Apr 2023

How Pandemic Changed Critical Care Telemedicine

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Disclaimer

- Personal view.
- Purely USA experience.

Outline

- Introduce telemedicine concepts
- Telemedicine benefits
- Legal requirements
- COVID induced changes
- What is ahead (Technology part)

Telemedicine

Telemedicine vs Telehealth

Telemedicine: The use of technologies to remotely diagnose, monitor, and treat patients

Telehealth: The application of technologies to help patients manage their own illnesses through improved self-care and access to education and support systems

Source: Connected Health: A Review of Technologies and Strategies to Improve Patient Care with Telemedicine and Telehealth; Health Affairs 2014

Telemedicine vs Telehealth

- **Telehealth** is different from telemedicine because it refers to a ***broader scope of remote healthcare services*** than telemedicine.
- While **telemedicine** refers specifically to remote clinical services, telehealth can refer to remote non-clinical services, such as provider training, administrative meetings, and continuing medical education, in addition to clinical services.

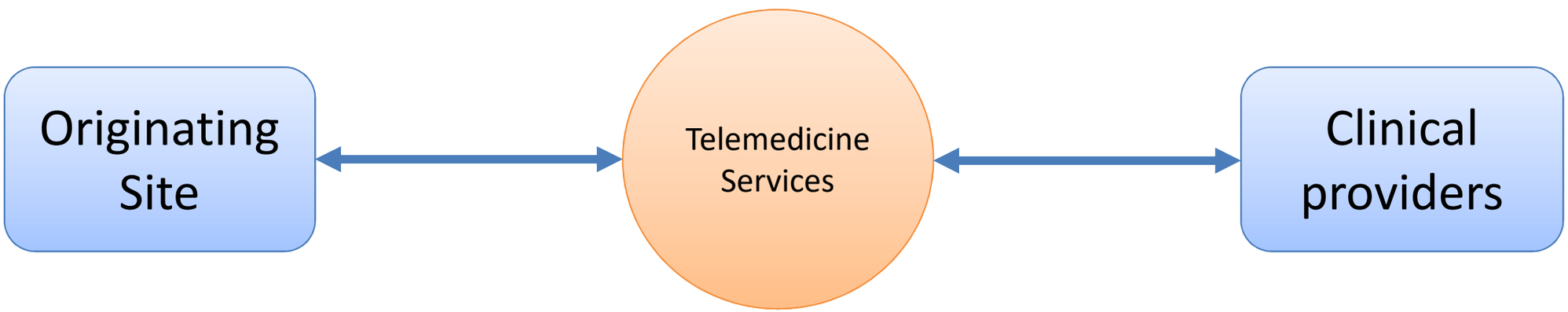
https://www.healthit.gov/providers-professionals/faqs/what-telehealth-how-telehealth-different-telemedicine

Telehealth Use Cases, Relevant Modalities

Modalites	Professional Consultation	Diagnosis & Treatment	Education & Engagement	Ongoing Monitoring & Care Coordination	Investment Required
Videoconference	+	+	+	+	• Need software, secure internet access for patients • Home and hospital-based technology
Asynchronous Store-and-Forward		+			• Need additional bandwidth, storage space • Can replace non-urgent phone calls and visits
Remote Device			+	+	• More expensive hardware investment • Used for high-risk patients in non-hospital site
Telephone	+			+	• Little tech investment, requires proper staffing • Used for pre-visit triage
Patient Portal			+		• High security needs require significant investment • Must integrate HER
Mobile App			+		• Minimal hardware investment for providers • Complex security and data storage issues

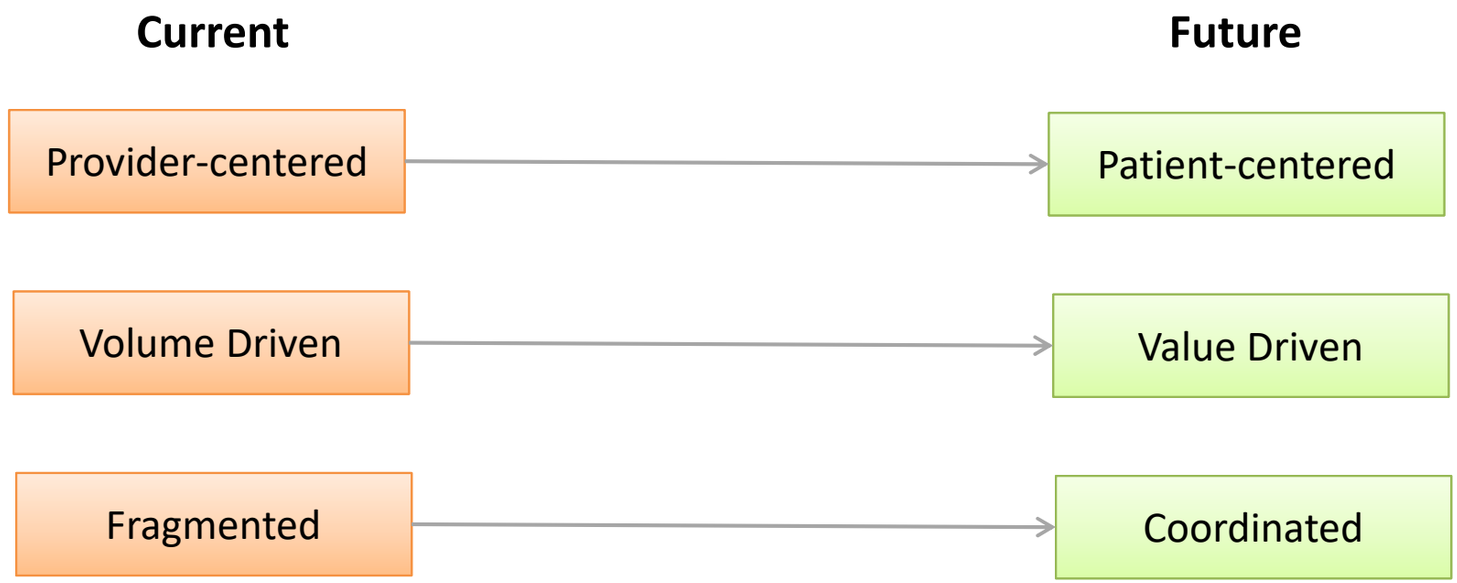
Source: Marketing and Planning Leadership Council interviews and analysis. (Advisory Board)

Structure of telemedicine services



Telemedicine benefits

Shift in care delivery



As healthcare shifts the benefit of providing care via telemedicine increases.

Potential **Telemedicine** Uses

- Ambulatory specialty care
- Direct to Patient e-Consultations
- Chronic disease management

- Expanded patient care access
- Tele-ICU - Remote critical care monitoring/consultation

- Hospital at home - Post-discharge monitoring

Overall benefits of telemedicine

Improved Access – For over 40 years, telemedicine has been used to bring healthcare services to patients in distant locations. Given the provider shortages throughout the world--in both rural and urban areas--telemedicine has a unique capacity to increase service to millions of new patients.

Cost Efficiencies – Reducing or containing the cost of healthcare is one of the most important reasons for funding and adopting telehealth technologies. Telemedicine has been shown to reduce the cost of healthcare and increase efficiency through better management of chronic diseases, shared health professional staffing, reduced travel times, and fewer or shorter hospital stays.

Improved Quality and Continuity of Care – Studies have consistently shown that the quality of healthcare services delivered via telemedicine are as good those given in traditional in-person consulations. In some specialties, particularly in mental health and ICU care, telemedicine delivers a superior product, with greater outcomes and patient satisfaction.

