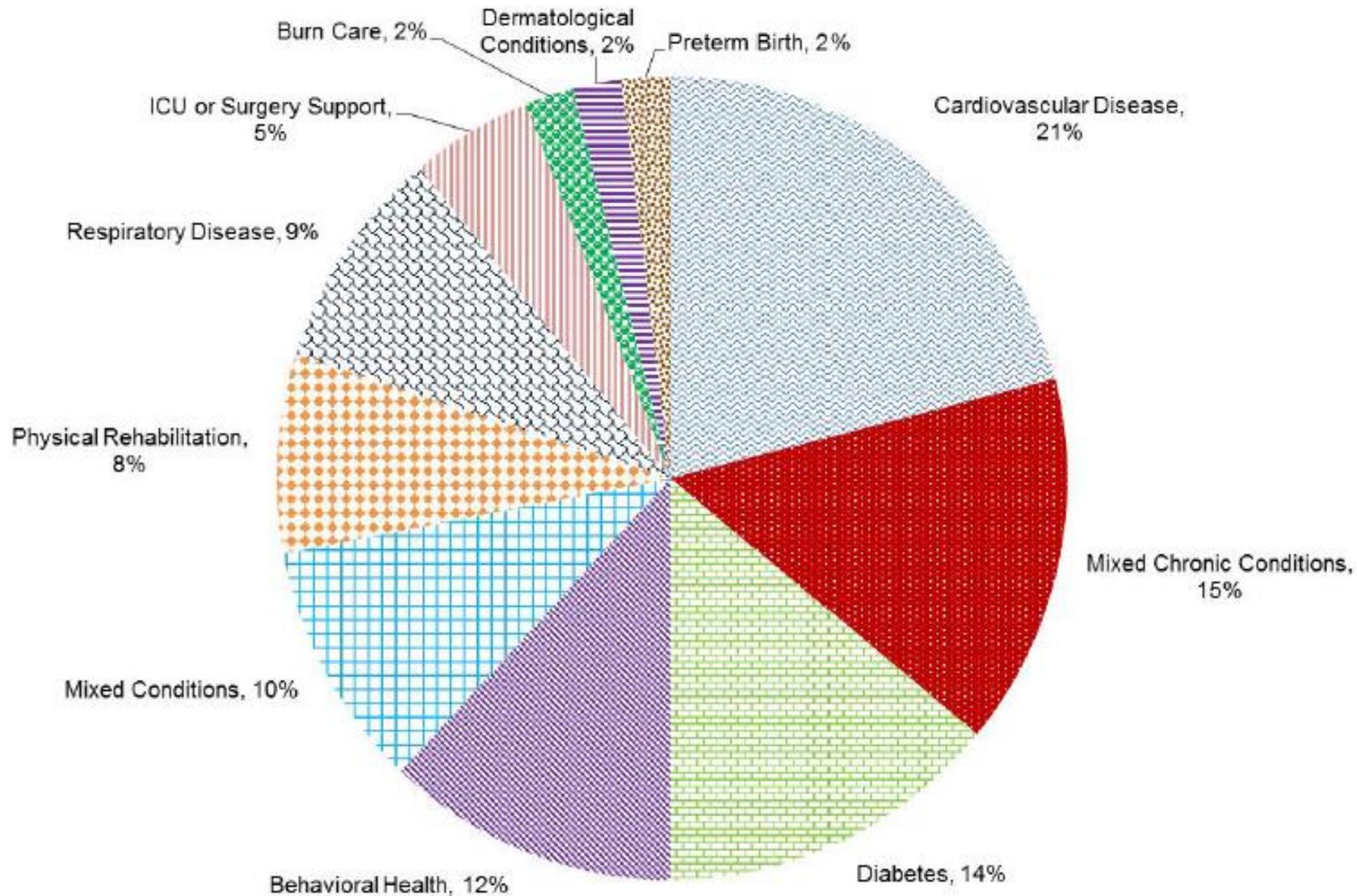
- **Sufficient evidence** to support the effectiveness of telehealth:
 - **Remote patient monitoring** for patients with chronic conditions
 - Communication and counseling for patients with **chronic conditions**
 - **Psychotherapy** as part of behavioral health.



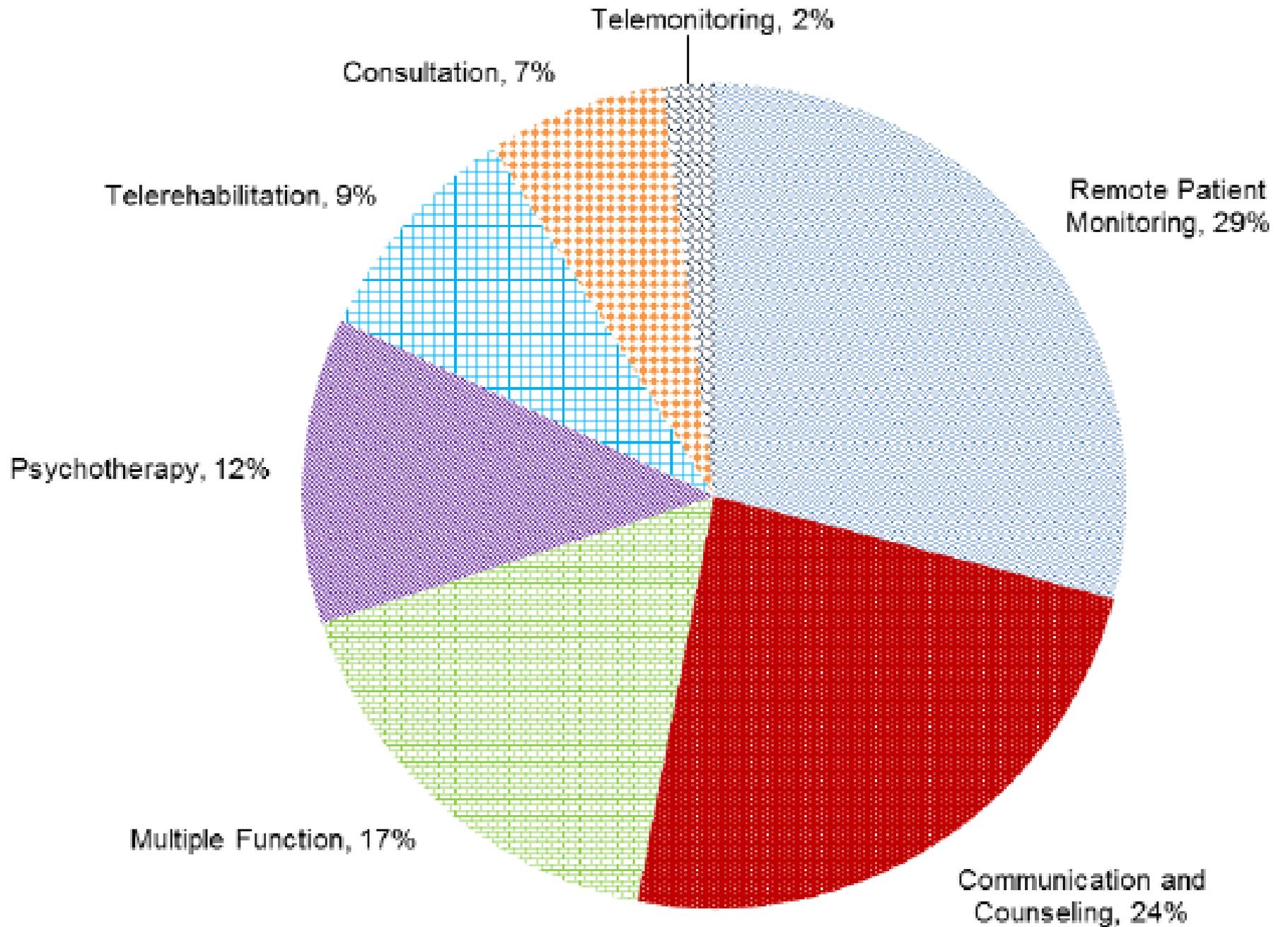
Distribution of Telehealth Modalities in this systematic Review



**Distribution of
clinical focus
across included
systematic
reviews**



**Distribution of
telehealth function
across included
systematic reviews**



Telehealth

- **Remote monitoring in Heart Failure**

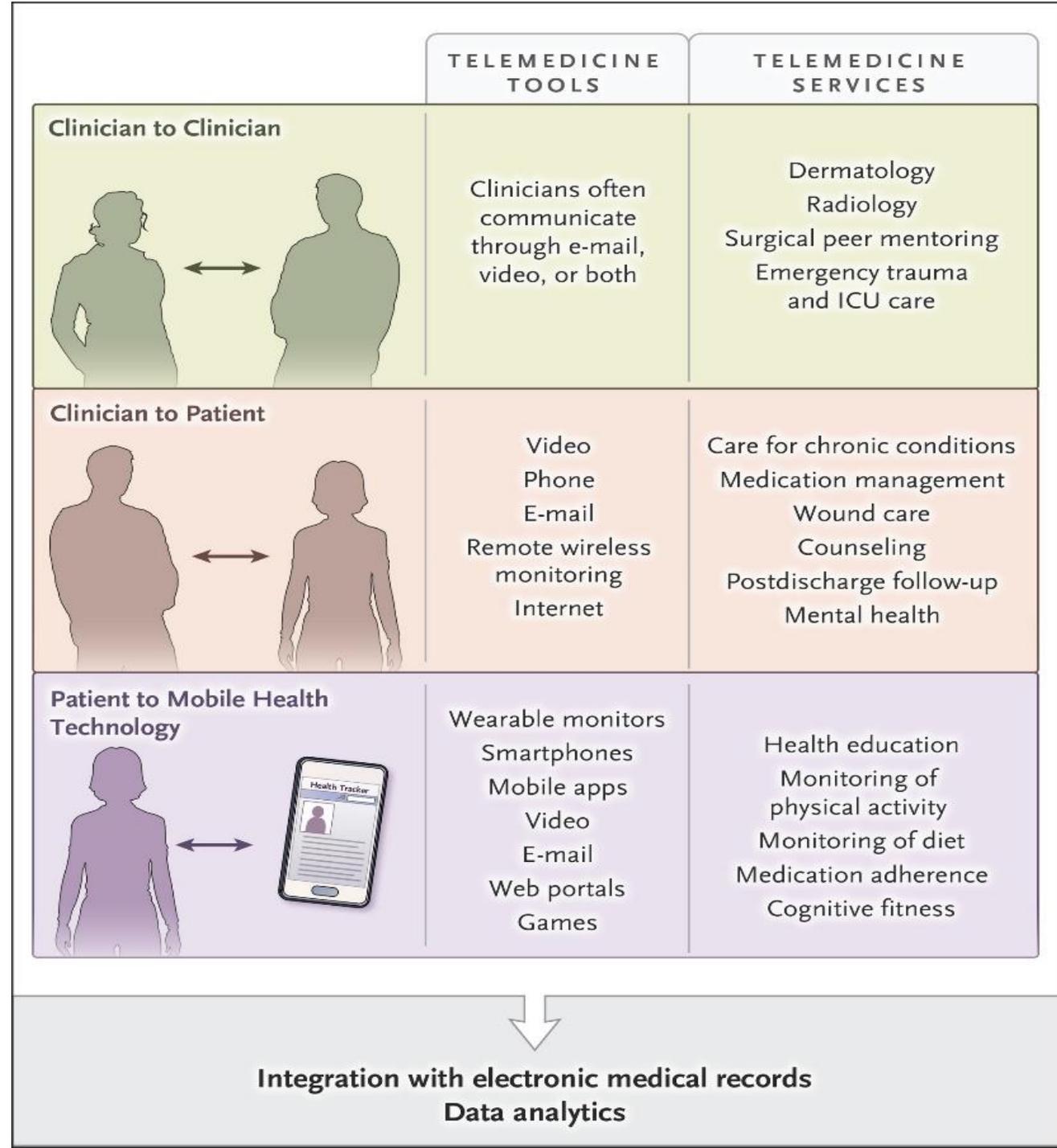
- Improves mortality and quality of life
 - Reduces hospitalizations and,
 - as a consequence, health care costs.

- Conway A, Inglis SC, Chang AM, et al. Not all systematic reviews are systematic: a meta-review of the quality of systematic reviews for non-invasive remote monitoring in heart failure. J Telemed Telecare. 2013 Sep;19(6):326-37. doi: <http://dx.doi.org/10.1177/1357633X13503427>. PMID: 24163297.



Telehealth

Tuckson RV, Edmunds M, Hodgkins ML.
Telehealth. *N Engl J Med.* 2017 Oct 19;377(16):1585-1592.
doi:
10.1056/NEJMsr1503323. PMID: 29045204.



Telehealth

Tuckson RV, Edmunds
M, Hodgkins ML.

Telehealth. *N Engl J*

Med. 2017 Oct

19;377(16):1585-1592.

doi:

10.1056/NEJMsr150332

3. PMID: 29045204.

Table 1. Five Key Trends That Will Influence the Growth of Telehealth Care Delivery.

Trend

Continuous innovation in the consumer technology market (e.g., with respect to applications, wearable sensors with wireless monitoring capabilities, and related digital capabilities), which will continue to attract financial capital for product development¹²

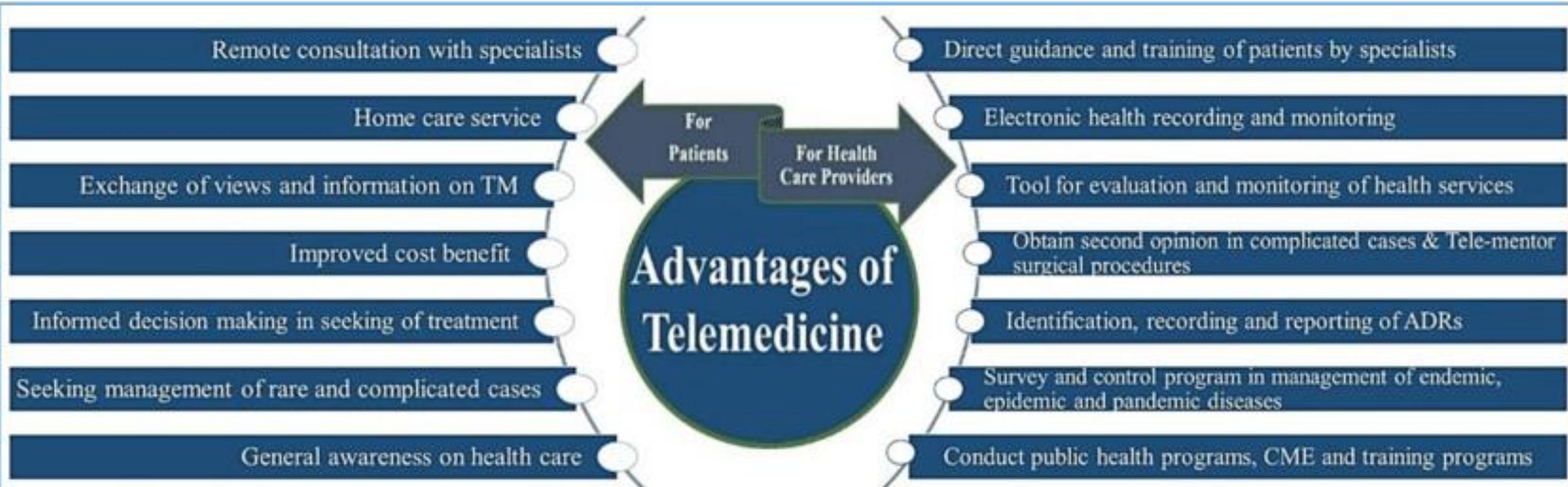
Continuous advancement in electronic health records and clinical-decision support systems, which has the potential to better integrate telehealth services into care-delivery processes and thus make care delivery more efficient for clinicians¹³

Projected shortages in the health professional workforce, which will increase the need to provide access to primary and specialty care for rural and underserved urban populations¹⁴

Reorganization in the delivery and financing of medical care, as a result of private-sector initiatives and the Affordable Care Act, toward value-based reimbursement, which provides an incentive for service delivery in lower-cost care settings outside of traditional hospital facilities¹⁵⁻¹⁷

Growth of consumerism in health care, with increasing public expectations for convenient and real-time access to health services, personal health information, prescription refills, and other health interventions in a manner similar to other sectors of the economy¹⁸⁻²⁰

Telemedicine



Opposition Group

- Telehealth has inherent limitations, and the rush to alternatives to in-person care could exacerbate health disparities and increase risks of compromising personal health or other information.

1. Siwicki B. [Survey: Americans' perceptions of telehealth in the COVID-19 era](#). Healthcare IT News. April 3, 2020. Accessed April 19, 2020.
2. Ostherr K. [Telehealth overpromises during the Covid-19 pandemic](#). StatReports. March 19, 2020. Accessed April 21, 2020.
3. Siwicki B. [Telemedicine during COVID-19: Benefits, limitations, burdens, adaptation](#). Healthcare IT News. March 19, 2020. Accessed April 30, 2020

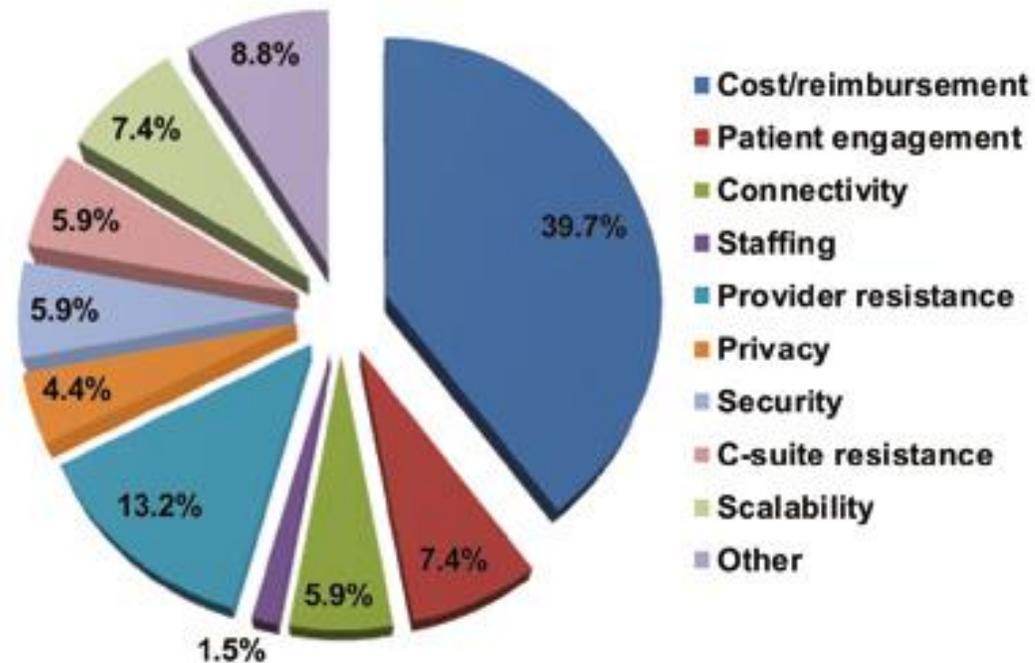


Telemedicine

Disadvantages

- Incorrect diagnoses
- Cost of hardware
- Need good telecommunication network
- Training of staff
- Medicolegal concerns- patient confidentiality

Top Barriers to Telehealth & Telemedicine Program Implementation



Source: 2015 Healthcare Benchmarks: Telehealth & Telemedicine
May 2015

Privacy and Confidentiality

- Information Privacy is the patient's right to control the use and dissemination of information that relates to them.
- Confidentiality is a tool for protecting the patients' privacy.
- In 1998 the Notice of the Proposed Rule from the **Department of Health and Human Services** concerning Security and Electronic Signature Standards was introduced (U.S. Department of Health and Human Services 1999) as part of the Health Insurance Portability and Accountability Act (HIPAA) that was passed in 1996.



Ethical considerations

- The first challenge relates to participation of health care providers and **the issue of licensing.**
- Medicine is practiced at the location where the patient is.
 - This issue has often been encountered with telemedicine applications that utilize videoconferencing systems.
- In these cases, **physicians have to be licensed to practice medicine in the state where the patient is at, during the teleconsultation.**



Telehealth

Tuckson RV, Edmunds M, Hodgkins ML.