Patient Demand – Consumers want telemedicine. The greatest impact of telemedicine is on the patient, their family and their community. Using telemedicine technologies reduces travel time and related stresses for the patient. Over the past 15 years, study after study has documented patient satisfaction and support for telemedical services. Such services offer patients the access to providers that might not be available otherwise, as well as medical services without the need to travel long distances

Benefits of telemedicine for patients

- **No transportation time or costs -** Patient can save money on gas, parking, and public transportation.
- **No need to take time off of work -** Speaking of work, video visits largely remove the need to take time off. Patient simply schedule your visit during a break, or before or after work without missing a day of work or wasting paid time off.
- **Eliminate child or elder care issues –** If there responsibility for caring for children or older adults finding alternative care can be difficult and expensive. Bringing them along can be stressful or impractical. Fortunately, telemedicine solves this challenge by allowing to see doctor while upholding family responsibilities.
- **On-demand options -** More and more physician's practices are offering telemedicine these days, there's a good chance that primary care physician would be available via video. If can't, but still need remote access to care, there are a number of online-only, on-demand options on the market today. Some insurance companies pay for this type of care.
- **Access to Specialists -** Some patients who need the care of a specialist must drive long distances and invest a lot of time for each visit. Telemedicine makes it possible for patient and primary care physician to leverage the expertise of specialists who are not nearby. When it comes to serious health issues, patients want to consult with the best, not the closest.
- **Less Chance of Catching a New Illness -** While everyone does their best to prevent one patient from catching something from another, it is always possible, especially in crowded waiting rooms. By staying home, patient get the care need while avoiding the risk of exposure.
- **Less Time in the Waiting Room -** Video visit via telemedicine technology eliminates all that time spent looking at old magazines in a doctor's office.
- **Better Health -** When patient be able to see doctor as often as need to, without the challenges of getting into the office, patient can practice better management of medication, lifestyle, and any chronic conditions that might have.

Patients like it…

The survey of 399 virtual visit patients indicated that virtual visits were liked by patients, with 372 (**93.2%**) of respondents saying their **virtual visit was of high quality** and 364 (**91.2%**) reporting their virtual visit was "**very" or "somewhat" helpful to resolve their health issue**.

98%	"Very satisfied" patients with telehealth visit
95%	Patients who would use telehealth again
95%	Patients who would recommend telehealth visit to friend

McGrail, K. M., Ahuja, M. A., & Leaver, C. A. (2017). Virtual Visits and Patient-Centered Care: Results of a Patient Survey and Observational Study. Journal of Medical Internet Research, 19(5), e177. http://doi.org/10.2196/jmir.7374

Patients' Satisfaction with and Preference for Telehealth Visits. Polinski JM et al, J Gen Intern Med March 2016

Forces Enable Telemedicine Expansion

- Consumer demand
- Cost saving efforts: Commercial and employer-based insurance, ACO shared savings program
- Value-based care and population management incentives
- Patient access/workforce limitations
- New technology capabilities

Telemedicine platforms

1 Doc Way	1 Doc Way has been around since 2011 and uses hourly pricing model at $25 per hour of video conference.
American Well	Powered by Vidyo, American Well is the platform used by LiveHealth Online, currently contracts health insurer Anthem / Wellpoint.
Carena	Based in Washington state, Carena provides a “virtual care model and configurable technology platform to let health systems offer care to consumers.” In addition to a virtual clinic platform, they provide digital marketing services to increase consumer awareness and utilization.
CarePaths	Behavioral Health EHR and Practice Management platform with video, patient portal, scheduling, secure messaging, claims and billing management, and ePrescribe.
ChironHealth	A brand-able telemedicine platform with insurance eligibility checking, scheduling, virtual waiting room, and video. ChironHealth stands out in that it guarantees private payer reimbursement for telemedicine video visits.
CloudVisit	Telepsychiatry platform that recently (March 2015) launched its mobile app for iOS and Android devices; pricing starts at $150/month and includes scheduling.
DigiGone	Specializing in low bandwidth maritime commmunications, DigiGone combines software application development and hardware integration for its video solutions. It is currently used by the George Washington University Emergency Medical Department’s Maritime Medical Access team to provide telemedicine.
Doxy.me	Beautiful, thoughtfully planned, free platform that supports a waiting room workflow. Since it uses WebRTC for video, it does not support video calls on Internet Explorer or Safari. Mobile apps coming in May.
eVisit	eVisit is telemedicine designed by providers, for providers. It provides 2-way HD video, ePrescribe, medical charting, automated patient engagement emails, and on-boarding support.
iPath	A free, opensource store-and-forward platform for collaborative exchange of medical knowledge, distance consultations, group discussions and distance teaching in medicine; no video.
MedSymphony	Primarily a proprietary EMR with video add-on option at $25 for 2 hours and $15 for each additional hour
REACH Health	Georgia-based company providing interactive physician-to-patient telemedicine and telestroke solutions. Initially designed for telestroke, the system brings together videoconferencing, medical imaging, and patient data.
Secure Telehealth	Platform appears to be limited to PCs only; uses OmniJoin by Brother for video.
SecureVideo	Initially focused on telepsychiatry, SecureVideo has been expanding its offerings. Its platform includes scheduling and optional PayPal integration. In addition, it has excellent technical support services.
SightCall	Formerly Weemo, this is one of the early WebRTC-based video calling platforms out there.
SnapMD	Secure, cloud based telemedicine technology
thera-LINK	Telemental health platform with scheduling, ePay (via Stripe), and file storage, it offers a 15-day free trial and $45/month for unlimited video. It uses WebRTC video which means not supported on IE and Safari browsers.
Vidyo	Vidyo’s low pricing may be deceptive because it doesn’t include hardware and maintenance costs. Read our Vidyo review here.
Virtual Care Works	Medical-grade network service provider that bundles communications solutions including videoconferencing, secure email, secure texting, and image archival.
Virtual Therapy Connect	Free for less than 5 hours of video; $50 per month for unlimited video conference; more pricing here
VirtuMedix	Complete telemedicine platform with patient records, scheduling, and online payment; but uses the slowly-going-obsolete Flash-based video.
VSee	VSee is NASA’s official video chat + telemedicine platform aboard the International Space Station. It integrates secure health communications, virtual care workflows, and SDKs to easily build and grow any telehealth platform. Offerings include telemedicine kits & carts with medical devices.
WeCounsel	Telehealth platform with an emphasis on behavioral health, including scheduling, messaging, and file storage. It’s currently offering a1 month free trial and $14.99/mo unlimited use; it uses Vidyo for video.