Telehealth. *N Engl J*

Med. 2017 Oct

19;377(16):1585-1592.

doi:

10.1056/NEJMsrr150332

3. PMID: 29045204.

Table 2. Recommendations for Telehealth Research.

Topic	Recommendation
Physician leadership	Physicians should seek to enhance telehealth care delivery through collaborations with telehealth technology and service providers and contribute to the evidence base by comparing telehealth outcomes with usual care.
Reimbursement	Current Procedural Terminology codes should be updated to facilitate reimbursement-related research in fee-for-service settings, and the effect of alternative payment models that use bundled telehealth services should be studied to determine purchaser returns on investment.
Licensure	The necessary facilitation of interstate licensure should be supported by ongoing research regarding any quality-of-care issues that may arise.
Liability	Evidence is necessary to better understand what, if any, quality and safety risks may differentiate telehealth service delivery from traditional in-person care.
Human factors	Research on user-centered design is needed to facilitate the integration of telehealth into clinical workflows and to optimize patient engagement.
Device interoperability and data integration	Evidence-based best practices and standards that support the most effective integration of devices and data streams from clinician and patient telehealth engagement should be widely shared.
Privacy and security	Standardized guidelines are necessary and should be based on evidence and best practices to support appropriate safeguards and regulatory oversight.
Performance measurement	Enhanced evidence is required to address gaps in existing telehealth-related clinical performance measures and enhance those currently available.
Patient engagement and the evolving patient–physician relationship	Evidence-based guidance is needed to support health professional counseling and engagement with patients and caregivers across the full spectrum of telehealth services and technologies.
Research design and methods	Telehealth research in real-world settings requires alternative research designs, new research methods, and innovative analytic techniques that supplement traditional randomized, controlled trials and should be supported with enhanced funding and an expanded workforce.

Telephone Consultation

- There is a lack of high level evidence for telephone consultations in a GP setting; however, current evidence suggests that **telephone consultations as an alternative to face-to-face general practice consultations** offers an

appropriate option in certain settings.



Telephone Consultation

- Telephone consultation is a **cost-effective alternative** to face-to-face consultation for the routine outpatient follow-up of children and adolescents with **IBD**.



Telephone Consultation

- The frequency of telephone consultations and families' evaluations of them in a paediatric outpatient clinic during the initial weeks of the COVID-19 pandemic lockdown.
- A total of **103 families** participated in a **telephone interview**
- A total of 100 (**97.0%**) of the families agreed or strongly agreed that **they felt good about being offered a substitute telephone consultation**



Telephone Consultation

- 14 (13.6%) said that a telephone consultation was not the best option, whereas 89 (80.4%) would not have preferred a face-to-face consultation;
- 98 (95.1%) felt that the telephone consultation was useful to them.





Cochrane
Library

Cochrane Database of Systematic Reviews

Training interventions for improving telephone consultation skills in clinicians (Review)

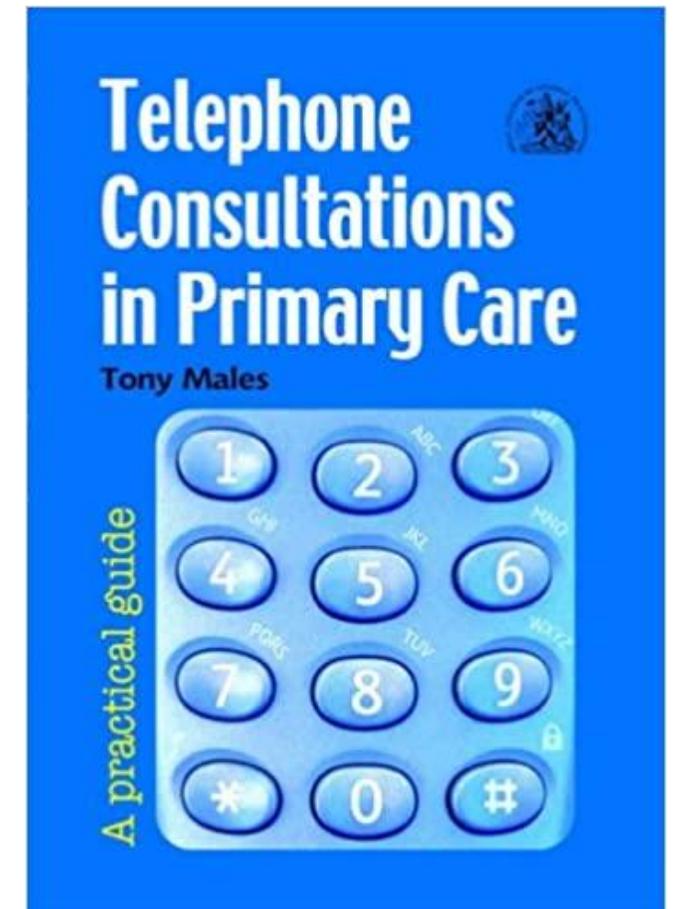
Vaona A, Pappas Y, Grewal RS, Ajaz M, Majeed A, Car J

Training interventions for improving telephone consultation skills in clinicians

- Nowadays, up to a quarter of all care consultations are conducted by Telephone.
 - Studies have quantified the impact of medical telephone consultation on clinicians' workload and detected the need for quality improvement.

- **Objectives**

To assess the effects of training interventions for clinicians' telephone consultation skills and patient outcomes.



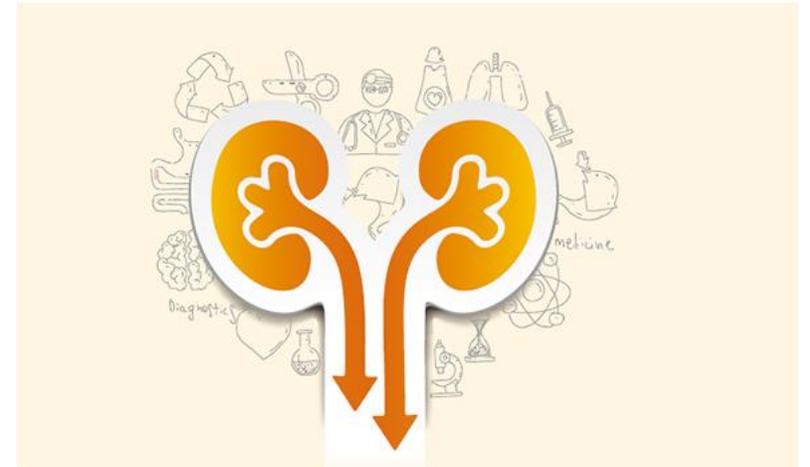
Training interventions for improving telephone consultation skills in clinicians

- Telephone consultation skills are **part of a wider set of remote consulting skills** whose importance is growing as more and more medical care is delivered from a distance with the support of information technology.



Telephone Consultation

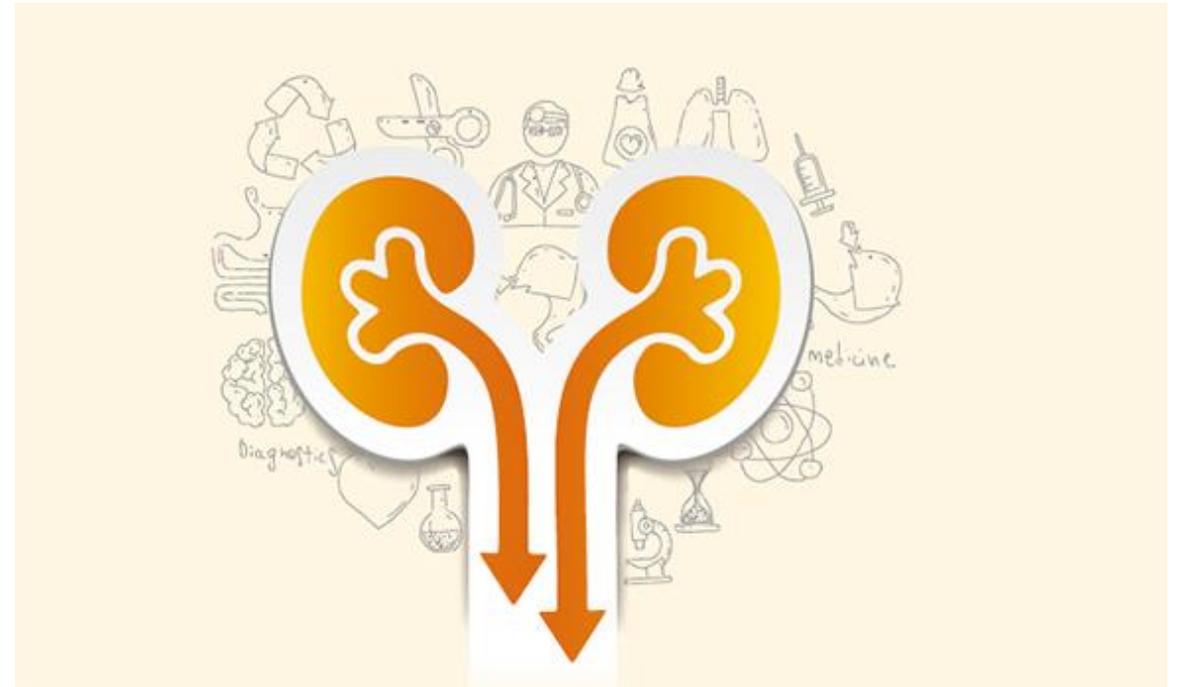
- **The follow-up of renal transplant recipients by telephone consultation: three years experience from a single UK renal unit**



Telephone Consultation

High quality healthcare should be

- safe,
- timely,
- effective,
- efficient,
- equitable,
- patient-centred
- sustainable.



Andrew Connor, Frances Mortimer and Robert Higgins DOI:
<https://doi.org/10.7861/clinmedicine.11-3-242> Clin Med June 2011

Telephone Consultation

The benefits of telephone consulting:

- **Patient-centred, convenient care**
- **Safe Care:** This study therefore suggests that **the increased communication afforded by more frequent contact** may be the determinant of the underlying health benefits of telephone care.



Telephone Consultation

- **Sustainable care**

The reduction in greenhouse gas emissions was examined.

Data were collected prospectively from **30 patients** attending two consecutive telephone clinics.

It was assumed that, had patients attended a face-to-face clinic, they would have travelled from, and returned to, their homes.

Each patient's return journey length was calculated from their postcode using Google Maps.

Had these patients attended clinic, they would have travelled a total of 1180.10 km (mean 39.34 km, range 1.76–241.26 km), with only 64.74 km (5.8%) undertaken by public transport.



Telephone Consultation

- The greenhouse gas emissions arising from each patient's travel were calculated using DEFRA conversion factors specific to the transport modality that they would use to attend their local clinic.
- The annual 350 telephone consultations therefore result in an estimated reduction in greenhouse gas emissions of 2,818 kgCO₂eq.



Telephone Consultation

Potential disadvantages and barriers

- Telephone consultation is not appropriate when formal physical examination is a likely necessity.

Its role is primarily in the management of established chronic disease, rather than where diagnostic evaluation is required.

- A thorough history is therefore important and familiarity with the patient must not be considered a substitute for this.



Telephone Consultation

- **Potential disadvantages and barriers**

Cultural barriers, as well as
logistical and
administrative challenges,
may present potential barriers to
effective implementation of
telephone services.



Telephone Consultation

- Experience suggests that, implemented appropriately, the use of telephone consulting for the follow-up of renal transplant recipients is **safe, empowers patients, improves access to healthcare and confers environmental benefits.**



Telephone Consultation

PRO'S	CON'S
It's quicker	Interruptions can occur
It's cheaper	You can't read body language
It's easier	Less effort on candidate's behalf
You can assess communications	The signal could be faulty
You can reach long-distance candidates	Locations could be disruptive
You can cull weak candidates pre-interview	It'll probably be scheduled out of working hours
	It's difficult to build rapport

Telephone triage

- **Listen to the Entire History Before Triageing**
- **Techniques For Better Telephone Triage**
 - Smile and have a friendly voice when talking with the patient.
 - Believe it or not, people can tell when you're smiling over the phone!
 - Show empathy. Your goal is to gain the callers trust.
 - Friendly, professional and encouraging.



Telephone triage

- Be calm and confident.

Most callers are scared, so it is important that you remain calm as you listen intently to their concerns and keep confident as you help them through their situation.

- Believe in yourself, your ability, and your knowledge.
- To sound confident to the caller, you want to avoid weak phrases such as “I think”, “Maybe”, or “I’m not sure”.
- Instead, when faced with a question you don’t know the answer to, say “Let me check into that for you.”



Telephone triage

Practice the three types of effective listening:

- Active listening,
- Reflective listening,
- Empathic listening.



Telephone triage

- **Active listening** refers to **short verbal demonstrations** that you are paying attention.
- Use words such as “Okay”, “I see”, and “Yes, I understand”.



Telephone triage

- **Reflective listening** includes paraphrasing what the caller is saying, asking clarifying questions, and encouraging the caller to speak in more detail by asking open ended questions such as
“Can you describe what happened?” Open ended questions cannot be answered with just one word; this will get the caller to better explain what is happening.



Telephone triage

- **Empathic listening** is the skill that demonstrates attention to the **emotional aspect of the patient's story**, not just the facts of the matter.



Telehealth

Effectiveness of telephone-based interventions for managing osteoarthritis and spinal pain: a systematic review and meta-analysis

- **Systematic review**
- Seven electronic databases from inception to May 2018. Randomised controlled trials (RCTs), cluster-RCTs, and non-randomised controlled trials were included.
- O'Brien KM, Hodder RK, Wiggers J, Williams A, Campbell E, Wolfenden L, Yoong SL, Tzelepis F, Kamper SJ, Williams CM, PeerJ 2018 Oct 30;6:e5846



Telehealth

- 23 studies with 56 trial arms and 4,994 participants
- All studies utilised telephone-based interventions.
- We are **moderately confident** that **telephone-based interventions reduce pain intensity and disability in patients with osteoarthritis and spinal pain** compared to usual care.



- O'Brien KM, Hodder RK, Wiggers J, Williams A, Campbell E, Wolfenden L, Yoong SL, Tzelepis F, Kamper SJ, Williams CM, PeerJ 2018 Oct 30;6:e5846

A Telephone-based Physiotherapy Intervention for Patients with Osteoarthritis of the Knee

[Int J Telerehabil.](#) 2013 Fall; 5(2): 11–20. Published online 2013 Dec 19.

doi: [10.5195/ijt.2013.6125](https://doi.org/10.5195/ijt.2013.6125), PMCID: PMC4352988, PMID: [25945214](https://pubmed.ncbi.nlm.nih.gov/25945214/)

[Adesola C. Odole, Oluwatobi D. Ojo](#)

A Telephone-based Physiotherapy Intervention for Patients with Osteoarthritis of the Knee

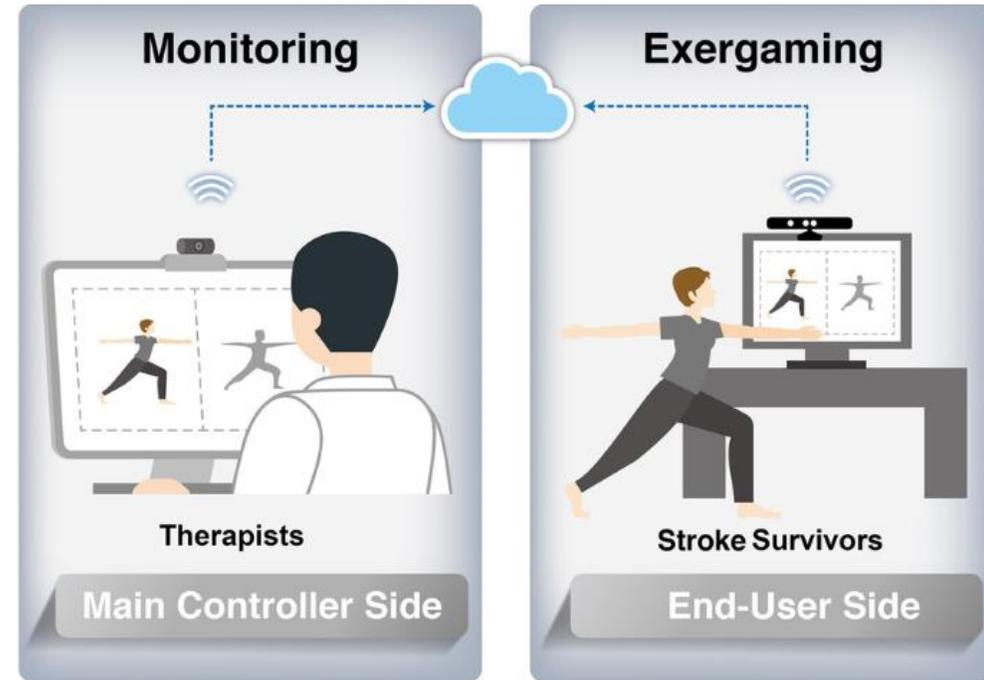
- This study demonstrated that a six-week course of structured telephone calls thrice-weekly to patients at their home, to monitor self-administered osteoarthritis-specific exercises for patients with knee OA (i.e., tele-physiotherapy) achieved comparable results to physiotherapy conducted in the clinic.



Telehealth

Real-time telerehabilitation appears to be **effective and comparable to conventional** methods of healthcare delivery for the improvement of physical function and pain in a variety of musculoskeletal conditions.

- **Real-time telerehabilitation for the treatment of musculoskeletal conditions is effective and comparable to standard practice: a systematic review and meta-analysis [with consumer summary]**, Cottrell MA, Galea OA, O'Leary SP, Hill AJ, Russell TG, Clinical Rehabilitation **2017** May;31(5):625-638



Telehealth

COVID-19 pandemic

- Transformations ranging from converting hospital spaces and non-healthcare facilities into intensive care units (ICUs) to rolling out new clinical guidelines and policies.
- **Oregon Health & Science University**, the number of digital health visits ballooned from **1,100 in February** to nearly **13,000 in March**, and all 1,200 ambulatory faculty were able to conduct virtual visits by April 3, 2020.



Robinson E. [OHSU telehealth rockets into 'new era of medicine': Global pandemic instigates exponential expansion of OHSU telemedicine program](#). OHSU News. April 13, 2020. Accessed April 13, 2020

Telehealth

Forward triage for Covid-19

- Sorting of patients before they arrive in the emergency department (ED).
- Direct-to consumer (or on-demand) telemedicine, a 21st-century approach to forward triage that allows patients to be efficiently **screened**, is both patient-centered and **conducive to self-quarantine**, and it protects patients, clinicians, and the community from exposure.
- Virtually Perfect? Telemedicine for Covid-19, List of authors. Judd E. Hollander, M.D., and Brendan G. Carr, M.D., [April 30, 2020](#), N Engl J Med **2020**; 382:1679-1681, DOI: 10.1056/NEJMp2003539



Telehealth

- This response has been fueled by necessity and rapid legislative and regulatory changes to payment and privacy requirements, particularly the temporary waivers and new rules by the Centers for Medicare & Medicaid Services that have broadened access and facilitated payment for a wider range of telehealth services

[Medicare Telemedicine Health Care Provider Fact Sheet: Medicare Coverage and Payment of Virtual Services](#). Baltimore, MD: CMS. March 17, 2020. Accessed April 20, 2020.

[CMS News Alert April 13, 2020](#); [CARES Act: AMA COVID-19 pandemic telehealth fact sheet, April 27, 2020](#)





Teletriage

- **Speak** to a nurse Monday-Sunday, 8 A.M. to 10 P.M.

Teletriage Advice Line

- A **link** is sent to the patient's phone. When the appointment begins, the patient selects the link, and it takes them to a video visit via Face-Time with the doctor.

Teletriage Video Visit

- *These activities occur in the home. However, there are health professionals present.
- * The patient must have a smartphone or computer with access to internet, microphone, and camera.

Medent E-visit

- Designed for Minor Medical Issues
- Used via **Patient Portal**

*Patient answers short questionnaire and the doctor responds with details on how to manage medical conditions.