Challenges for telemedicine

Quality

- Provider credentials
- Continuity of care
- Efficacy

Reimbursement

- Medicare
- Medicaid
- Commercial

Clinical use

- Adequacy of virtual exam
- Patient selection

Implementation

- IT infrastructure
- Clinical workflow
- Licensing and credentialing

Legal requirements (USA)

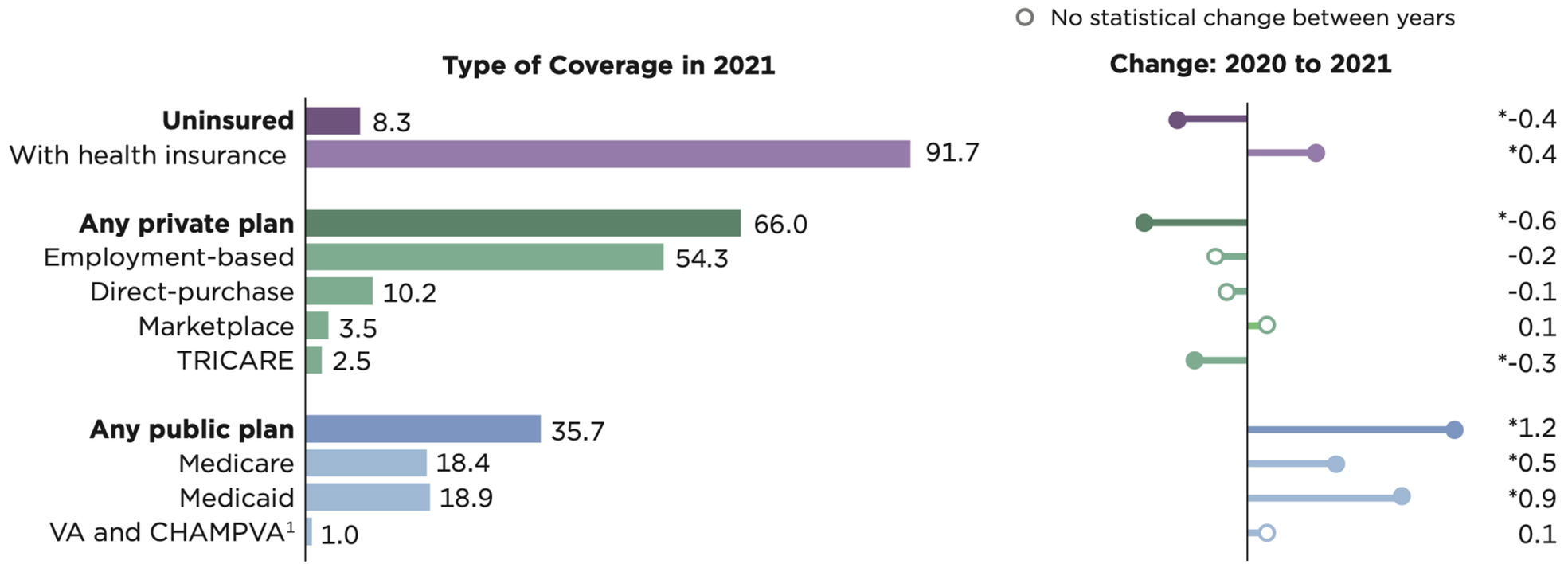
Two major administrative components of telemedicine practice

- Financial (reimbursement)
- Licensure

Figure 1.

Percentage of People by Type of Health Insurance Coverage and Change From 2020 to 2021

(Population as of March of the following year)



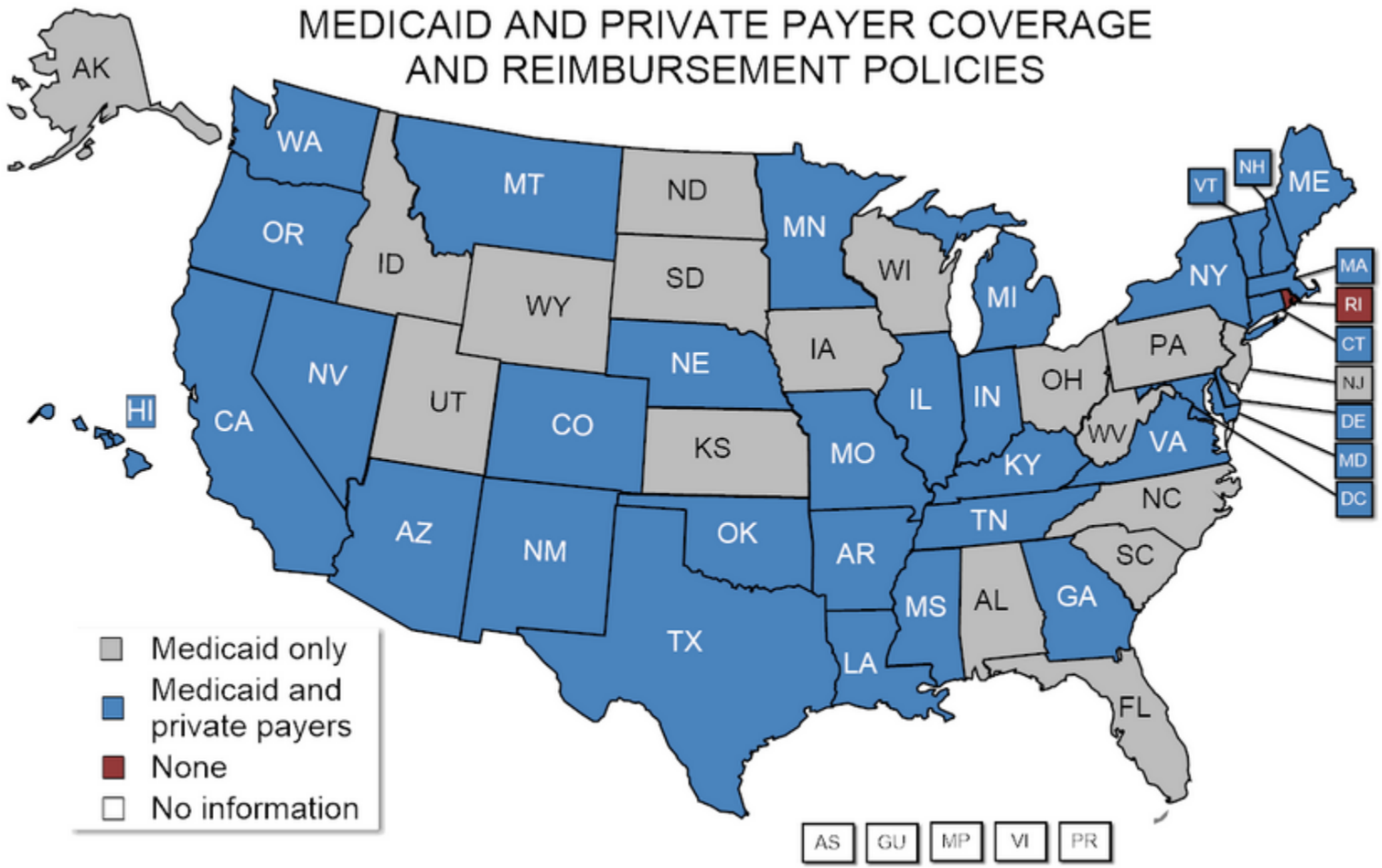
* Denotes a statistically significant change between 2020 and 2021 at the 90 percent confidence level.

[1] Includes CHAMPVA (Civilian Health Medical Program of the Department of Veterans Affairs), as well as care provided by the Department of Veterans Affairs (VA) and the military.

Note: The estimates by type of coverage are not mutually exclusive; people can be covered by more than one type of health insurance during the year. Information on confidentiality protection, sampling error, nonsampling error, and definitions is available at <https://www2.census.gov/programs-surveys/cps/techdocs/cpsmar22.pdf>.

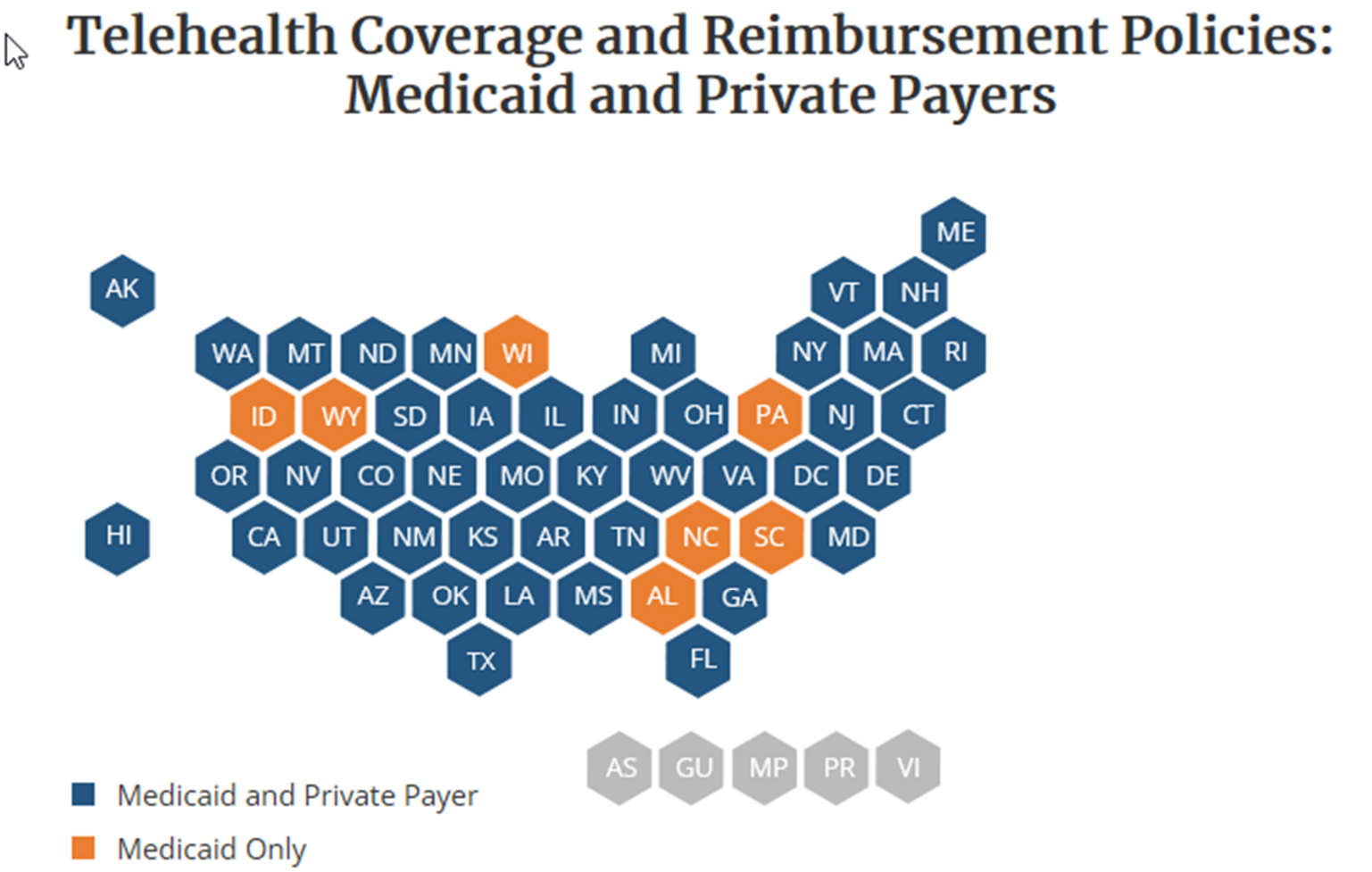
Source: U.S. Census Bureau, Current Population Survey, 2021 and 2022 Annual Social and Economic Supplements (CPS ASEC).

Reimbursement Coverage - 2016



NCSL – National Conference of State Legislatures http://www.ncsl.org/

Reimbursement Coverage - 2021

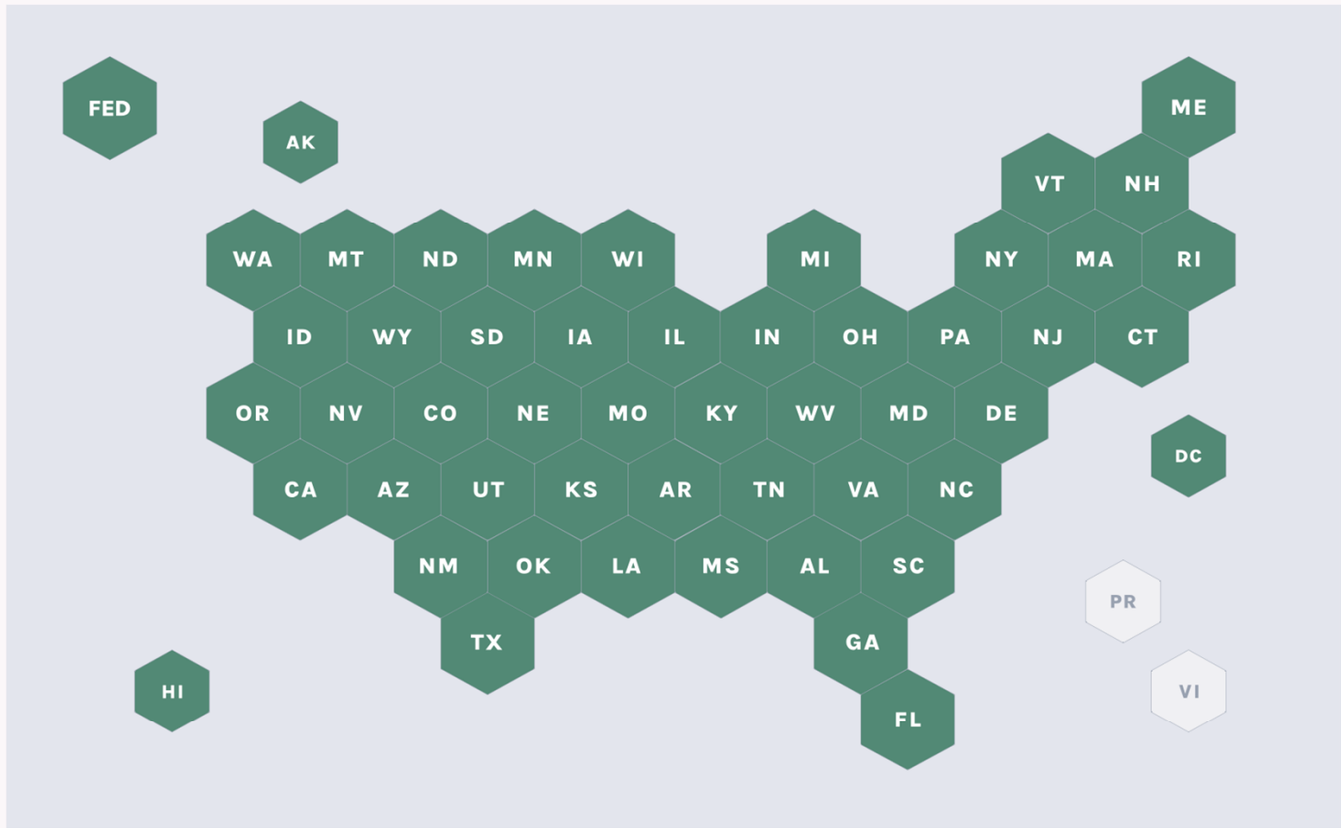


NCSL – National Conference of State Legislatures http://www.ncsl.org/

Reimbursement Coverage - 2023

Live Video Medicaid Reimbursement

Fifty states and Washington DC provide reimbursement for some form of live video in Medicaid fee-for-service. Both the jurisdictions of Puerto Rico and Virgin Islands do not indicate they reimbursement for live video in their Medicaid programs. The most predominantly reimbursed form of telehealth is live video, with every state offering some type of live video reimbursement in their Medicaid program. However, what and how it is reimbursed varies widely with some Medicaid programs limiting the types of reimbursable services and placing additional requirements and restrictions such as provider type and originating site stipulations. Map based on research conducted between January-March 2023.