Teletriage Home Visit

- A **nurse visits** the patient's home and conducts an exam with the doctor on the phone. Blood pressure, ears, throat, lungs, heart rate, and HbA1c can be checked during this visit.

*The doctor reviews the medication list
*This is an effective alternative for patients who have difficulty making it to the clinic.

Skype Meeting

Chat with the doctor skype-to-skype.

*Patient must have a smartphone and will need to download the skype app.



***If a patient requires prescription pain medication or needs a refill on pain medication, the patient must be seen in the clinic.**

Telehealth

- Reports that as many as **100 health care workers at a single institution** have to be **quarantined** at home because of exposure to **Covid-19** have raised concern about workforce capacity.
- At institutions with ED tele-intake or direct-to-consumer care, **quarantined physicians can cover those services, freeing up other physicians to perform in-person care.**



Telehealth

- Office-based practices can also employ quarantined physicians to care for patients remotely.
- The challenge is that other health professionals (nurses, medical assistants, physician assistants) also contribute to in-person care, and telemedicine cannot replace them all.



Telehealth

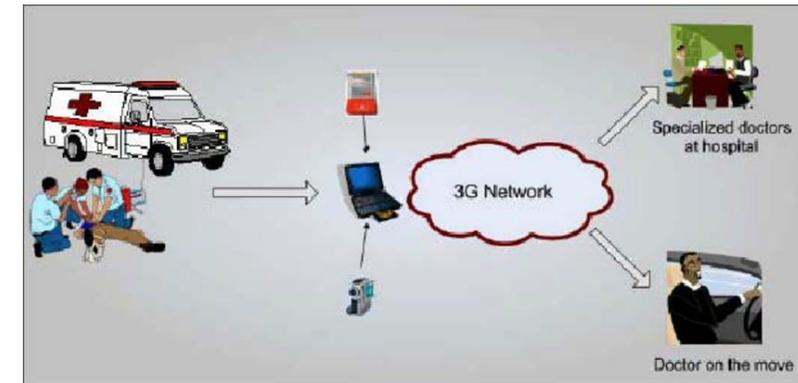
- Implementing telehealth visits with palliative care patients with advanced cancer at the UCSD Moores Cancer Center Outpatient Palliative Care Team
- Has the potential to improve or maintain patient satisfaction with symptom management and the overall visit, adequately address palliative needs, and improve quality of life.



- Fitzgerald, Kori BSN, RN, PHN, FNP/DNP Student, "Utilization of Evidence-Based Telehealth for Routine Follow-Up Visits in Outpatient Palliative Care" (2019). *Doctor of Nursing Practice Final Manuscripts*. 96.
<https://digital.sandiego.edu/dnp/96>

Telehealth

- Fewer heart attack patients died when consultations based on transmitted data were provided to EMS personnel in the field or during transport



- Totten AM, Cheney TP, O'Neil ME, et al. Physiologic Predictors of Severe Injury: Systematic Review. Comparative Effectiveness Review No. 205. (Prepared by the Pacific Northwest Evidence-based Practice Center under Contract No. 290-2015-00009-I.) AHRQ Publication No. 18-EHC008-EF. Rockville, MD: Agency for Healthcare Research and Quality; April 2018. doi: 10.23970/AHRQEPCCER205. PMID: 30748156.
- Sasser SM, Hunt RC, Faul M, et al. Guidelines for field triage of injured patients: recommendations of the National Expert Panel on Field Triage, 2011. MMWR Recomm Rep. 2012 Jan 13;61(RR-1):1-20. PMID: 22237112

Telehealth

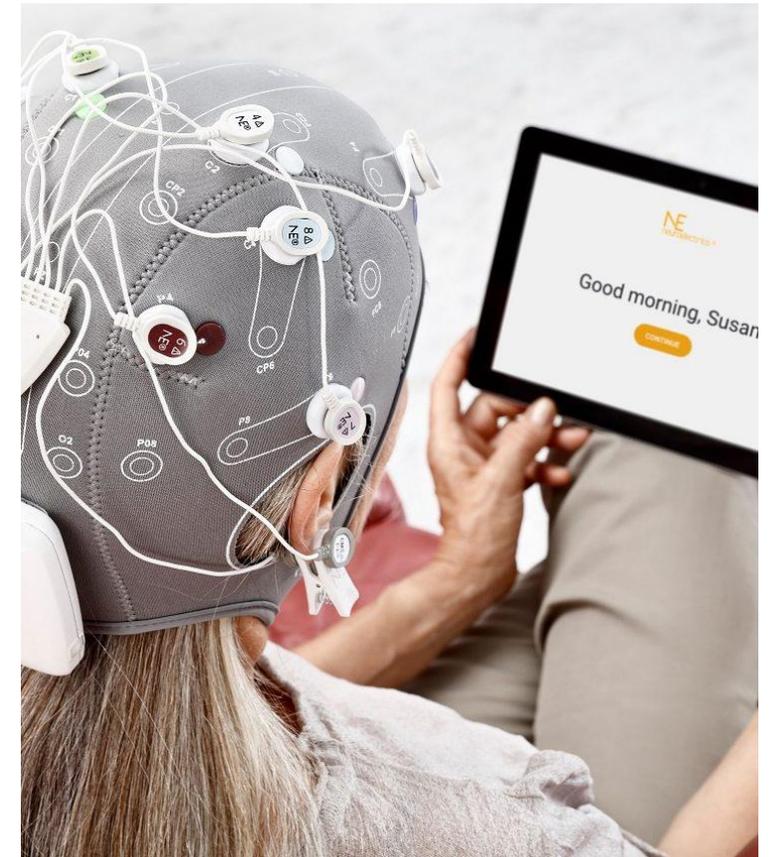
- **Cardiac patients** and their partners found telerehabilitation technologies a useful digital toolbox in the rehabilitation process.
- **Telerehabilitation** motivated the patients to integrate rehabilitation activities into their work schedule and everyday life and made them feel like unique individuals.



- Dinesen B, Nielsen G, Andreasen JJ, Spindler H, **Integration of Rehabilitation Activities Into Everyday Life Through Telerehabilitation: Qualitative Study of Cardiac Patients and Their Partners**, J Med Internet Res 2019;21(4):e13281, URL: <https://www.jmir.org/2019/4/e13281>, DOI: 10.2196/13281

Telehealth

- **Impact occurs when speed matters.**
- Systems that allowed images or data (e.g., electrocardiogram [EKG], electroencephalogram [EEG]) to be quickly shared and interpreted produced positive results.



- Totten AM, Cheney TP, O'Neil ME, et al. [Physiologic Predictors of Severe Injury: Systematic Review](#). Comparative Effectiveness Review No. 205. (Prepared by the Pacific Northwest Evidence-based Practice Center under Contract No. 290-2015-00009-I.) AHRQ Publication No. 18-EHC008-EF. Rockville, MD: Agency for Healthcare Research and Quality; **April 2018**. doi: 10.23970/AHRQEPCCER205. PMID: 30748156.
- Sasser SM, Hunt RC, Faul M, et al. [Guidelines for field triage of injured patients: recommendations of the National Expert Panel on Field Triage](#), 2011. MMWR Recomm Rep. 2012 Jan 13;61(RR-1):1-20. PMID: 22237112

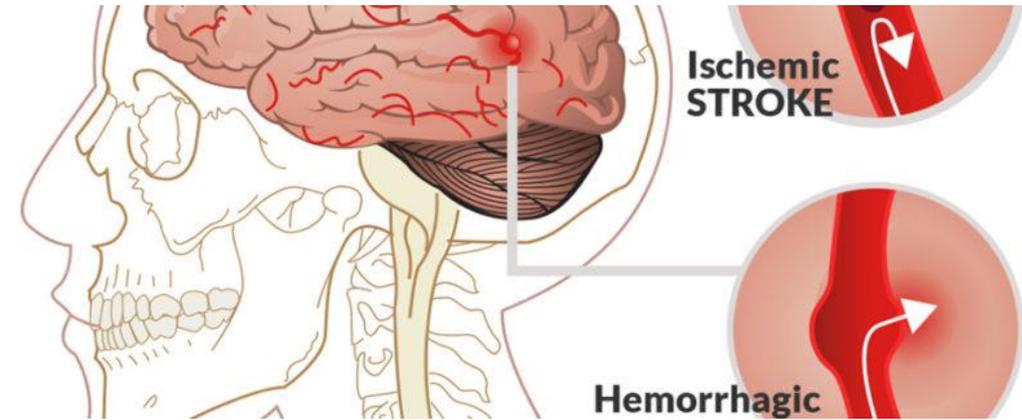
Telehealth

- Telehealth consultations have been used to support
 - Emergency medical services (EMS),
 - Urgent care,
 - Emergency departments.
- Across 22 EMS studies and 19 emergency department studies, emergency telehealth consultations **improved triage by decreasing the time to decisions about transport and treatment and ultimately to patient receipt of care.**
- In the current situation, reducing the time patients spend in the emergency department may help to reduce risk of exposure.



Telehealth

- Much medical decision making is cognitive, and telemedicine can provide rapid access to subspecialists who aren't immediately available in person.
- This approach has been explored most fully in the context of **stroke**, for which systems such as Jefferson Health, Cleveland Clinic, and the University of Pittsburgh provide **virtual emergency neurologic care** at large numbers of hospitals.



Telemedicine in Orthopaedic Surgery

- Reported benefits and roles for **continued telehealth utilization** past the COVID-19 pandemic include
 - Improved access
 - Improved communication with patients undergoing surgical treatment,
 - Improved reporting of functional outcomes in research settings.



Blank E, Lappan C, Belmont PJ Jr, Machen MS, Ficke J, Pope R, Owens BD. Early analysis of the United States Army's telemedicine orthopaedic consultation program. *J Surg Orthop Adv*. 2011 Spring;20(1):50-5.

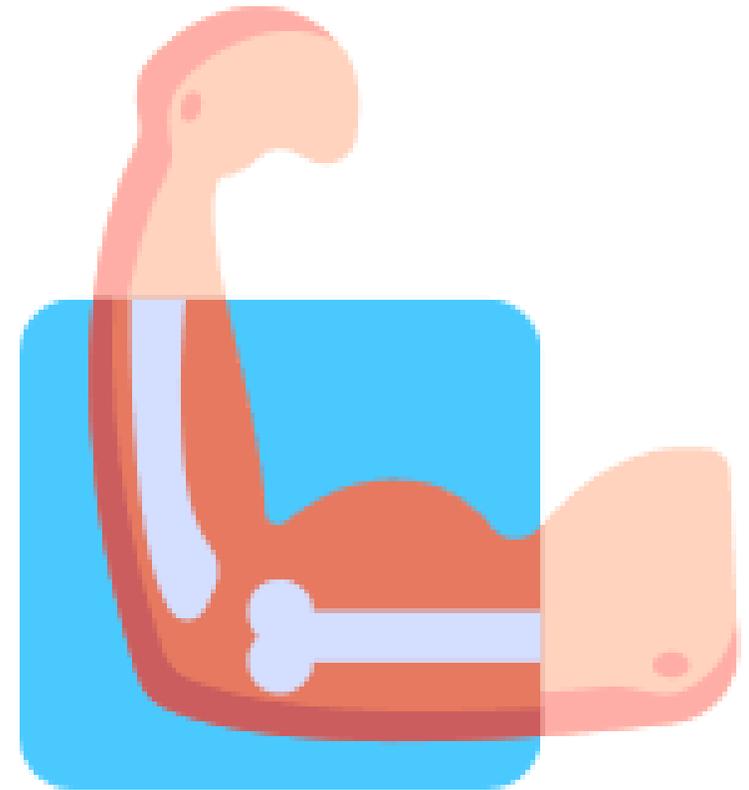
Seto E, Smith D, Jacques M, Morita PP. Opportunities and challenges of telehealth in remote communities: case study of the Yukon Telehealth System. *JMIR Med Inform*. 2019 Nov 1;7(4):e11353.

De La Cruz Monroy MFI, Mosahebi A. The use of smartphone applications (apps) for enhancing communication with surgical patients: a systematic review of the literature. *Surg Innov*. 2019 Apr;26(2):244-59. Epub 2019 Jan 2.

Good DW, Lui DF, Leonard M, Morris S, McElwain JP. Skype: a tool for functional assessment in orthopaedic research. *J Telemed Telecare*. 2012 Mar;18(2):94-8. Epub 2012 Jan 13.

Telemedicine in Orthopaedic Surgery

- A randomized controlled trial based in Norway compared video consultations with standard orthopaedic visits and included new referrals to the outpatient clinic, postoperative patients, and patients undergoing follow-up for traumatic or chronic orthopaedic disorders.



Buvik A, Bugge E, Knutsen G, Smabrekke A, Wilsgaard T. **Quality of care for remote orthopaedic consultations using telemedicine: a randomised controlled trial.** BMC Health Serv Res. **2016** Sep 8;16(1):483

Telemedicine in Orthopaedic Surgery

- It was **safe to offer video-assisted consultations for selected orthopaedic patients**, with no adverse events reported as a result of this and no difference in patient-reported satisfaction and health.



- Buvik A, Bugge E, Knutsen G, Smabrekke A, Wilsgaard T. Patient reported outcomes with remote orthopaedic consultations by telemedicine: a randomised controlled trial. J Telemed Telecare. 2019 Sep;25(8):451-9. Epub 2018 Ju

Telemedicine in Orthopaedic Surgery

- The use of telemedicine for **orthopaedic visits** in Norway has been shown to be **cost-effective**, particularly when considering travel time for patients.
- The authors reported that this conclusion held as long as >151 visits were performed per year.



Buvik A, Bergmo TS, Bugge E, Smaabrekke A, Wilsgaard T, Olsen JA. Costeffectiveness of telemedicine in remote orthopedic consultations: randomized controlled trial. J Med Internet Res. 2019 Feb 19;21(2):e11330.

Telemedicine in Orthopaedic Surgery

- The use of mobile radiology services in Norway has been shown to increase access to imaging.



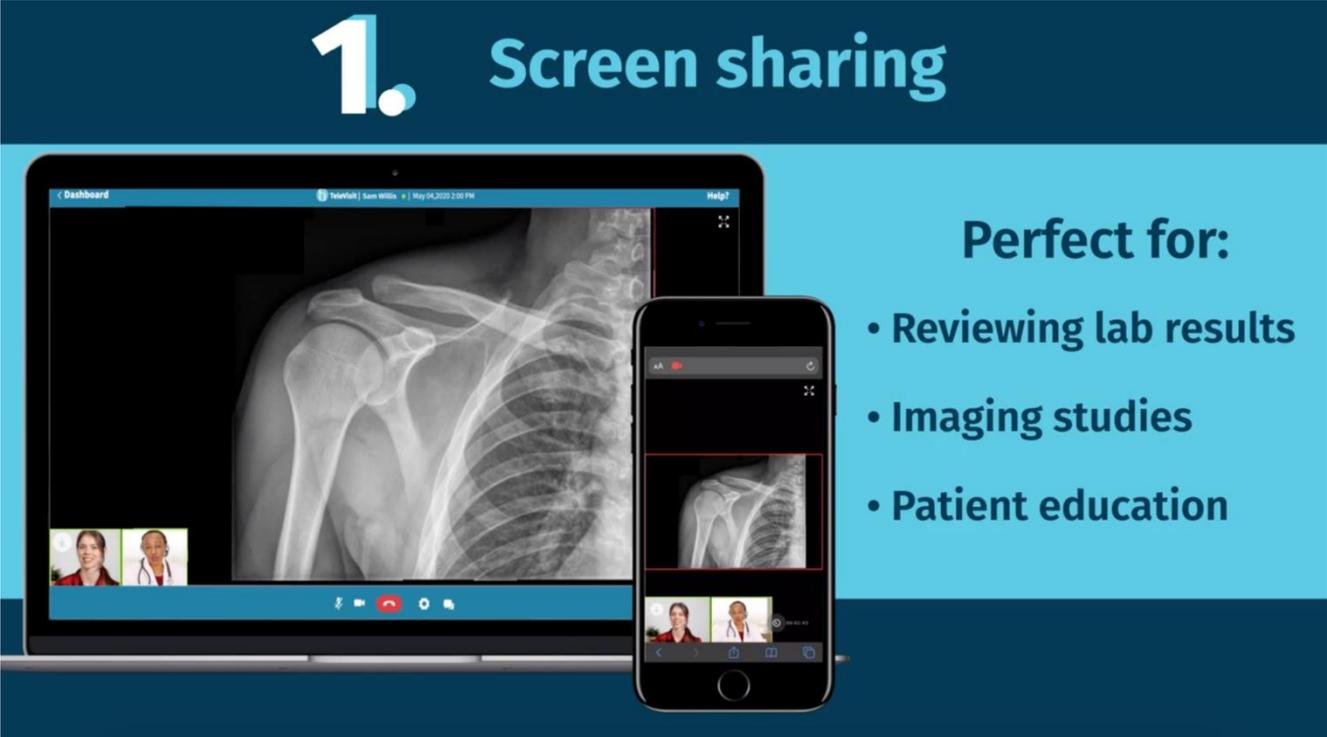
Kjelle E, Lysdahl KB, Olerud HM. Impact of mobile radiography services in nursing homes on the utilisation of diagnostic imaging procedures. BMC Health Serv Res. 2019 Jun 26;19(1):428.

Telemedicine in Orthopaedic Surgery

Sharing the information with patient

- After the assessment, the **screen-sharing** function:
- shared visualization and explanation of imaging studies.
 - Without the use of **anatomic models, prepared pictures** can be used as adjunct visual aids during the discussion with the patient.

1. Screen sharing



Perfect for:

- Reviewing lab results
- Imaging studies
- Patient education

Telemedicine in Orthopaedic Surgery

- A systematic review of **telemedicine-based rehabilitation** has shown **strong evidence in favor of this method** for postoperative hip and knee arthroplasty visits.
- The use of telemedicine in the care of patients with sports medicine diagnoses has not previously been addressed.



Pastora-Bernal JM, Mart´in-Valero R, Bar´on-L´opez FJ, Estebanez-P´erez MJ.
Evidence of benefit of telerehabilitation after orthopedic surgery: a systematic review. J Med Internet Res. 2017 Apr 28;19(4):e142.

Telemedicine in Orthopaedic Surgery

- Some authors reported success in treating patients with orthopaedic trauma, particularly that related to fracture management.



Prada C, Izquierdo N, Traipe R, Figueroa C. [Results of a new telemedicine strategy in traumatology and orthopedics. Telemed J E Health. 2019 Jul 9. \[Epub ahead of print\].](#)

Blank E, Lappan C, Belmont PJ Jr, Machen MS, Ficke J, Pope R, Owens BD. Early analysis of the United States Army's telemedicine orthopaedic consultation program. *J Surg Orthop Adv.* 2011 Spring;20(1):50-5.

Telemedicine in Orthopaedic Surgery

- Provocative testing
- Discrete palpation
- Strength testing
- Stability testing



Telemedicine in Orthopaedic Surgery, Challenges and Opportunities

Melvin C. Makhni, Grant J. Riew, and Marissa G. Sumathipala

Investigation performed at Harvard Medical School, Boston,
Massachusetts

J Bone Joint Surg Am. 2020;102:1109-15 d
<http://dx.doi.org/10.2106/JBJS.20.00452>

Telemedicine in Orthopaedic Surgery

Benefits

- (1) high patient satisfaction rates
- (2) Increased patient convenience,
- (3) Increased access to care,
- (4) Decreased overhead for providers,
- (5) Societal cost savings.



Telemedicine in Orthopaedic Surgery

- Challenges

The use of telemedicine has been strikingly low as a percentage of total health-care services.

Prior to COVID-19, only between 2.4% and 10% of patients utilized virtual visits.



Telemedicine in Orthopaedic Surgery

- **Challenges**

- Lack of Awareness, Access, and Technology Literacy
- Technology Implementation and Maintenance Costs
 - Inefficiencies Introduced
- Decreased Ability to Perform Physical Examinations
 - Lack of Perceived Benefit
- Negative Financial Implications for Providers
 - Possible Increased Medico-legal Exposure
 - Regulatory Barriers



Telemedicine in Orthopaedic Surgery

- The widespread use of telemedicine in orthopaedic surgery is **feasible**.
- In addition to **improving the cost and quality of care**, developing virtual care pathways would prepare health systems for future public-health crises.