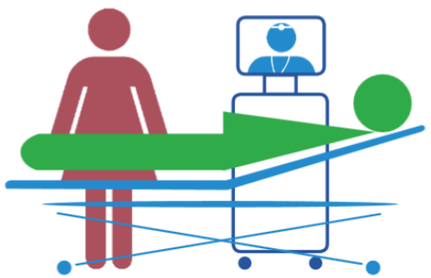
Reimbursement requirement

Core Eligibility Requirements for CMS Reimbursement

Medicare provides reimbursement to the originating and distant sites for telehealth services.

Originating Site

Location* of patient receiving the telehealth service.



Originating site receives facility fee from Medicare to cover costs of facilitating a telemedicine visit. The site could be a:

- hospital
- physician's office or other practitioners' office
- critical access hospital
- rural health clinic
- federally qualified health center
- community mental health center
- skilled nursing facility
- hospital-based renal dialysis facility

Note: State Medicaid programs and private insurers may pay a transmission fee instead of, or in addition to, the facility fee.

*Beneficiaries receiving telehealth services must be in a facility in a rural health professional shortage area, a rural census tract, or a county not in a Metropolitan Statistical Area (MSA).

Medicare pays for 75 individual service codes in 2015.

Congress defines telehealth services as:

- professional consultations
- office visits
- office psychiatry services
- others as determined by the Secretary

Distant Site

Location of health care provider providing the telehealth service.

Physician or other practitioner receives professional fee from Medicare for treating the patient.

The Medicare statute does not specify which facilities may serve as distant sites, though CMS has excluded rural health clinics and federally qualified health centers.

Source: Adapted from Center for Connected Health Policy, State Laws and Reimbursement Policies

Originating site

Originating Site – location of eligible Medicare beneficiary. Must be a Health Professional Shortage Area (HPSA) located either outside of a Metropolitan Statistical Area (MSA) or in a rural census tract; or a county outside of an MSA

- **Office of physician or practitioner**
- **Hospital (inpatient or outpatient)**
- **Critical access hospital (CAH)**
- Rural health clinic (RHC) and Federally Qualified Health Center (FQHC)
- Hospital-based or CAH-based renal dialysis center (including satellites)
- Skilled nursing facility (SNF)
- End-stage renal disease (ESRD) facilities
- Community mental health center
- Dental clinic
- Residential facilities, such as a group home and assisted living
- Home (a licensed or certified health care provider may need to be present to facilitate the delivery of telemedicine services provided in a private home)
- School

Telemedicine services

- Consultations
- Telehealth consults: emergency department or initial inpatient care
- Subsequent hospital care services with the limitation of one telemedicine visit every 30 days per eligible provider
- Subsequent nursing facility care services with the limitation of one telemedicine visit every 30 days
- End-stage renal disease services
- Individual and group medical nutrition therapy
- Individual and group diabetes self-management training with a minimum of one hour of in-person instruction to be furnished in the initial year training period to ensure effective injection training
- Smoking cessation
- Alcohol and substance abuse (other than tobacco) structured assessment and intervention services

Distant site - Eligible providers

- Physician
- Advanced Care Practicioner (ACP) - Nurse practitioner - Physician assistant - Nurse midwife
- Registered dietitian or nutrition professional
- Dentist, dental hygienist, dental therapist, advanced dental therapist
- Mental health professional
- Pharmacist
- Certified genetic counselor
- Speech therapist
- Physical therapist
- Occupational therapist
- Audiolgist

Not all above eligible for CMS reimbursement

What IS NOT covered?

Usually following are <u>not covered under telemedicine</u>:

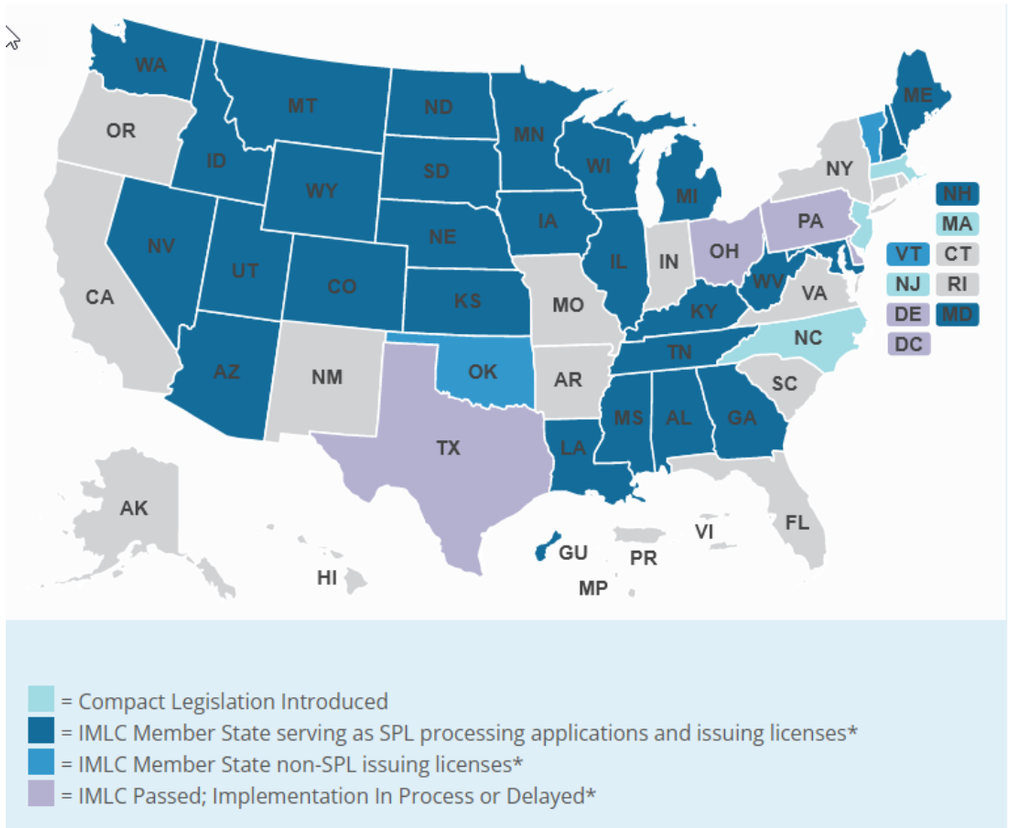
- Electronic connections that are not conducted over a secure encrypted website as specified by the HIPAA of 1996 Privacy & Security rules
- Prescription renewals
- Scheduling a test or appointment
- Clarification of issues from a previous visit
- Reporting test results
- Non-clinical communication
- Communication via telephone, email or fax
- Day treatment
- Partial hospitalization programs
- Residential treatment services
- Case management face-to-face contact

The following limitations apply:

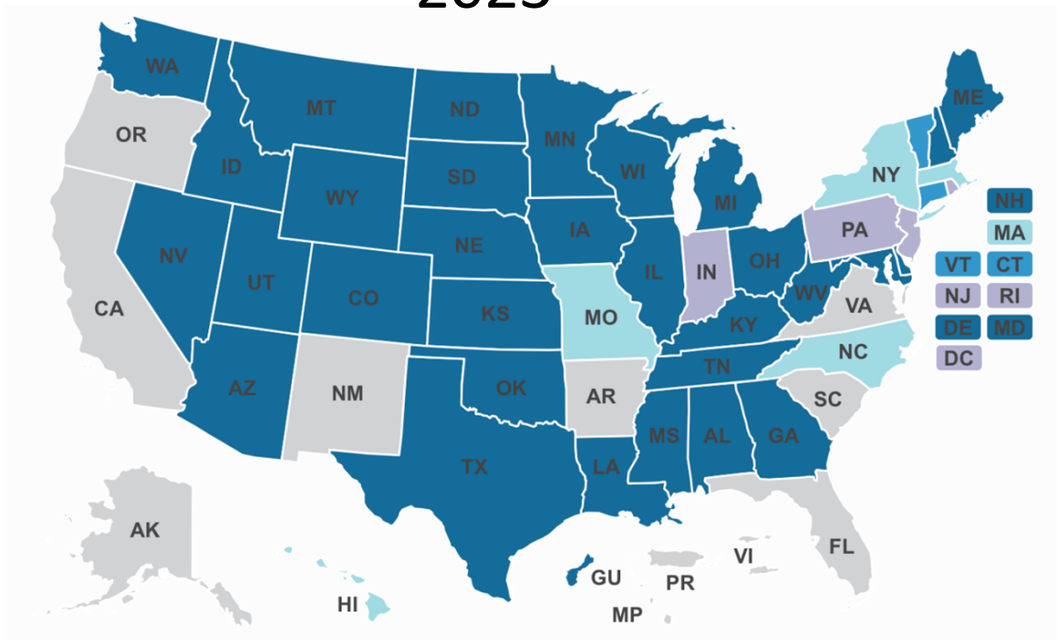
- Payment for telemedicine services is limited to three per week per recipient
- Payment is not available for sending materials to a recipient, other provider or facility

Licensing - U.S. State Participation in the Compact

2021



2023

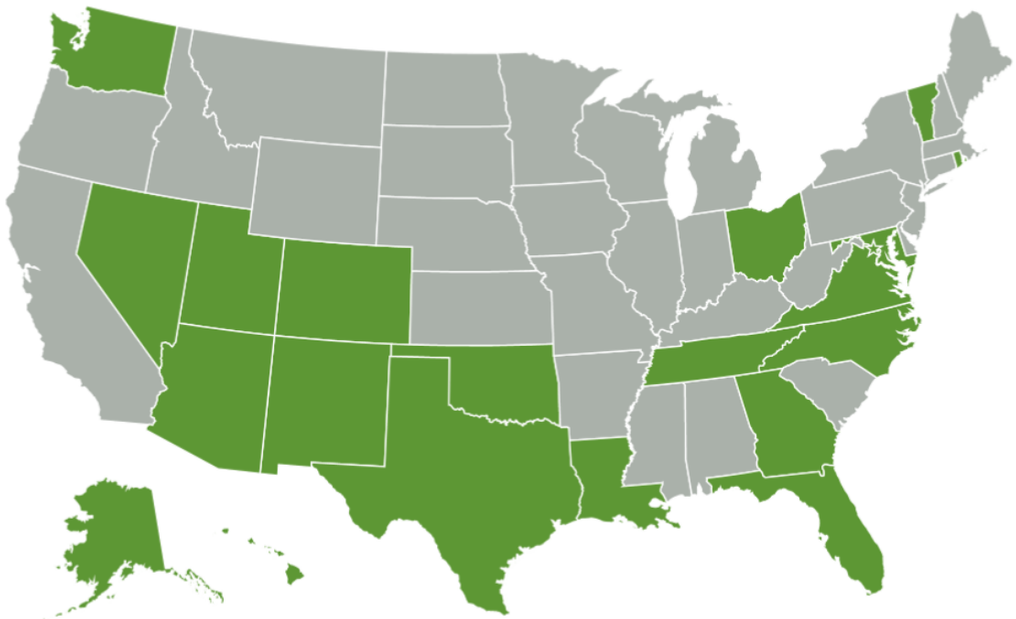


The Interstate Medical Licensure Compact offers a voluntary, expedited pathway to licensure for qualified physicians who wish to practice in multiple states. The Compact significantly streamlines the licensing process. The Compact currently includes 35 states. Compact became operational in April 2017.

https://www.imlcc.org/

Online prescribing

Twenty states allow physician-patient relationships to be established via telehealth technologies.



States that allow establishment of physician-patient relationships via telehealth technologies

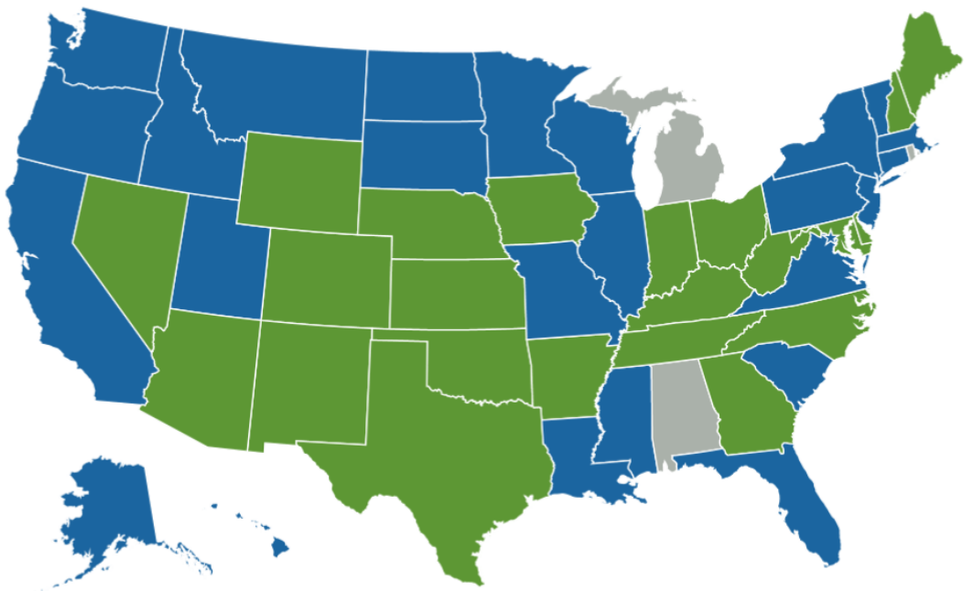
States that do not allow establishment of physician-patient relationships via telehealth technologies

Source: Center for Connected Health Policy, February 2015.

Establish physician-patient relationship before he/she may prescribe for the patient.

Health Professional Licensure acceptance **2016**

Most states have a consultation exception in their licensure requirements.