Telemedicine in Orthopaedic Surgery

- By tackling the

challenges of implementation and training,

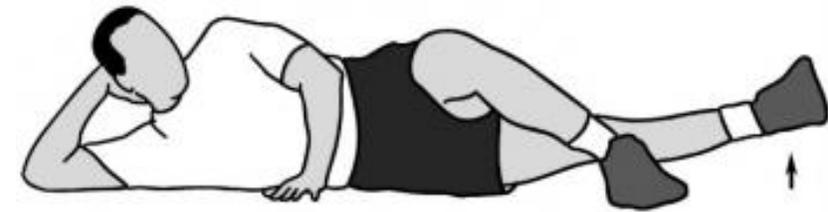
raising awareness and improving education,

streamlining technology, and collaborating with

patients, providers to align incentives,

the field of orthopaedic surgery may benefit from

telemedicine in the years to come.



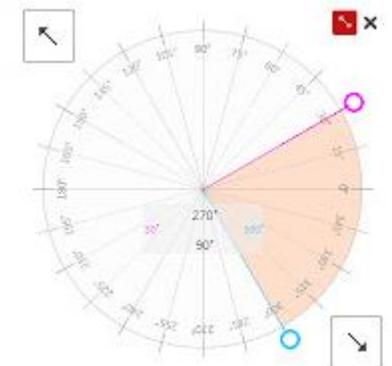
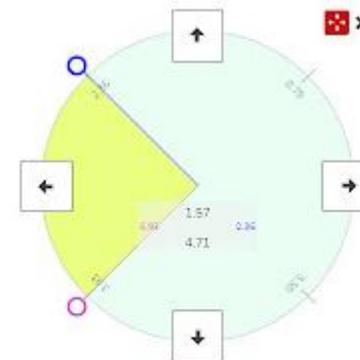
Telemedicine in Orthopaedic Surgery

- Examples:
 - Tennis Elbow
 - Plantar Fasciitis
 - Stenosing Tenosynovitis
 - Ankle Sprain
 - Non-displaced Fractures
 - ...
 - ..
 - .

Telemedicine in Orthopaedic Surgery

- **Range of Motion measurements** can be obtained using a **web-based goniometer**, which, in our case was used

as a browser extension (Protractor; Ben Burlingham) that is compatible with most applications (including Zoom, InTouch Health, and Doxy.me) when launched through the Chrome browser (Google).

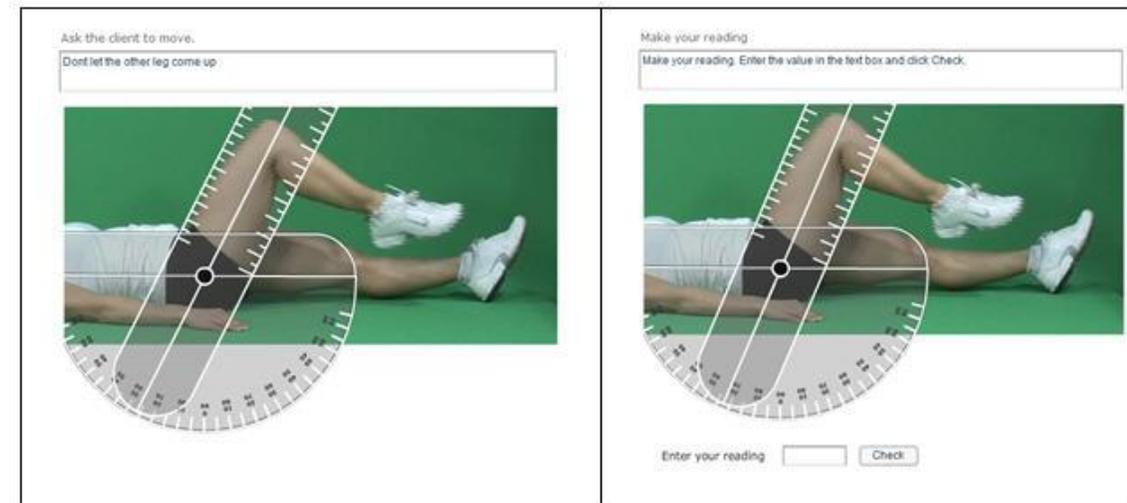


- Burlingham B. Protractor. 2020 Jan 23. Accessed 2020 Apr 14. <https://chrome.google.com/webstore/detail/protractor/kpjldaeddfokhmgdimpdlecmbaonnj>

Telemedicine in Orthopaedic Surgery

Virtual goniometers

- Russell et al. reported on the use of an **internet-based goniometer** to assess knee range of motion and found, in a comparison of **540 knee positions**, that face-to-face measurements and internet measurements showed **high intrarater and interrater reliability**.

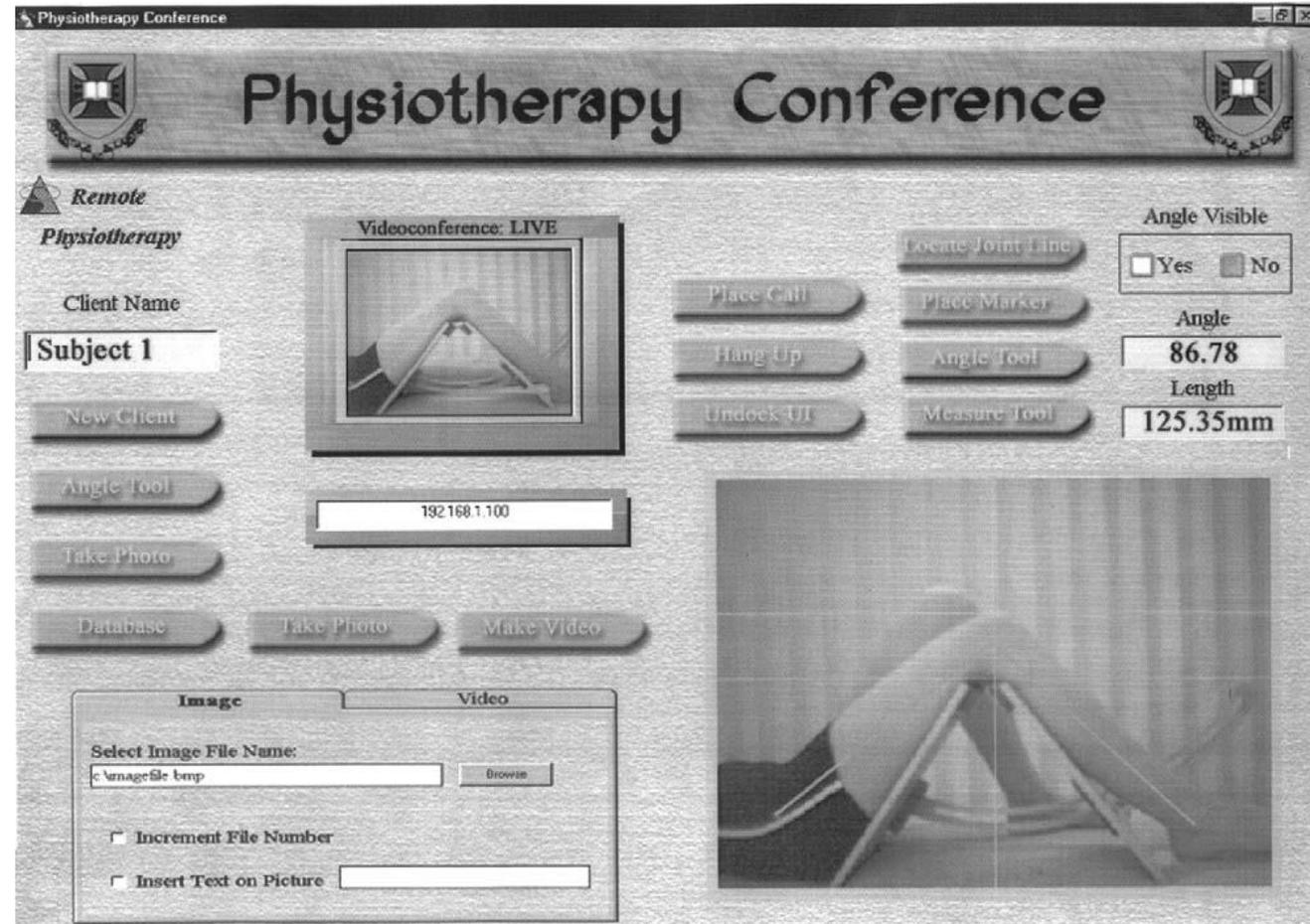


https://jolt.merlot.org/vol7no2/massy-westropp_0611.htm

Russell TG, Jull GA, Wootton R. Can the internet be used as a medium to evaluate knee angle? Man Ther. 2003 Nov;8(4):242-6.

Telemedicine in Orthopaedic Surgery

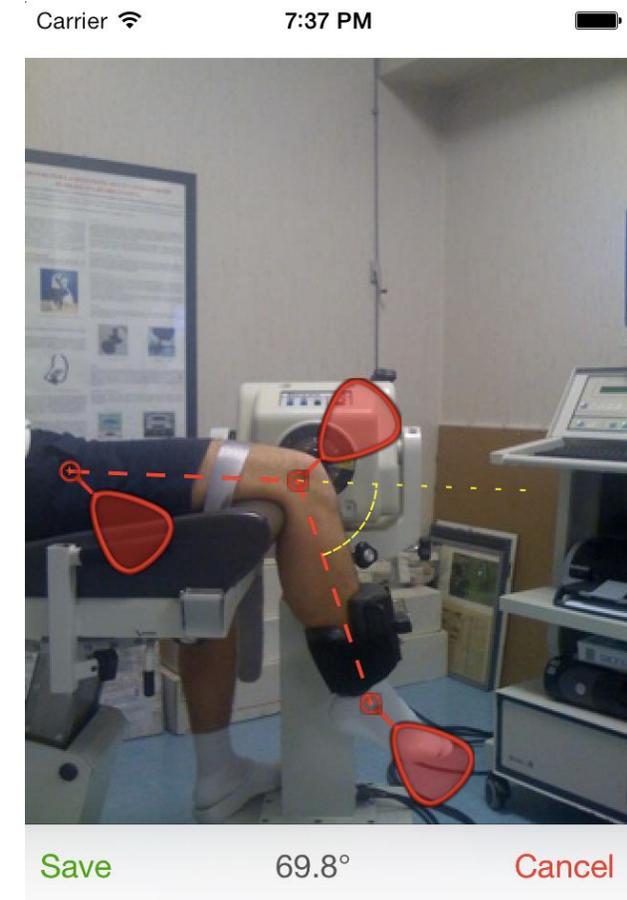
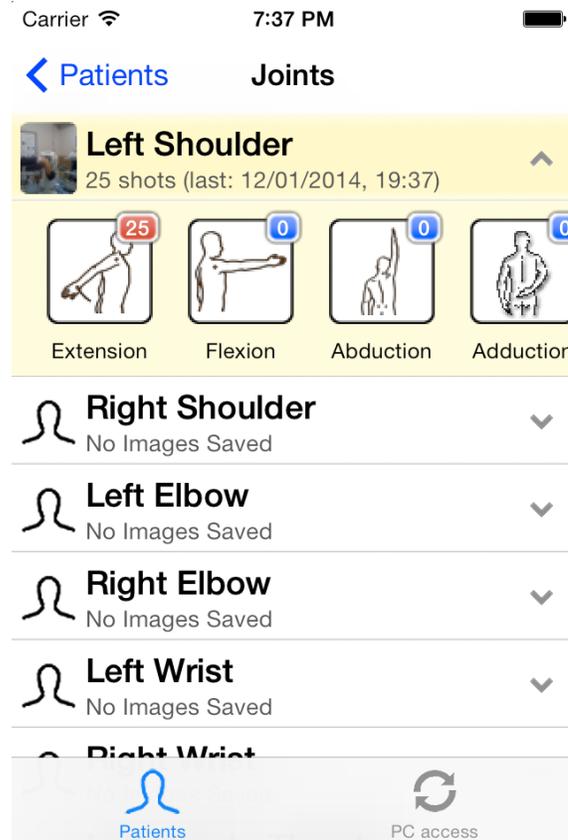
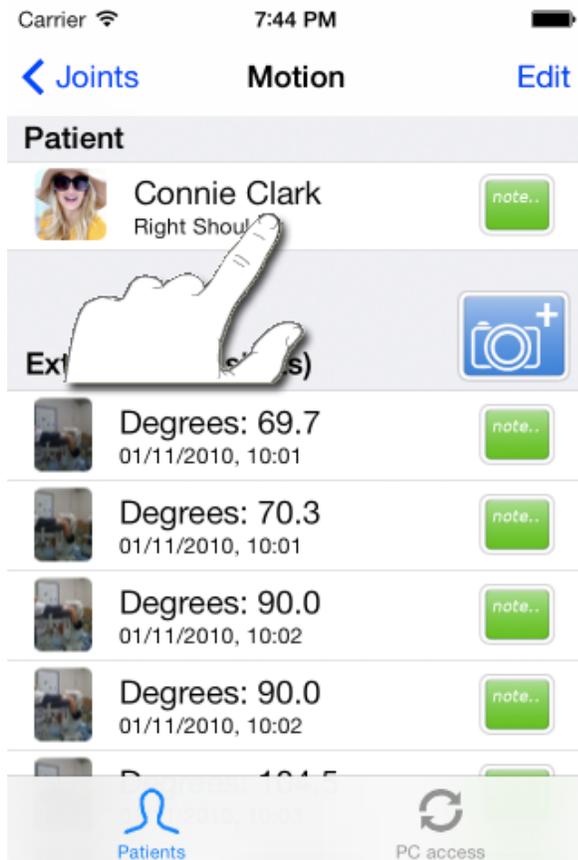
- The authors measured the angle from a laterally based view, using a line along the axis of the femur and a line drawn from the fibular head to the lateral malleolus.
- **The internet-based goniometer was a valid tool for measuring knee extension and flexion angles.**



<http://www.drgoniometer.com/>

- Castle H, Kozak K, Sidhu A, Khan RJK, Haebich S, Bowden V, Fick DP, Goonatillake H. Smartphone technology: a reliable and valid measure of knee movement in knee replacement. *Int J Rehabil Res* 2018;41(2):152-8
- Nava C, Sale P, Leggero V, Fundarò C, Ferrante S, Ferriero G, Ambrosini E. Feasibility of an iPhone-based application for knee joint goniometry during gait in a stroke patient. *JMIR [preprint]*
- Nussbaum R, Kelly C, Quinby E, Mac A, Parmanto B, Dicianno BE. Systematic review of mobile health applications in rehabilitation. *Arch Phys Med Rehabil* 2019 Jan;100(1):115-27
- Reid S, Egan B. The validity and reliability of DrGoniometer, a smartphone application, for measuring forearm supination. *J Hand Ther* 2019;32(1):110-7.
- Sánchez Rodríguez MT, Collado Vázquez S, Martín Casas P, Cano de la Cuerda R. Neurorehabilitation and apps: A systematic review of mobile applications. *Neurología* 2018;33(5):313-26
- Vercelli S, Sartorio F, Bravini E, Ferriero G. DrGoniometer: a reliable smartphone app for joint angle measurement. *Br J Sport Med* 2017;51(23)
- Choi W, Zheng H, Franklin P, Tulu B. mHealth technologies for osteoarthritis self-management and treatment: A systematic review. *Health Informatics J* 2017 Oct 1:1460458217735676
- Waddell BS, Duplantier NL, Luo Q, Meyer MS, Duncan SFM. Smartphone-based goniometry accuracy in clinical scenarios. *J Surg Orthop Adv* 2017;26(4):223-6
- Edwards SE, Lin Y, King JH, Karduna AR. Joint position sense - There's an app for that. *J Biomech* 2016;49(14):3529-33
- Jenny JY, Bureggah A, Diesinger Y. Measurement of the knee flexion angle with smartphone applications: Which technology is better?. *Knee Surg Sports Traumatol Arthrosc* 2016;24(9):2874-7
- Otter SJ, Agalliu B, Baer N, Hales G, Harvey K, James K, Keating R, McConnell W, Nelson R, Qureshi S, Ryan S, St John A, Waddington H, Warren K, Wong D. The reliability of a smartphone goniometer application compared with a traditional goniometer for measuring first metatarsophalangeal joint dorsiflexion. *J Foot Ankle Res* 2015;8:30
- Mourcou Q, Fleury A, Diot B, Franco C, Vuillerme N. Mobile phone-based joint angle measurement for functional assessment and rehabilitation of proprioception. *Biomed Res Int* 2015;2015:328142
- Kuegler P, Wurzer P, Tuca A, Sendlhofer G, Lumenta DB, Giretzlehner M, Kamolz LP. Goniometer-apps in hand surgery and their applicability in daily clinical practice. *Saf Health* 2015;1:11
- Ferriero G, Vercelli S, Sartorio F, Foti C. Is the smartphone app accurate enough?. *Knee* 2015;22(2):145-6
- Mitchell K, Gutierrez SB, Sutton S, Morton S, Morgenthaler A. Reliability and validity of goniometric iPhone applications for the assessment of active shoulder external rotation. *Physiother Theory Pract* 2014;30(7):521-5
- Ferriero G, Vercelli S, Sartorio F, Foti C. Accelerometer-based goniometer for smartphone and manual measurement on photographs: do they agree?. *Biomed Tech (Berl)* 2014;59(6):549-50
- Milani P, Coccetta CA, Rabini A, Sciarra T, Massazza G, Ferriero G. Mobile smartphone applications for body position measurement in rehabilitation: a review of goniometric tools. *PM R* 2014;6(11):1038-43
- Jenny JY. Answer to Ferriero et al. about "Measurement of the knee flexion angle..". *J Arthroplasty* 2014;29(2):449
- Ferriero G, Vercelli S, Sartorio F, Foti C. Accelerometer- and photographic-based smartphone applications for measuring joint angle: are they reliable?. *J Arthroplasty* 2014;29(2):448-9
- Ferriero G, Vercelli S, Sartorio F, Muñoz Lasa S, Ilieva E, Brigatti E, Ruella C, Foti C. Reliability of a smartphone-based goniometer for knee joint goniometry. *Int J Rehabil Res* 2013;36(2):146-51
- Ferriero G, Sartorio F, Foti C, Primavera D, Brigatti E, Vercelli S. Reliability of a new application for smartphones (DrGoniometer) for elbow angle measurement. *PM R* 2011;3(12):1153-4
- Mejia-Hernandez K, Chang A, Eardley-Harris N, Jaarsma R, Gill TK, McLean JM. Smartphone applications for the evaluation of pathologic shoulder range of motion and shoulder scores—a comparative study. *JSES Open Access* 2018;2(1):109–14
- Jeon IC, Kwon O, Weon J, Ha S, Kim S. Reliability and validity of measurement using smartphone-based goniometer of tibial external rotation angle in standing knee flexion. *Phys Ther Kor* 2013;20(2):60-68

<http://www.drgoniometer.com/>



Telemedicine in Orthopaedic Surgery

- **Assessments of function** have been found to be adequately performed during virtual evaluations of the **shoulder**.
 - With regard to the assessment of shoulder function, Goldstein et al. compared Constant scores between conventional face-to-face examinations and video examinations (on smartphones).



Goldstein Y, Schermann H, Dolkart O, Kazum E, Rabin A, Maman E, Chechik O. Video examination via the smartphone: a reliable tool for shoulder function assessment using the Constant score. J Orthop Sci. 2019 Sep;24(5):812-6. Epub 2019 Jan 25.

Telemedicine in Orthopaedic Surgery

- The mean Constant score for the video assessment was 0.53 point lower than that for the in-person assessment and concluded that video evaluations resulted in a reliable estimate of shoulder function.

Constant Score

Subjective Shoulder Assessment (35 total points)

Criteria	Points	Patient Score
Pain (15 points)		
None	15	= 15
Mild	10	
Moderate	5	
Severe	0	
Activities of daily living (10 points)		
Ability to work	0-4	= 4
Ability to engage in recreational activities	0-4	
Ability to sleep	0-2	
Ability to work at a specific level (10 points)		
Waist	2	= 10
Chest	4	
Neck	6	
Head	8	
Above head	10	

Objective Shoulder Assessment (65 points)

Criteria	Points	Patient Score
Flexion and abduction (scored separately)		
>150°	10	Flexion= 10 Abduction= 10
121°-150°	8	
91°-120°	6	
61°-90°	4	
31°-60°	2	
0°-30°	0	
Combined active external rotation (10 points)		
Hand behind head, elbow forward	2	= 2
Hand behind head, elbow back	2	
Hand on top of head, elbow forward	2	
Hand on top of head, elbow back	2	
Full elevation from top of head	2	
Combined active internal rotation (10 points)		
Interscapular region	10	= 10
Inferior tip of scapula	8	
Twelfth rib	6	
Lumbosacral junction	4	
Buttock	2	
Lateral thigh	0	
Strength (25 points)	1/lb	= 25
		Score
		100

FROM: Constant CR, CORR 1987;214:160

*example is a patient with normal shoulder function. Change values as indicated under "Patient Score" to determine patients Constant Score.

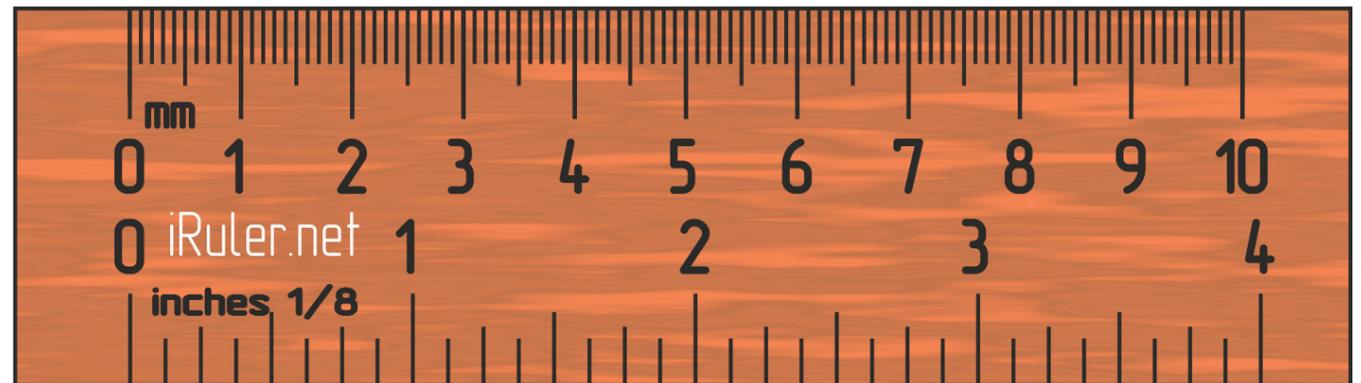
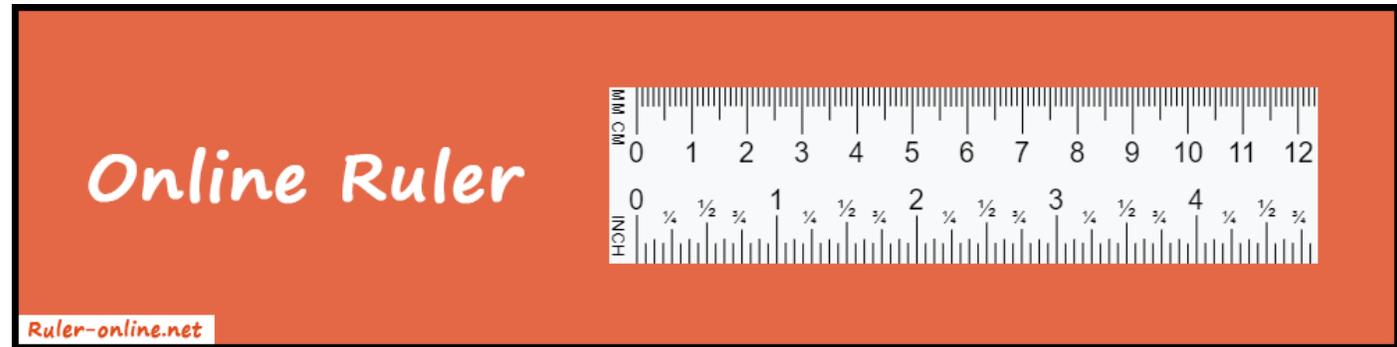
Telemedicine in Orthopaedic Surgery

- **Challenges** have been reported with telemedicine visits, particularly with implementation within the elderly population.
 - These patients may also benefit the most from televisit capabilities because of their **limited mobility and higher risk of morbidity** during the current pandemic.



Telemedicine in Orthopaedic Surgery

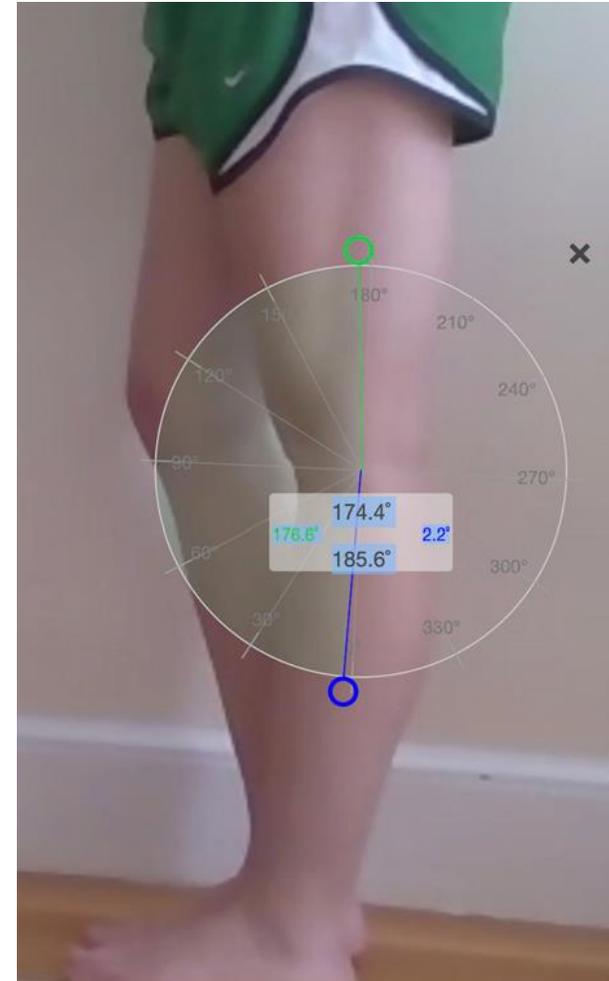
- For **leg length**, a virtual ruler can be used to make side-to-side comparisons of the measurements of the distance from the **anterior superior iliac spine (ASIS)** to the floor.
- Patients can be asked to place a *finger on the ASIS* to assist with finding this landmark for measurement.



Telemedicine in Orthopaedic Surgery

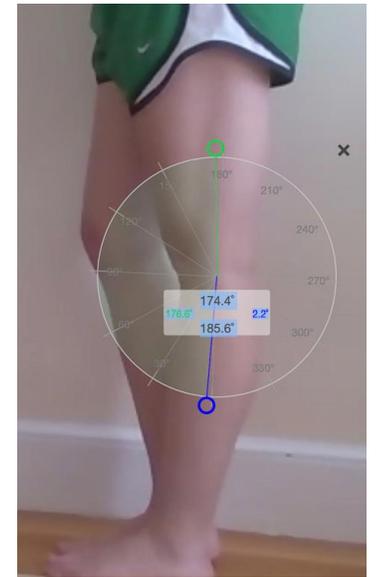
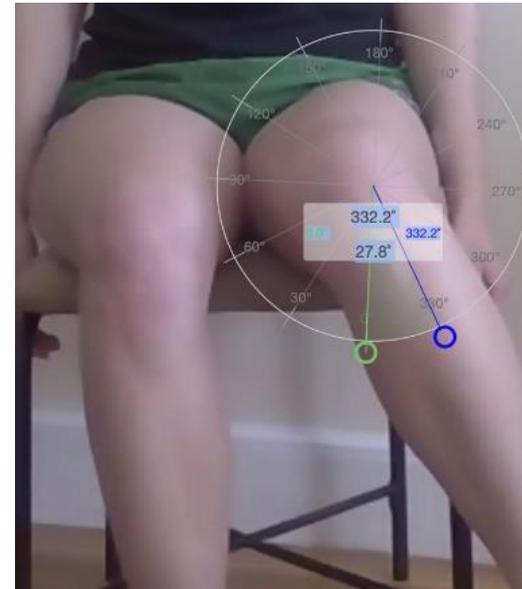
- Alignment
- Range of Motion

Telemedicine in the Era of COVID-19 The Virtual Orthopaedic Examination. [Miho J. Tanaka, MD](#), [Luke S. Oh, MD](#), [Scott D. Martin, MD](#), [Eric M. Berkson, MD](#)
The Journal of Bone and Joint Surgery, Section COVID-19
June 17, 2020; 102 (12): e57, DOI: 10.2106/JBJS.20.00609



Telemedicine in Orthopaedic Surgery

- Digital lines can be added to evaluate for pelvic obliquity, and side-to-side comparisons of pixel measurements can serve as a substitute for leg-length or circumference measurements.
- Observation of the J sign in a sitting position facing the camera can be helpful in the evaluation of patellar instability.



Telemedicine in Orthopaedic Surgery

- External rotation can be assessed by asking the patient to initiate crossing the legs or placing them in a figure-of-4 position.
- Localization of pain and tenderness is assessed by asking the patient to point to this area.



Telemedicine in Orthopaedic Surgery

- In atraumatic cases, flexion, adduction, and internal rotation (FADIR) and flexion, abduction, and external rotation (FABER)

tests may be performed by demonstrating (or providing a visual example of) the test and having the patient mimic this motion, to help differentiate between hip and spine-related pain.

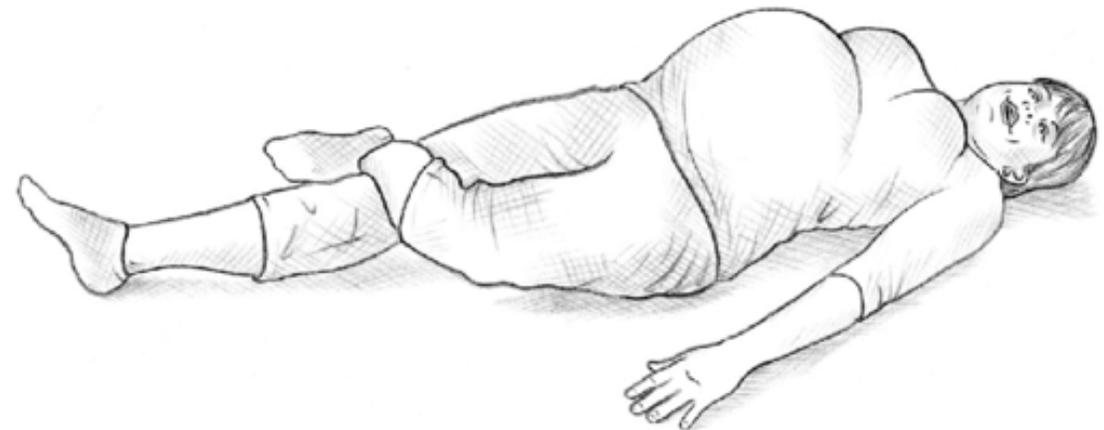


FADDIR Test



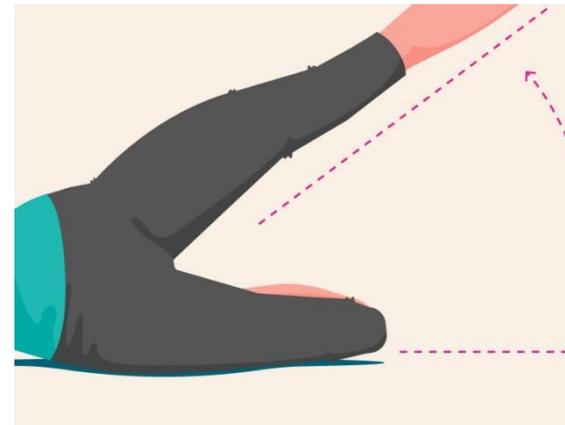
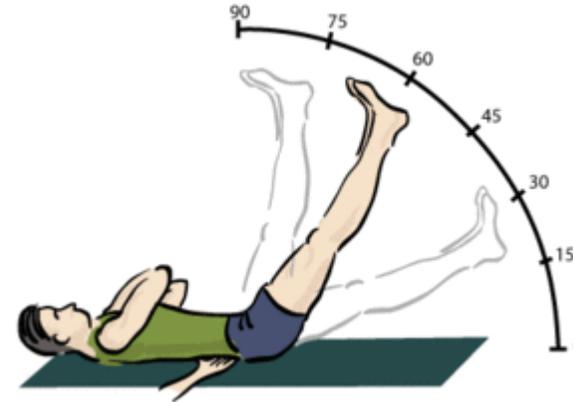
- FADDIR Test (Flexion ADDuction Internal Rotation) or as it called the **Anterior apprehension test of the hip joint** is used to examine the:
 1. Femoroacetabular impingement syndrome.
 2. Anterior labral tear.
 3. Iliopsoas tendinitis.
- This test is also called **Femoroacetabular Impingement Test**.

ORTHOFIXAR.COM



Telemedicine in Orthopaedic Surgery

- A straight-leg raise to test for hip strength and pain is performed.
- The evaluation of abduction strength in the side-lying position (gluteus medius, L5) can be assessed.
 - Having the patient perform **toe-walking** can demonstrate strength in L5/S1 and having the patient perform **heel-walking** can demonstrate strength in L4.



Telemedicine in Orthopaedic Surgery

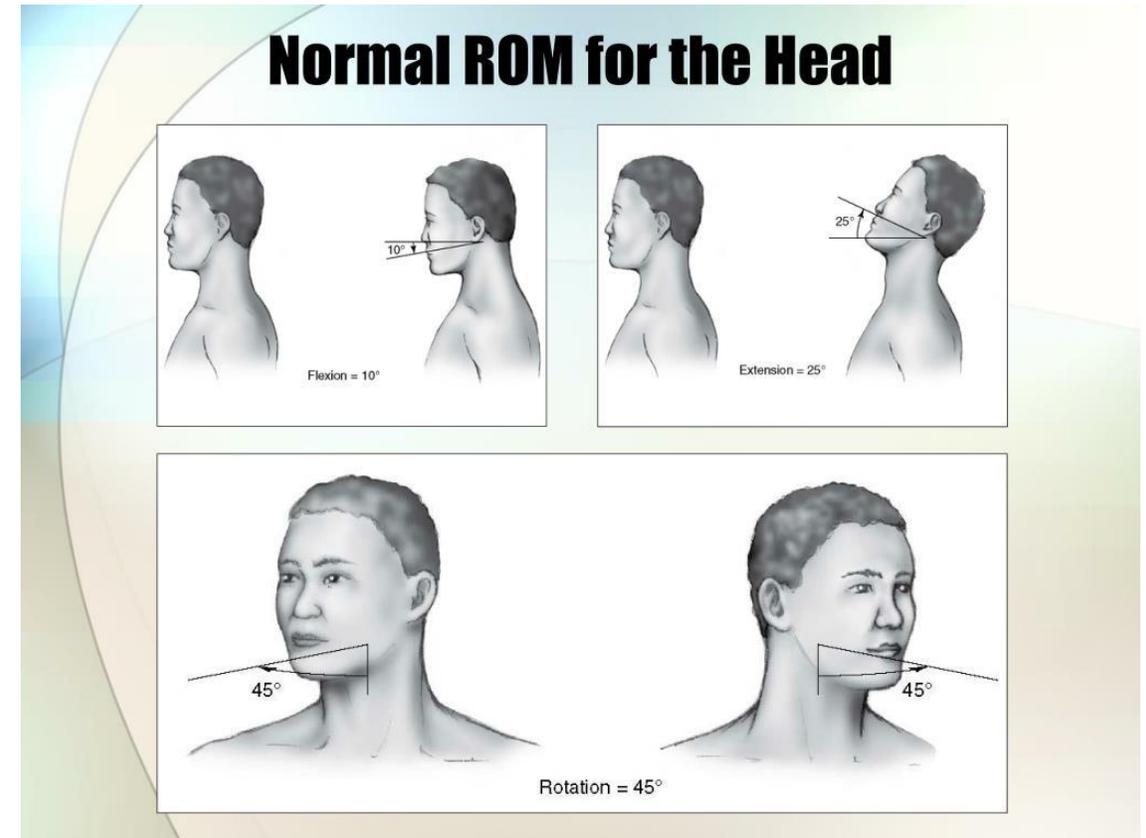
- Hip extension strength can be assessed by having the patient sit back in a chair and arise without using the arms to assist.



Telemedicine in Orthopaedic Surgery

Neck & Shoulder

- Cervical range of motion.
- Inspection anteriorly and posteriorly for overlying skin changes, scars, erythema or ecchymosis, and atrophy.
- The patient is asked to point with 1 finger to the area of maximal discomfort.