States that permit consultations with no restrictions on frequency

States that permit consultations if provided on an infrequent basis

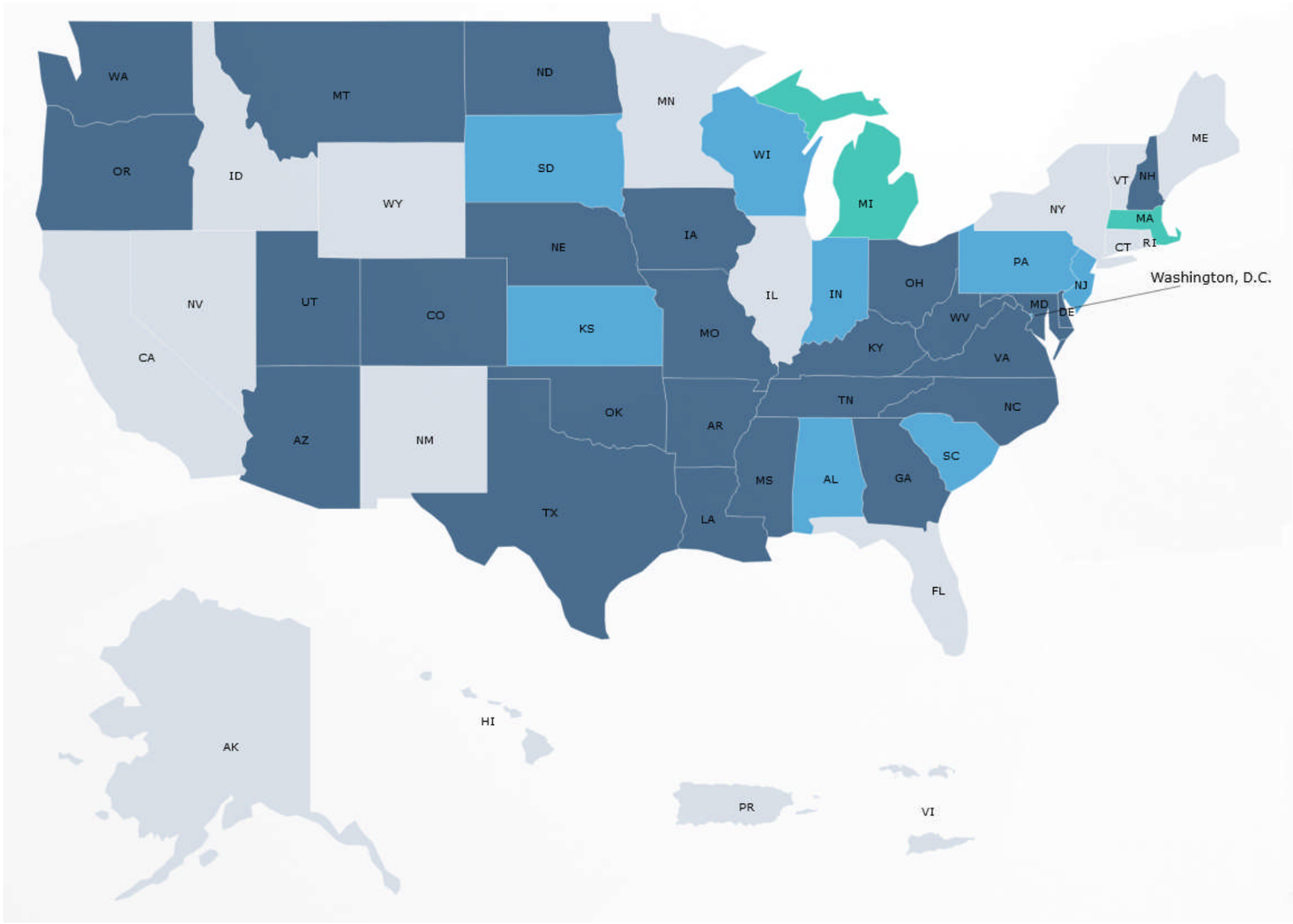
States without consultation exceptions

Source: Center for Connected Health Policy, February 2015.

Special Telemedicine Licenses:

- Alabama
- Louisiana
- Montana
- Nevada
- New Mexico
- Ohio
- Oklahoma
- Oregon
- Tennessee
- Texas

Complex law – Physical therapy example



- Member State – Actively Issuing and Accepting Compact Privileges
- Enacted Legislation – Not Yet Issuing or Accepting Compact Privileges
- PT Compact Legislation Introduced
- Non-Member States Without Legislation Introduced

http://ptcompact.org/ptc-states

Telemedicine Guidelines

- AMA and ATA have policy statements on telemedicine
- Overarching principles include:
  - Establishment of valid patient-provider relationship
  - Professional judgment in appropriateness for telemedicine in clinical setting
  - Continuity of care/shared medical record
  - Use of evidence-based clinical guidelines for telemedicine
  - Telemedicine held to same standard as in-person visit

COVID induced changes

1135 waiver

- Effective for services starting March 6, 2020 and for the duration of the COVID-19 Public Health Emergency, Medicare will make payment for Medicare telehealth services furnished to patients in broader circumstances for professional services furnished to beneficiaries in all areas of the country in all settings.

- Telemedicine visits are considered the same as in-person visits and are paid at the same rate as regular, in-person visits.

All 50 states and Washington, D.C., have taken actions to improve access to telehealth in response to COVID-19.

In 33 states, commercial insurance carriers are temporarily relaxing requirements around telehealth, either through state mandates or on their own.

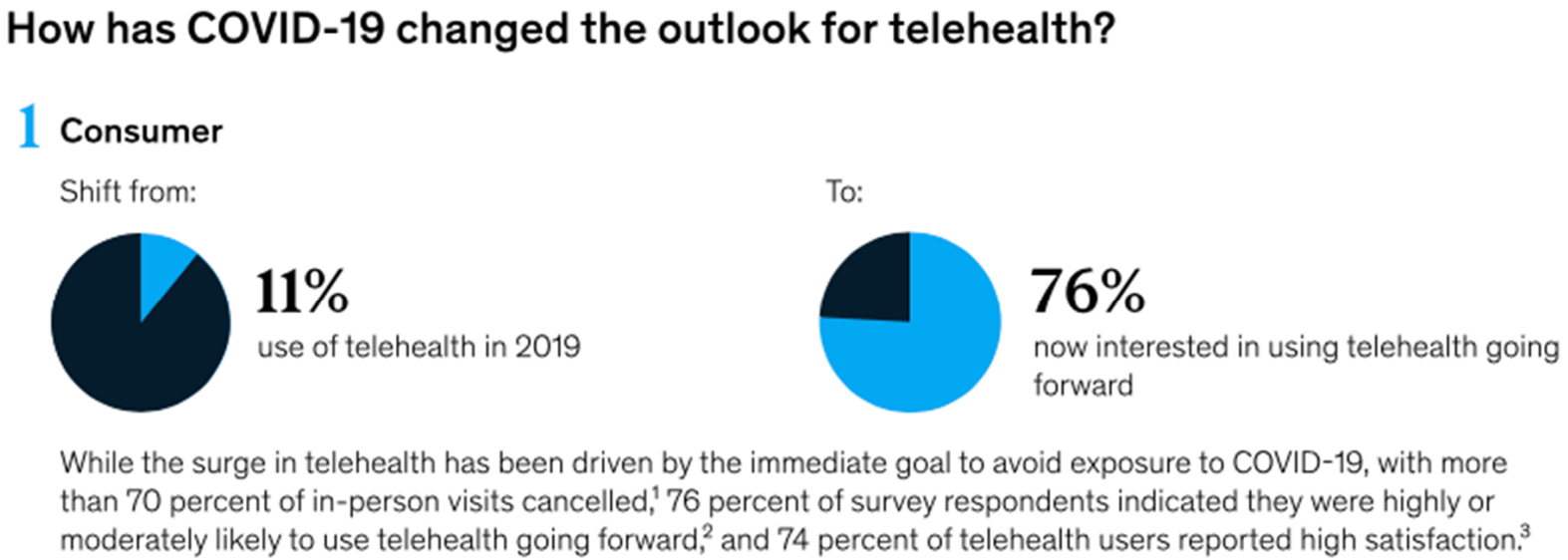
https://www.medicaid.gov/medicaid/benefits/downloads/medicaid-chip-telehealth-toolkit.pdf

McKinsey Report: Telehealth is Massive

A recent report from McKinsey & Co. documents the “massive acceleration in the use of telehealth” since the COVID-19 epidemic.