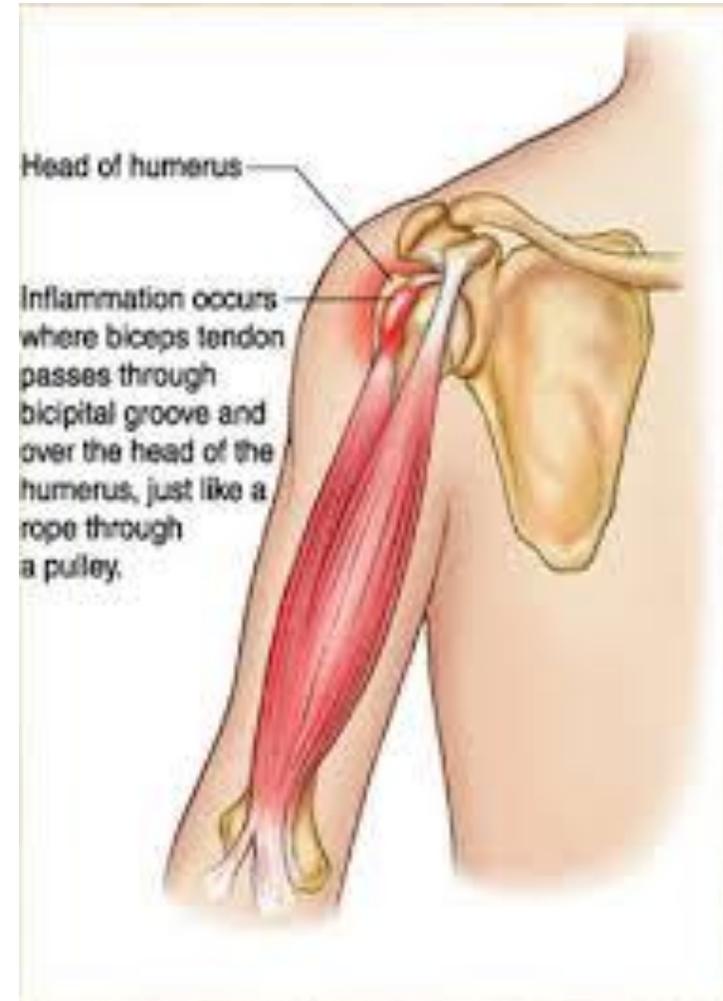


Telemedicine in Orthopaedic Surgery

- **Palpation:** the patient can be directed to find the sternal notch and then walk the fingers to the sternoclavicular joint, across the clavicle, to the acromioclavicular joint.
- The bicipital groove faces forward with the arm in 10 of external rotation and can often be localized and palpated by a cooperative patient.
 - Tenderness in each of these areas is noted

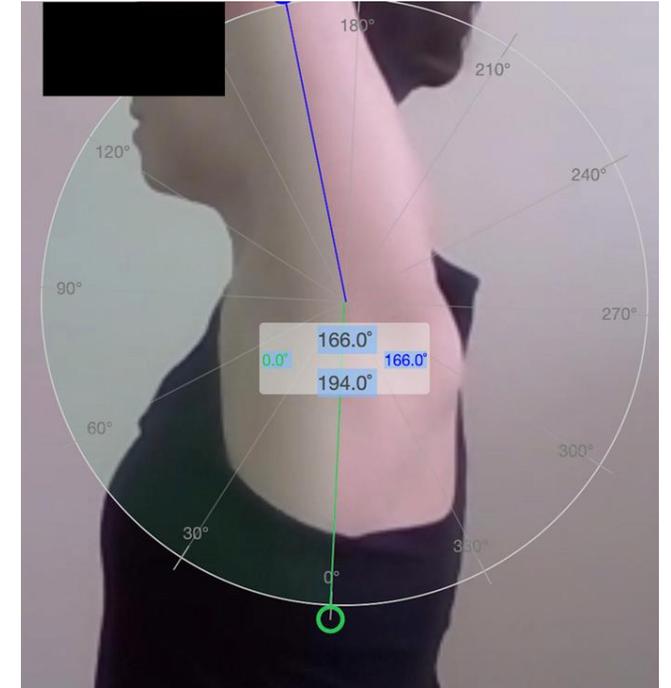
Telemedicine in Orthopaedic Surgery

- The **bicipital groove** faces forward with the arm in 10 degrees of external rotation and can often be localized and palpated by a cooperative patient.
- Tenderness in each of these areas is noted



Telemedicine in Orthopaedic Surgery

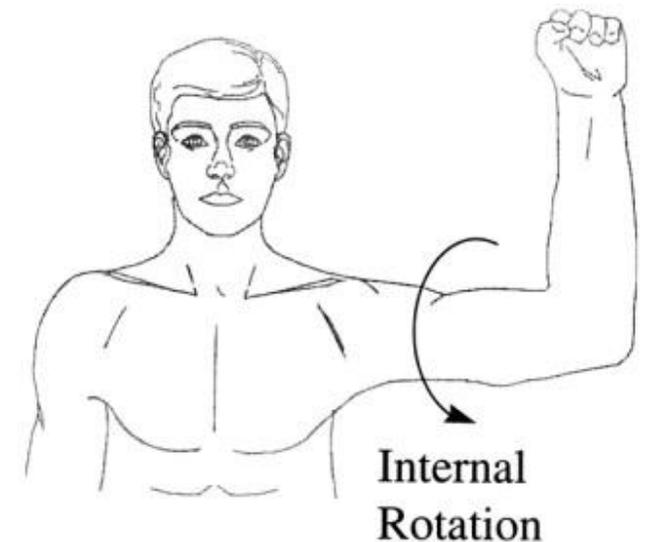
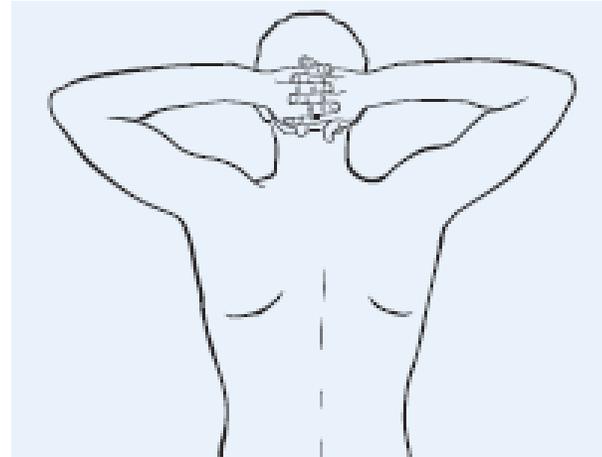
- An internet-based goniometer can be used to assess forward flexion by measuring the angle between the midaxillary line and a line along the axis of the humeral shaft.
 - Active abduction is performed with the patient facing the camera.
- With the arms at the waist, external rotation is assessed.
- Forward flexion is assessed by having the patient turn 90 to the side



Telemedicine in the Era of COVID-19 The Virtual Orthopaedic Examination. [Miho J. Tanaka, MD](#), [Luke S. Oh, MD](#), [Scott D. Martin, MD](#), [Eric M. Berkson, MD](#); The Journal of Bone and Joint Surgery, Section COVID-19, **June 17, 2020**; 102 (12): e57, DOI: 10.2106/JBJS.20.00609

Telemedicine in Orthopaedic Surgery

- In the same position, the arms are abducted to 90, and external and internal rotation are assessed in the limb closest to the camera.
- **Internal rotation** is additionally viewed with the patient facing away from the camera.
- Instruction using visual demonstration and mirroring can be helpful in this setting.



Telemedicine in Orthopaedic Surgery

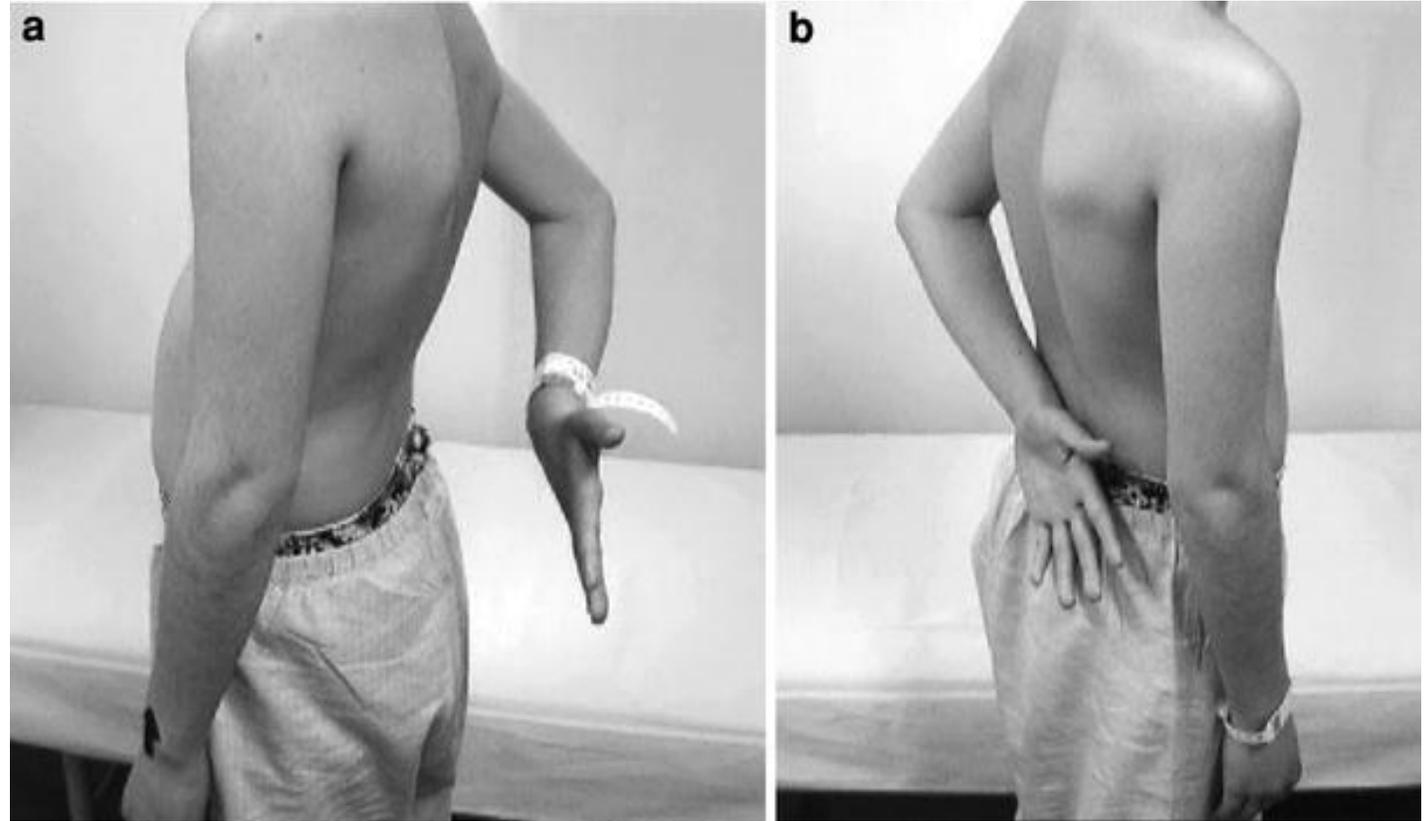
Strength testing

in the upper extremity can be performed against gravity and with the addition of common household items of known weights.



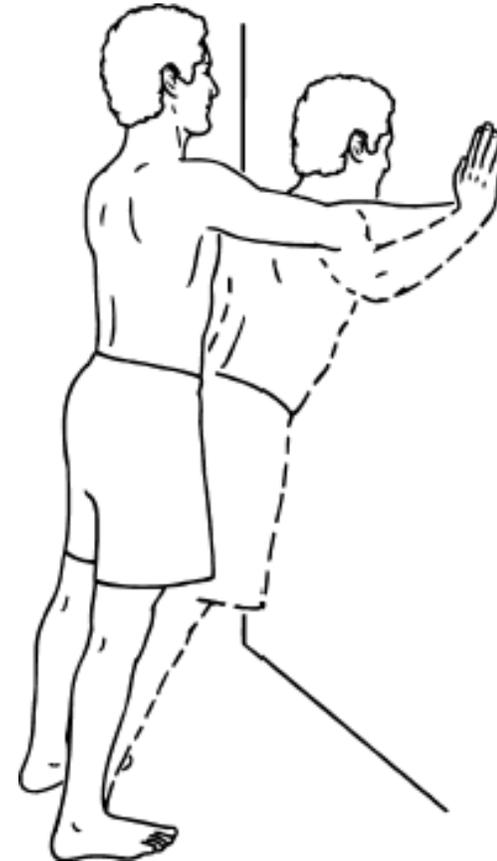
Telemedicine in Orthopaedic Surgery

- The **lift-off test** against gravity is viewed from the side.



Telemedicine in Orthopaedic Surgery

- In atraumatic cases, **scapular motion** is assessed by having the patient face away from the camera during active abduction and forward flexion.
- A **wall push-up** can be performed while observing for **scapular symmetry and strength** along with an evaluation for **scapular winging**.

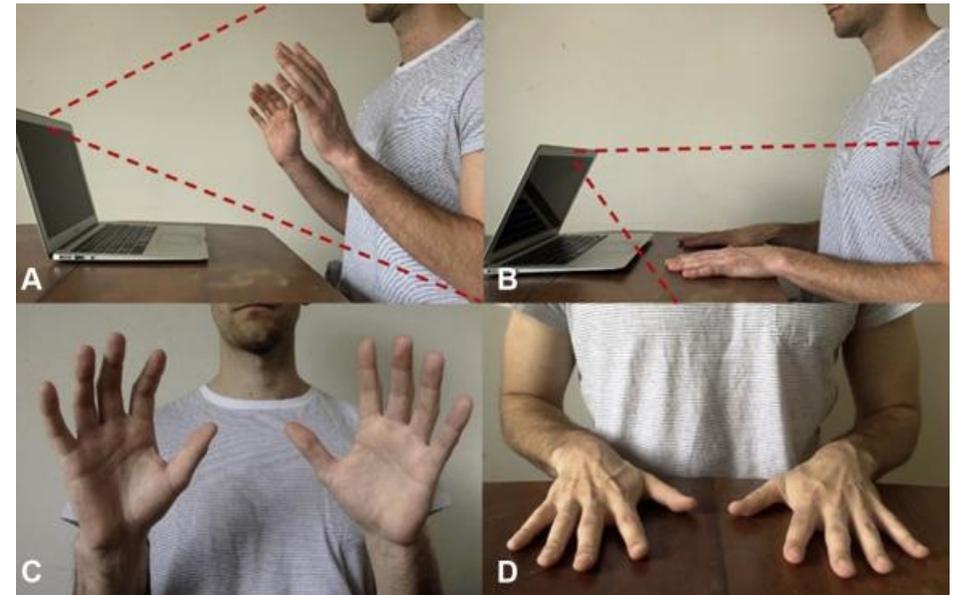


Telemedicine in Orthopaedic Surgery

Elbow

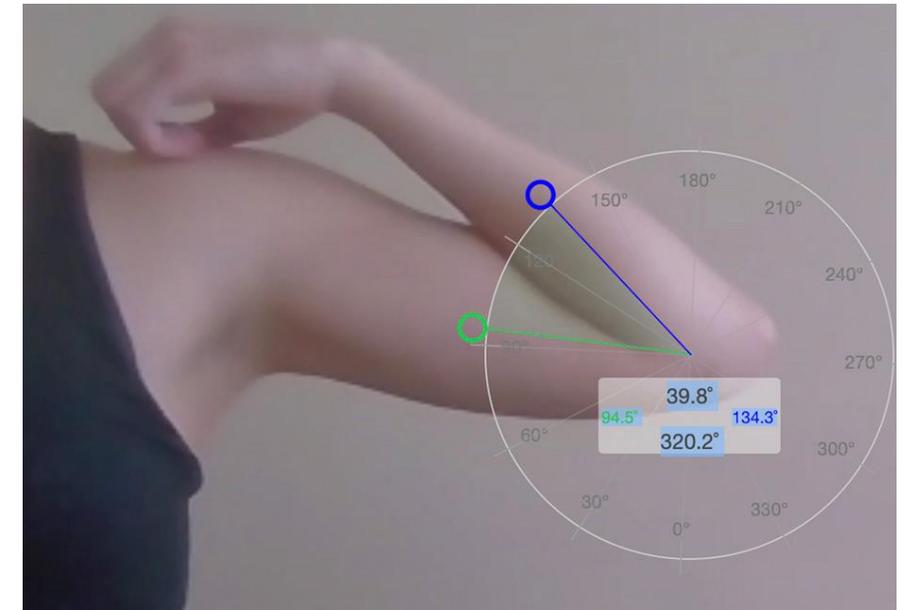
- The virtual examination of the elbow begins with **visual inspection**.
- The presence of skin changes, effusion, erythema, or ecchymosis is noted. The patient is asked to point to the area of maximal pain.
- Flexion and extension of the elbow are observed with the patient facing the camera and abducting the arm to 90, with the palms facing upward.

Physical Examination of the Elbow



Telemedicine in Orthopaedic Surgery

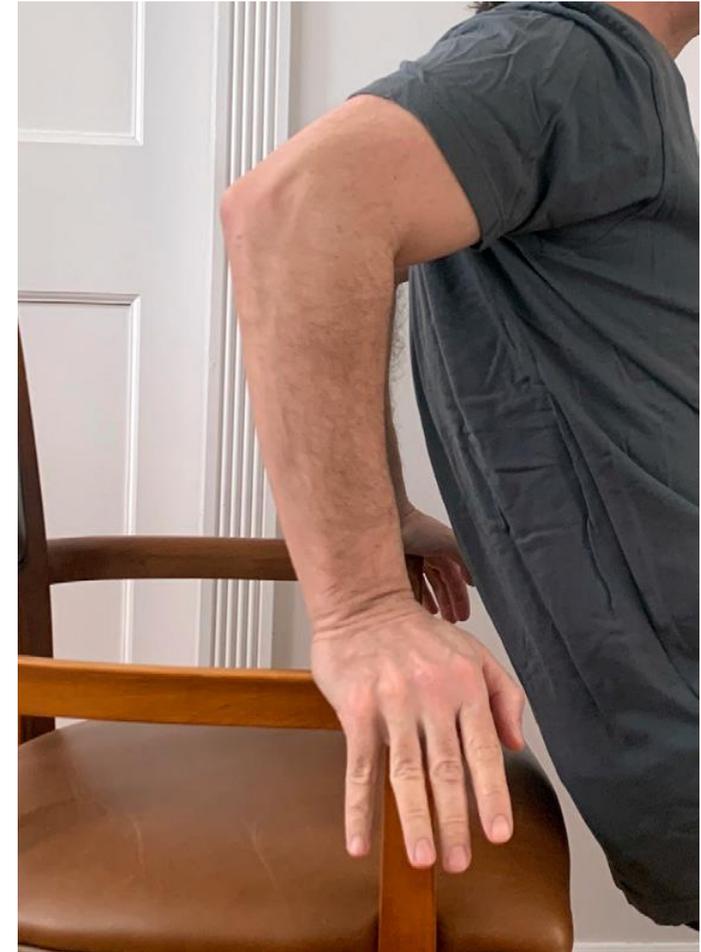
- Range of motion of the elbow is assessed from the front, with the arm abducted to 90.
- **Supination and pronation** are assessed by having the patient facing the camera, with the arms at the sides and the elbows bent to 90.
- **Abduction and extension of the fingers** during assessment of supination and pronation can aid in visualization and in measurements if a goniometer is utilized



Telemedicine in the Era of COVID-19 The Virtual Orthopaedic Examination. [Miho J. Tanaka, MD](#), [Luke S. Oh, MD](#), [Scott D. Martin, MD](#), [Eric M. Berkson, MD](#); The Journal of Bone and Joint Surgery, Section COVID-19, **June 17, 2020**; 102 (12): e57, DOI: 10.2106/JBJS.20.00609

Telemedicine in Orthopaedic Surgery

- The **chair push-up test** can be used for the evaluation of posterolateral rotatory instability.
- The patient is asked to turn 90° with the injured elbow closest to the camera and to then push off from a chair with the fingers pointed away from the body.
- **Pain or apprehension** during this maneuver may indicate possible posterolateral rotatory instability.



Telemedicine in Orthopaedic Surgery

- **Strength testing** can be performed against gravity and while holding objects of known weight during wrist and elbow flexion and extension.

TABLE II Approximate Weights of Household Items That Can Be Used During Strength or Provocative Testing of the Upper Extremity

Item	Approximate Weight*
Handheld plastic stapler	0.2 (0.5)
Bottle of water (450 mL or 16 oz); empty wine bottle (750 mL)	0.5 (1)
Quart of milk (950 mL); 1-L bottle of soda	1 (2)
Half-gallon of milk (1.9 L); 2-L soda bottle (full); unopened bottle of wine (750 mL)	2 (4 to 5)
Gallon of milk (3.8 L)	4 (8)

*The values are given in kilograms, with pounds in parentheses.

Telemedicine in Orthopaedic Surgery

*Edward R. Laskowski, MD, Shelby E. Johnson, MD,
Randy A. Shelerud, MD, Jason A. Lee, DO, Amy E.
Rabatin, MD, Sherilyn W. Driscoll, MD, Brittany J. Moore,
MD, Michael C. Wainberg, MD, Carmen M. Terzic, MD,
PhD*

Mayo Clinic Proceedings

Volume 95 Issue 8 Pages 1715-1731 (August 2020)

DOI: 10.1016/j.mayocp.2020.05.026



Telemedicine in Orthopaedic Surgery

Low Back
Inspection



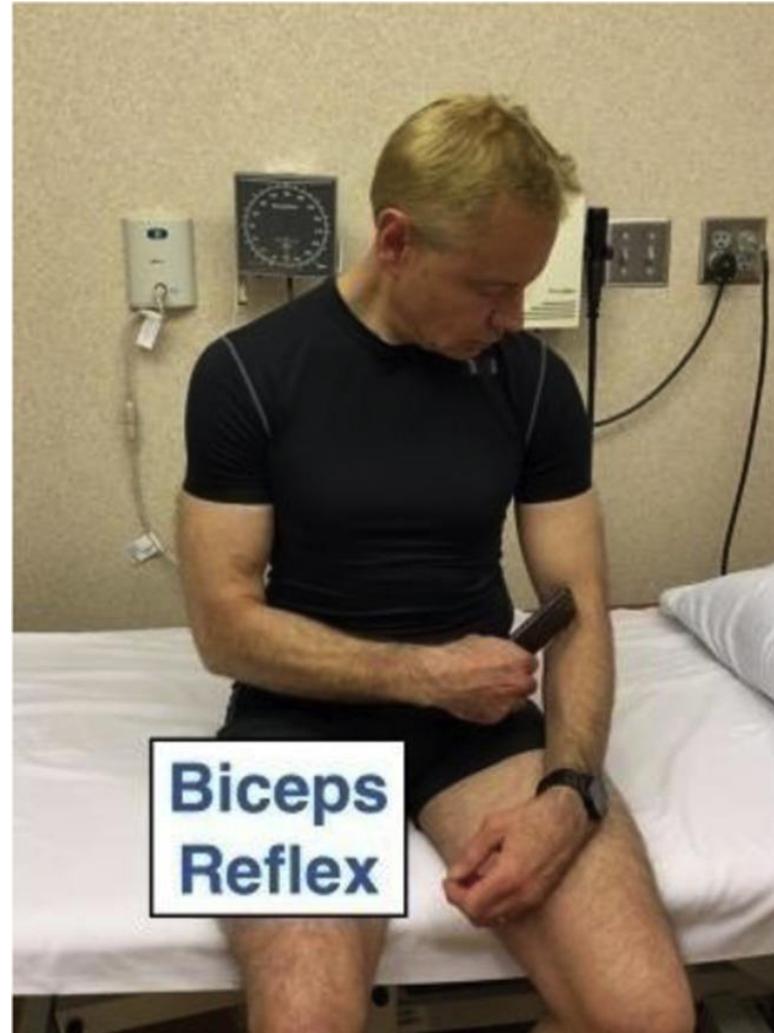
Telemedicine in Orthopaedic Surgery



Telemedicine in Orthopaedic Surgery

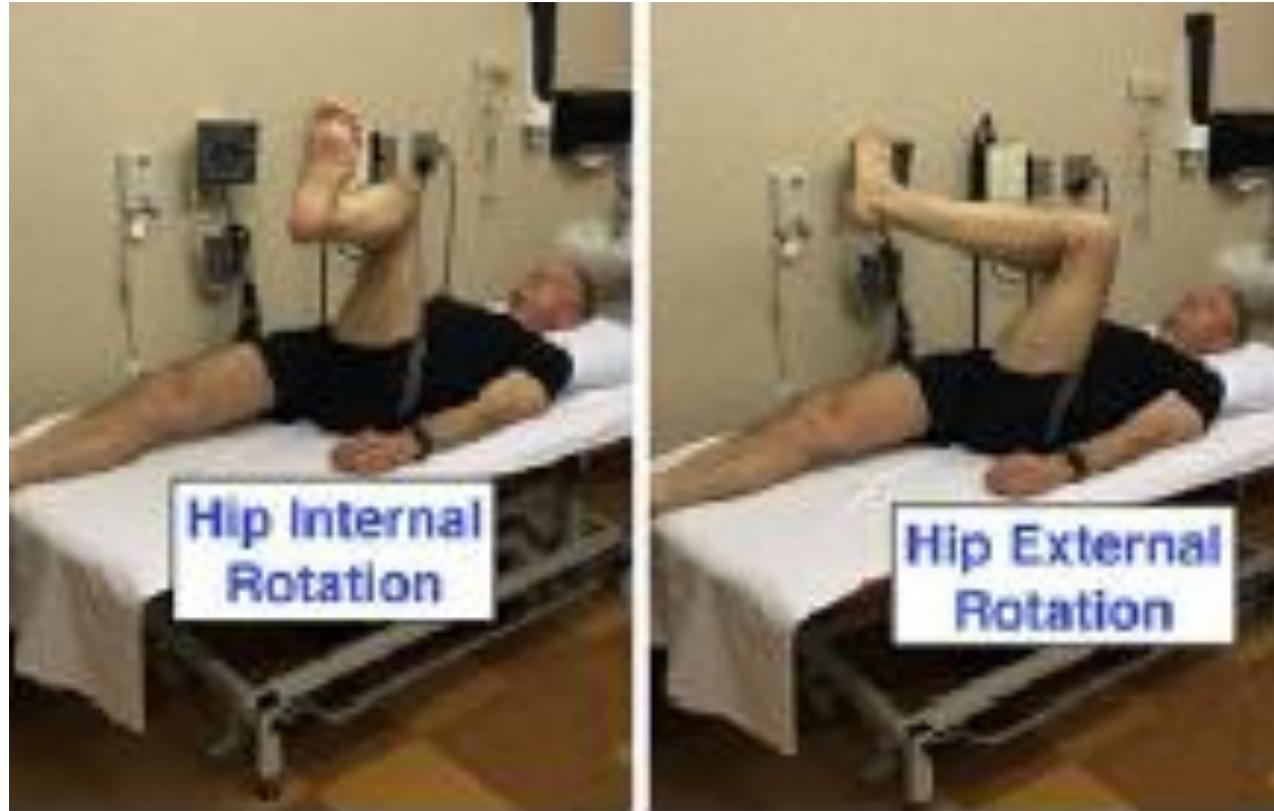


Telemedicine in Orthopaedic Surgery



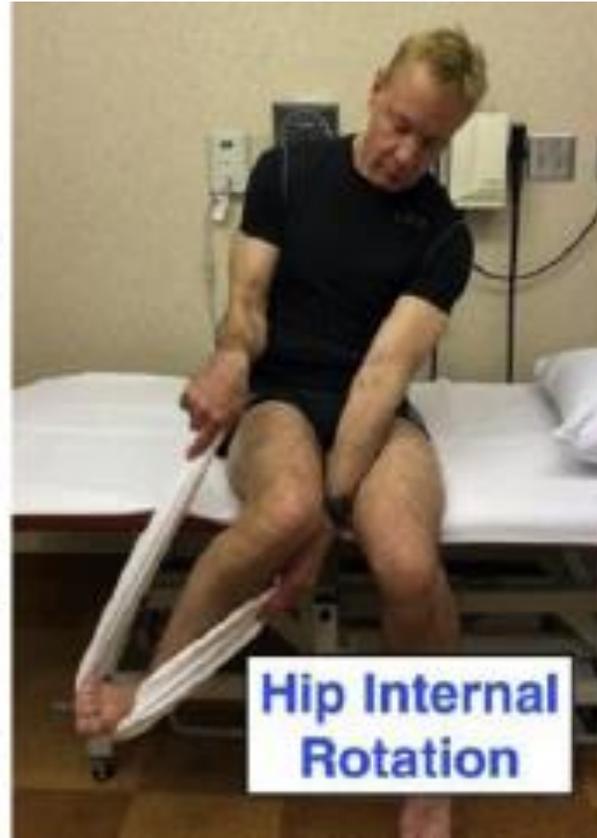
Telemedicine in Orthopaedic Surgery

Hip Examination



Telemedicine in Orthopaedic Surgery

Seated Hip Examination



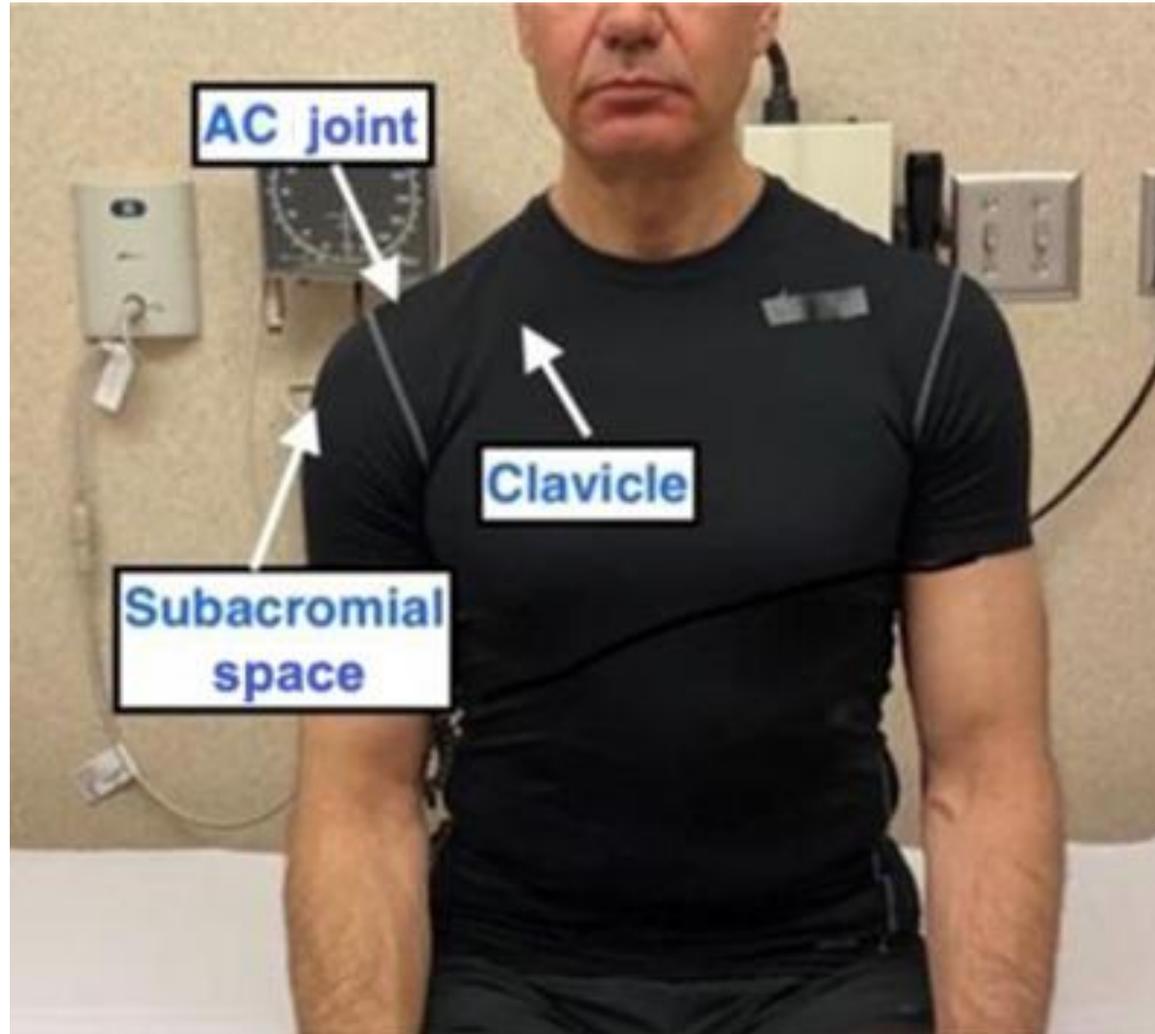
Telemedicine in Orthopaedic Surgery

Seated Hip Examination



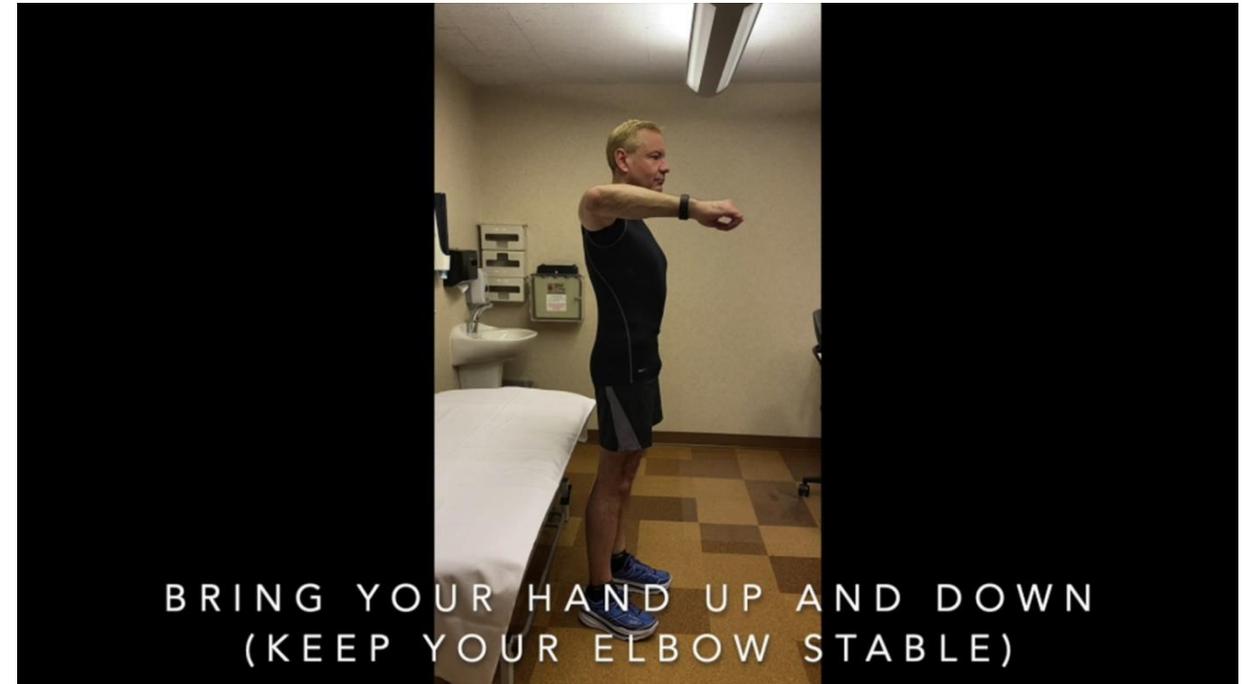
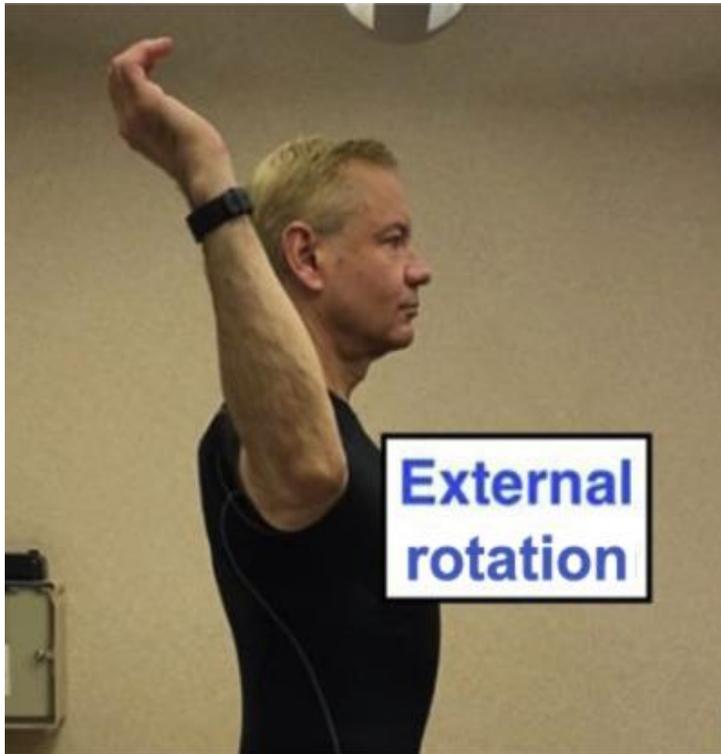
Telemedicine in Orthopaedic Surgery

Shoulder Examination



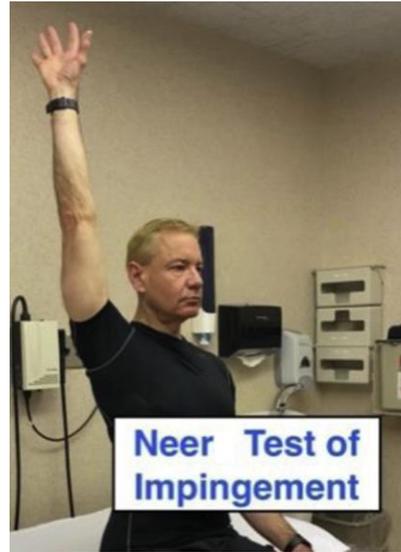
Telemedicine in Orthopaedic Surgery

Shoulder Examination



Telemedicine in Orthopaedic Surgery

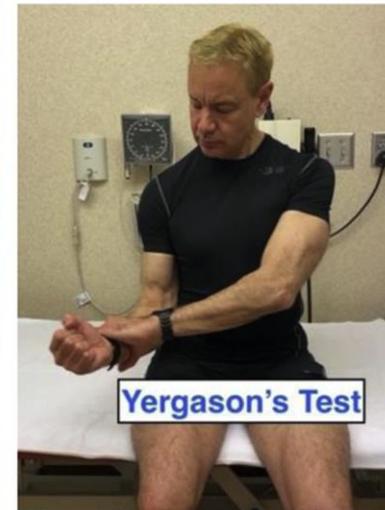
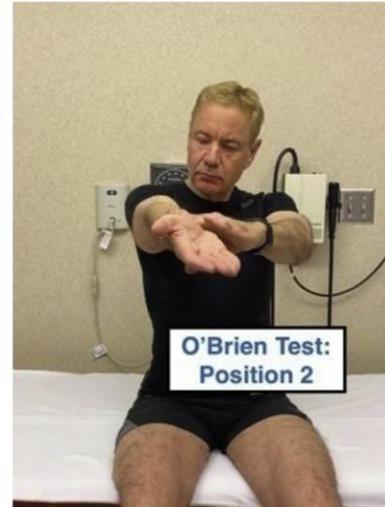
Shoulder Examination Impingement Tests



Telemedicine in Orthopaedic Surgery

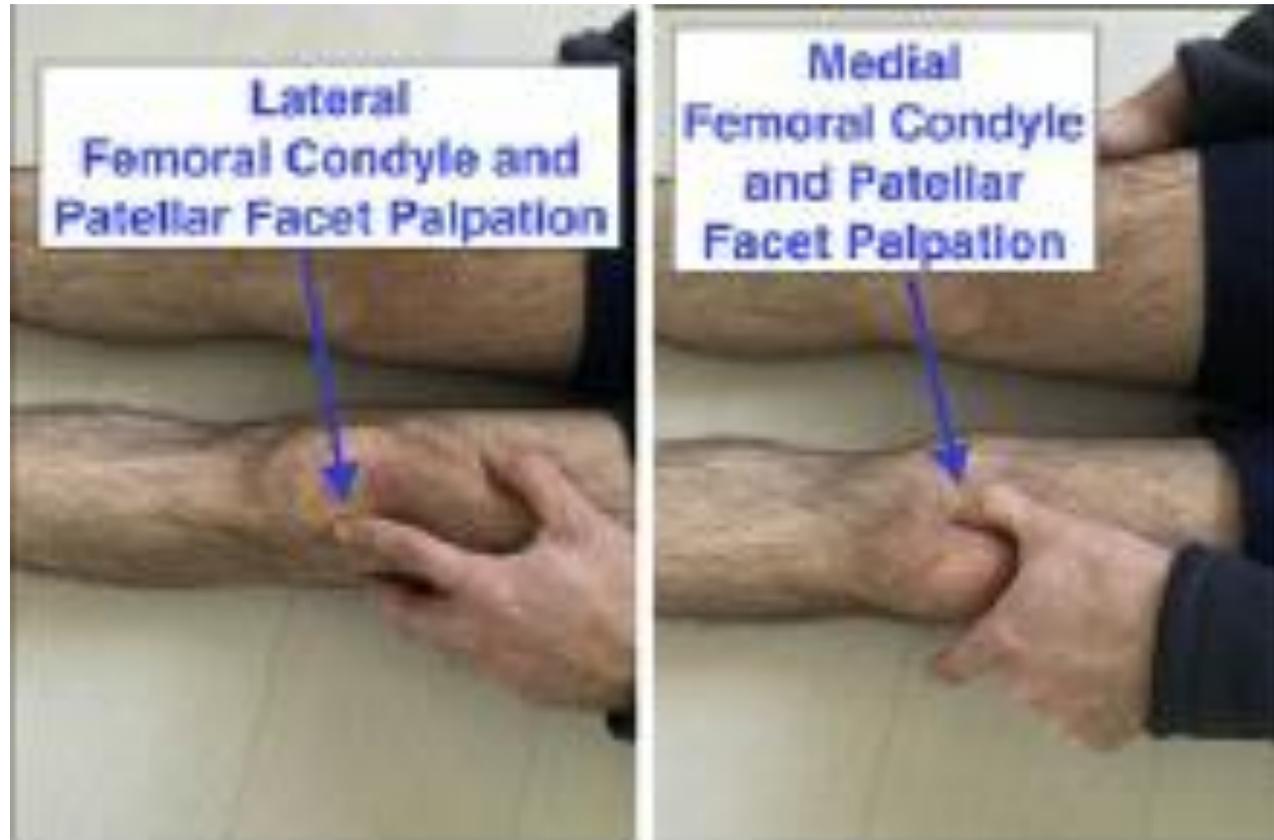
Shoulder
Examination

Bicipital Tendon Tests



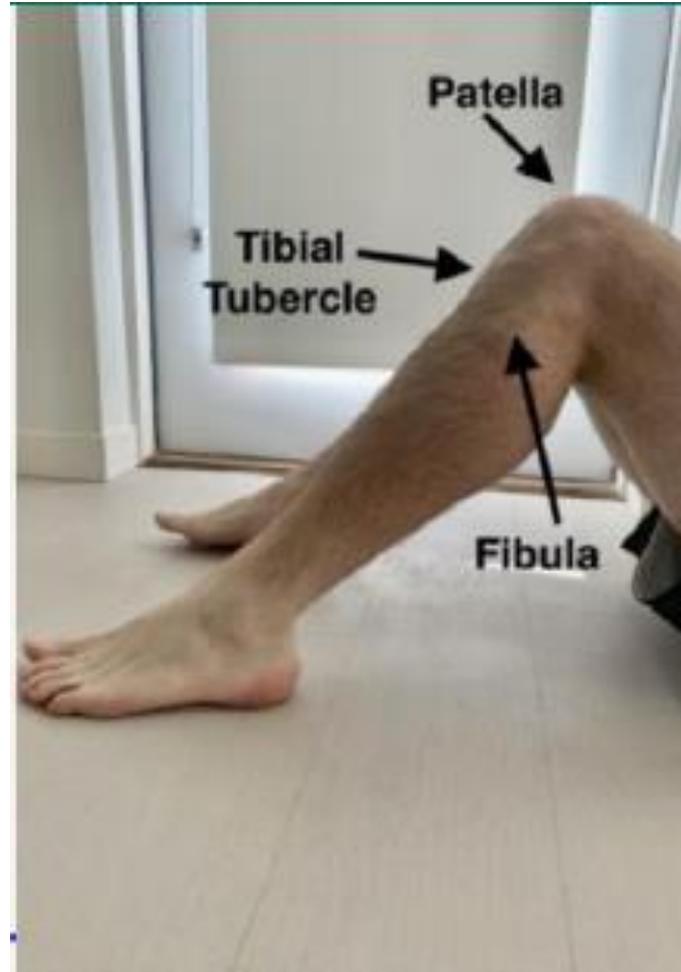
Telemedicine in Orthopaedic Surgery

Knee Examination



Telemedicine in Orthopaedic Surgery

Knee Examination



Telemedicine in Orthopaedic Surgery

Seated Knee Evaluation



Telemedicine in Orthopaedic Surgery

Seated
Knee Evaluation



Telemedicine in Orthopaedic Surgery

Ankle Examination



Telemedicine in Orthopaedic Surgery

Ankle Examination



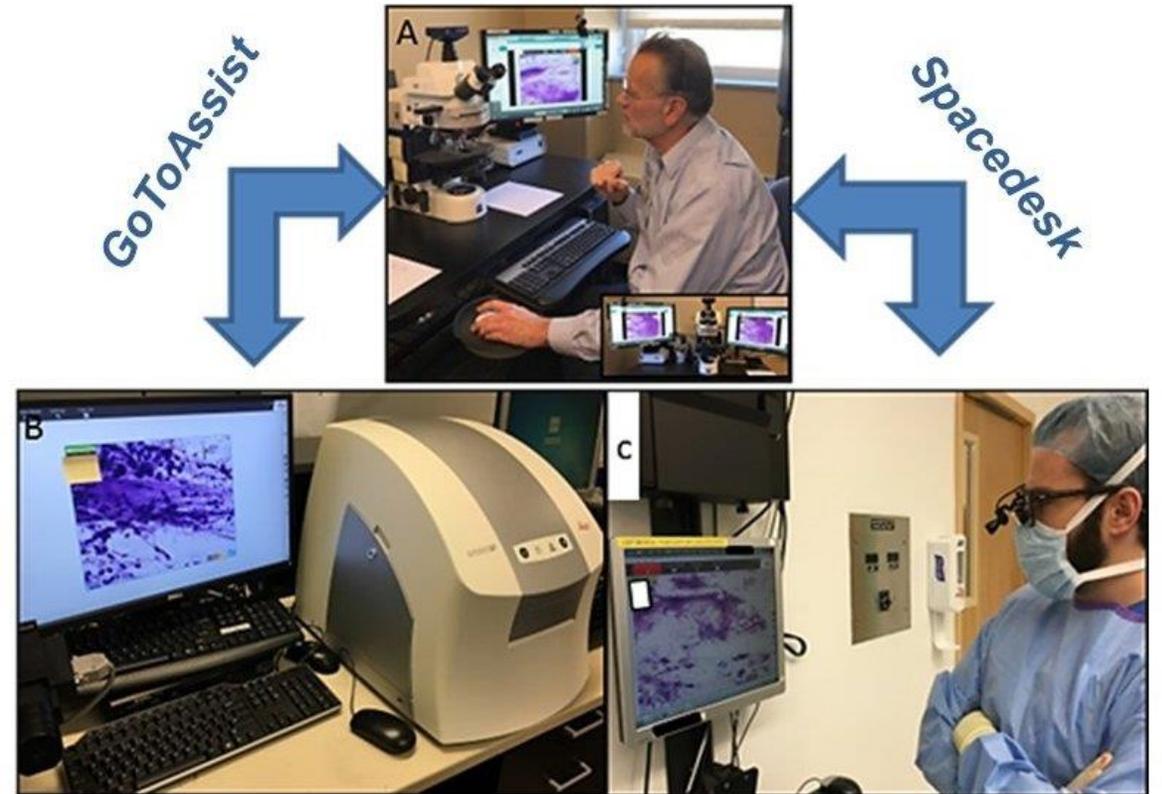
Telemedicine & Medical Education

- The cornerstone of medical education is patient care.
- While direct patient care has been appropriately limited at most schools, the lessons learned from these critical patient interactions cannot be fully replaced by readings, lectures, case studies, or online modules.



Telemedicine & Medical Education

- In pathology and radiology, screen-sharing technologies could allow students to become involved in review of slides and imaging remotely (EPAs 2 and 3).



Telemedicine & Medical Education

- Students can participate in consults or rounds without stepping into patient rooms through the use of tablets.

- Bashshur R, Doarn CR, Frenk JM, Kvedar JC, Woolliscroft JO. **Telemedicine and the COVID-19 Pandemic, Lessons for the Future.** Telemedicine and e-Health 2020 May 01;26(5):571-573. [doi: 10.1089/tmj.2020.29040.rb]
- DeJong C, Lucey CR, Dudley RA. **Incorporating a New Technology While Doing No Harm, Virtually.** JAMA 2015 Dec 08;314(22):2351-2352. [doi: 10.1001/jama.2015.13572] [Medline: 26647252]



Telemedicine & Medical Education

- Schools could use the following learning vehicles to help medical students explore these domains
- (1) asynchronous lectures covering telehealth history;
- (2) discussions on applications, ethics, safety, etiquette, and patient considerations;
- (3) faculty-supervised standardized patient telehealth encounters;
- (4) hands-on diagnostic or therapeutic procedures using telehealth equipment.



TeleRadiology

- Computed radiography with tele-radiology had significant clinical value in this resource-limited setting, with the potential to affect both patient outcomes and treatment costs through providing improved diagnostics and avoiding unnecessary treatments and medications.
- Final analysis included 536 cases.
- Diagnosis changed following radiography and teleradiology in 62% of cases, and treatment plans changed in 61%.

TeleRadiology

- Reduced final treatment plans were most common for
 - exploratory surgery (72% decrease),
 - surgical orthopaedic intervention (62% decrease),allowing more conservative medical or surgical management in 61 cases.



The impact of computed radiography and teleradiology on patients' diagnosis and treatment in Mweso, the Democratic Republic of Congo
Iona Crumley, Jarred Halton, Jane Greig, Lucien Kahunga, Jean-Paul Mwanga, Arlene Chua, Cara Kosack, January 2020, [PLoS ONE](https://doi.org/10.1371/journal.pone.0227773) 15(1):e0227773, DOI: [10.1371/journal.pone.0227773](https://doi.org/10.1371/journal.pone.0227773)

The term “telepathology” was introduced into The English language in 1986 by Weinstein [Weinstein 1986; Kaplan et al. 2012]



CLINICAL GUIDELINES FOR TELEPATHOLOGY

AUGUST 2014

Imaging System	Year
Real-time Imaging	
Television microscopy	1952
Dynamic-robotic telepathology	1986
Static Image Telepathology	
Store & Forward telepathology	1987
Whole slide imaging (automated)	1991
Whole slide imaging (operator-directed)	1994
Multi-Modality Telepathology	
Hybrid dynamic robotic/static imaging	1989
Whole slide imaging dynamic robotic/static imaging	2011



Telemedicine to follow patients in a **General Surgery** department, RCT

- A prospective randomized clinical trial (RCT) was conducted in 200 patients to compare conventional vs telemedicine follow-up in the outpatient clinics.
- The primary outcome was the feasibility of telemedicine follow-up and the secondary outcomes were its clinical impact and patient satisfaction
- The **primary outcome** was achieved in 90% of the conventional follow-up group and in 74% of the telemedicine group (P = 0.003). No differences were found in clinical outcomes (P = 0.832) or patient satisfaction (P = 0.099).
- Telemedicine is a good complementary service to facilitate follow-up management in selected patients from a General Surgery department.

Telesurgery

- Wireless networking and **robotic technology** to allow surgeons to operate on patients who are distantly located. This technology not only benefits today's shortage of surgeons, but it also eliminates geographical barriers that prevent timely and high-quality surgical intervention, financial burden, complications, and often risky long-distance travel.
- The system also provides improved surgical accuracy and ensures the safety of surgeons.

Telesurgery

Benefits of Telesurgery

Provides high-quality surgery to medically underserved locations [6] such as rural areas, battlefields, and spacecraft [5-8]

Eliminates the need for long-distance travels, along with travel-related financial burden and dangers [2-5,7]

Today's 3-Dimensional display system provides a shared, high-definition visual feedback to surgeons at different centers simultaneously [5,9]

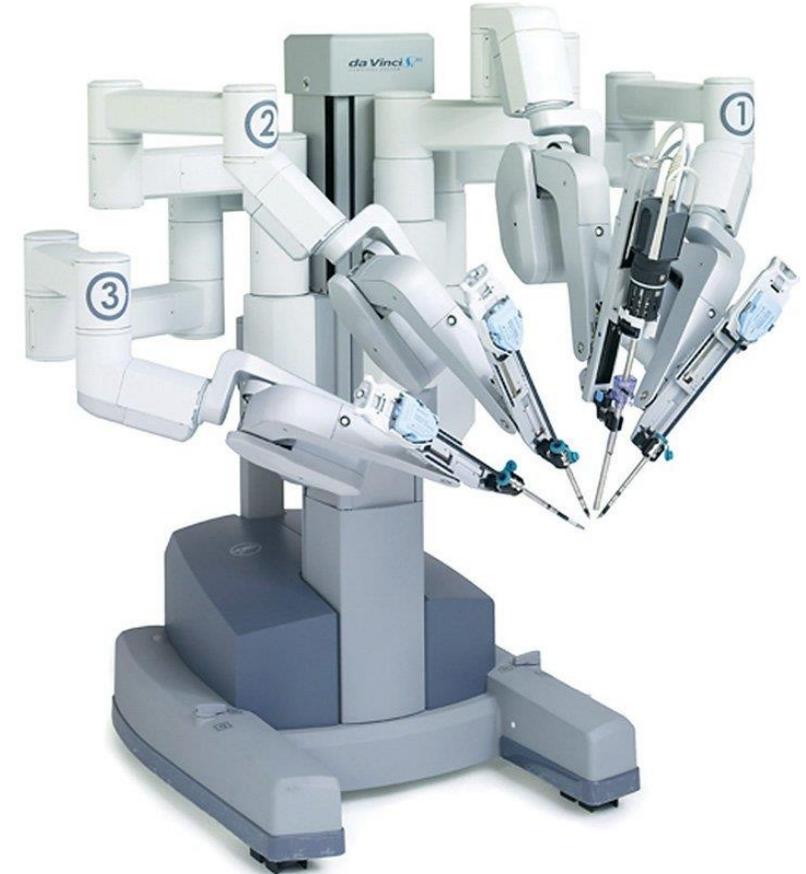
Allows for surgical collaboration amongst surgeons at different medical centers in real-time [3,10]

Operator's physiologic tremor can be canceled out in real-time with accelerometer technology [3,11-13], improving surgical accuracy and reducing damage to adjacent healthy tissues [3,12]

Minimized damage to healthy tissues quickens patient recovery [3]

Telesurgery

- Although a latency time of less than 100 milliseconds can be achieved with today's high-speed fiber optic cables and a dedicated asynchronous transfer mode (ATM), 40 technicians must be present during the surgery to maintain this speed.
- Interestingly, Xu et al. studied the effects of latency time training and claimed that a degree of inaccuracy from a time delay can be overcome via training the teleoperator.



Telesurgery

- The first telesurgery prototype that implemented haptic feedback technology was Telelap Alf-x (SOFAR S.p.A., ALF-X Surgical Robotics Department, Trezzano Rosa, Milan, **Italy**), which was introduced in 2015. Telelap Alf-x, by providing a haptic feedback to the surgeon, successfully reduced the average time of experimental cholecystectomy by 60 minutes.

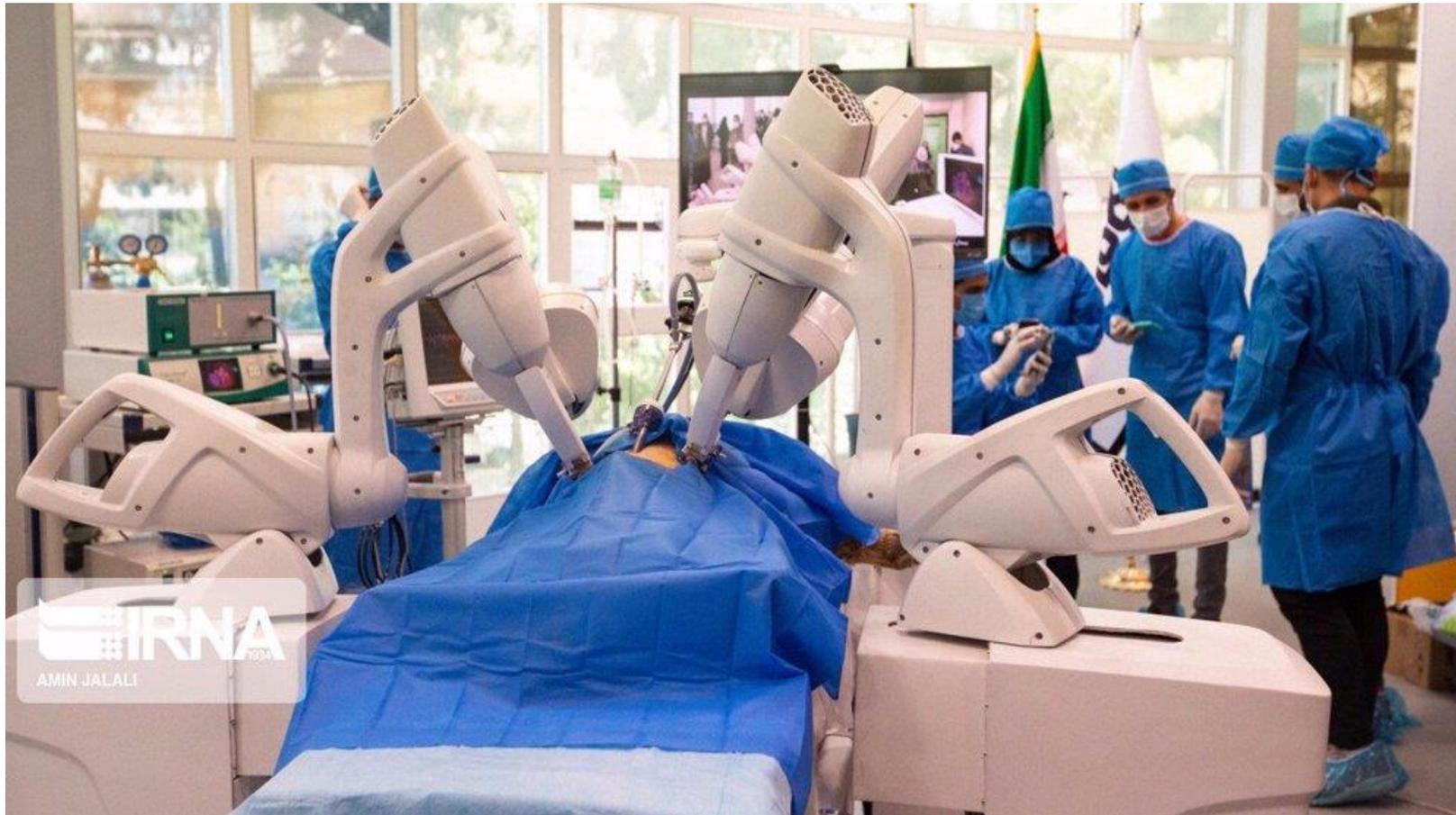


Sina

<https://sinamed.ir/>



Iran becomes 2nd country to successfully conduct robotic telesurgery



Wednesday, 23 June 2021

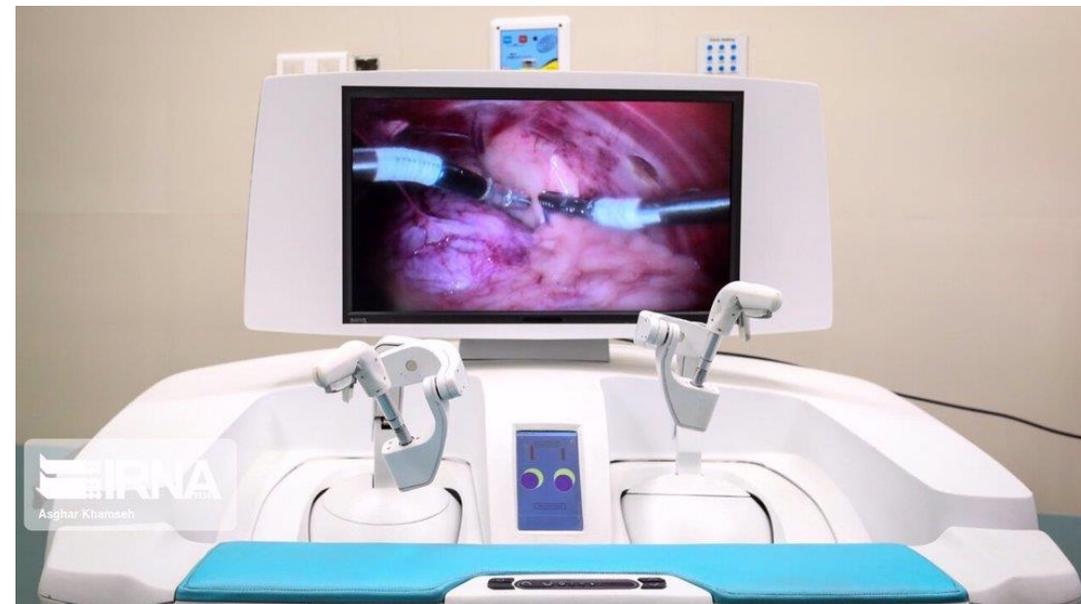
Telesurgery

- The operation was conducted at Tehran's **Imam Khomeini Hospital**, using a domestically-built robosurgeon on a dog.
- The surgeon handling the machine was based **seven kilometers (four miles) away at the capital's Sina Hospital**.
- The robot is outfitted with two mechanical arms. The arms are connected to a distant control panel manned by the human surgeon.



Telesurgery

siNa



THANK YOU