Consumer adoption moved from 11% to 46%, and **providers are now seeing from *50 to 175 times* the number of patients via telehealth than they did before.**

Pre-Covid, total annual revenues in telehealth were about $3 billion. With further provider adoption, up to $250 billion of US healthcare spending could be virtualized.



https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality

Post-COVID

- The COVID-19 Public Health Emergency (PHE) resulted in many changes to the health care system.
- PHE will end on May 11. 2023
- On December 29, 2022, the Consolidated Appropriations Act of 2023 (CAA) extended many flexibilities and waivers authorized during the PHE through December 31, 2024, particularly around telehealth services.

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Permanent telehealth changes on the horizon

AE

By **MOHANA RAVINDRANATH** | 06/19/2020 10:00 AM EDT

With help from Darius Tahir (@dariustahir) and Tim Starks (@timstarks)

Programming announcement: *Our newsletters are evolving. Morning*

Healthcare IT TODAY

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What COVID-19 Taught Us About Telehealth and its (Now Permanent) Role in Patient Care

June 29, 2020 Guest Author 5 Min Read

Guest Author

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The following is a guest article by Michael Morgan and Andrew Barbash, MD from Updox.

Prior to COVID-19, telemedicine was a novelty for the majority of providers. Concerns over privacy, technology costs and reimbursements limited the ability of hospitals to integrate virtual visits into routine care. Likewise, many independent practices struggled with how to fully incorporate telehealth into their businesses.

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'I can't imagine going back': Medicare leader calls for expanded telehealth access after Covid-19

By CASEY ROSS / JUNE 9, 2020

Reprints

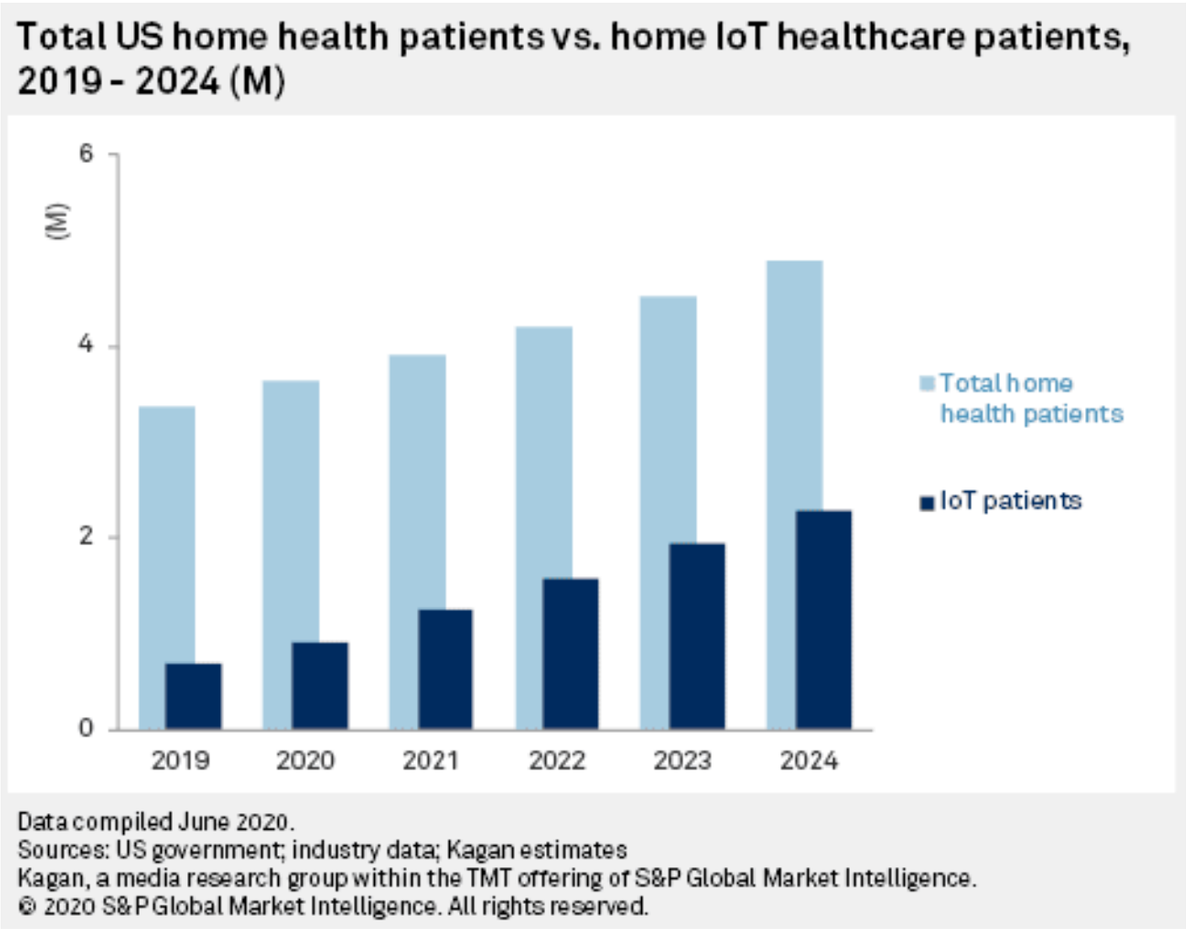
Seema Verma testifies before the Senate Finance Committee on her nomination to be the administrator of the Centers for Medicare and Medicaid Services.
MANDEL NGAN/AFP/GETTY

President Trump's top Medicare official said Tuesday that expanded access to telemedicine should continue after the coronavirus pandemic recedes and that officials are examining ways to act without waiting for legislation from Congress.

"I can't imagine going back," said Seema Verma, administrator of the Centers for Medicare and Medicaid Services, told STAT during a live virtual event. "People recognize the value of this, so it seems like it would not be a good thing to force our

MAYO CLINIC

Hospital at Home: A Leading Care Model for the Future?



- Sensors
- Remote monitoring
- Remote labs

https://liberatehealth.medecision.com/how-the-pandemic-is-accelerating-the-hospital-at-home-concept/

- List of approved programs - https://www.cms.gov/files/document/covid-acute-hospital-care-home-program-approved-list-hospitals.pdf

Telemedicine companies

2016

American Well	American Well	A telehealth services company that brings healthcare into the homes and workplaces of patients
Avizia	Avizia	Provides real-time video collaboration to meet the unique product requirements of healthcare
DaVincian Healthcare	DaVincian Healthcare	Provides healthcare solutions that improve clinical outcomes, by intelligently and securely connecting mobile devices, healthcare expertise, and healthcare data
etiam One-Click Telemedicine	ETIAM	Allows health professionals to enrich, store, visualize and share the patient medical record within and outside the hospital, in real time
FORA	ForaCare, Inc.	Provides chronic disease management solutions
KRIXICare Telemedicine Redefined	Krixi Corporation	An innovator of web based telemedicine and telestroke services
SnapMD	SnapMD	SnapMD is the leader in white-label cloud-based Virtual Care Management (VCM) systems focused on the patient and clinician telemedicine experience
TELADOC	Teladoc	Delivers on-demand health care anytime, and anywhere via mobile devices, the Internet, secure video and phone
VirtuMedix	VirtuMedix	Provides reliable and secure telemedicine platform that allows healthcare practitioners virtual interaction with patients via mobile devices, web portal or telephone
WELLVIA	WellVia	A nationwide telehealth organization delivering affordable, convenient, quality healthcare to patients round the clock

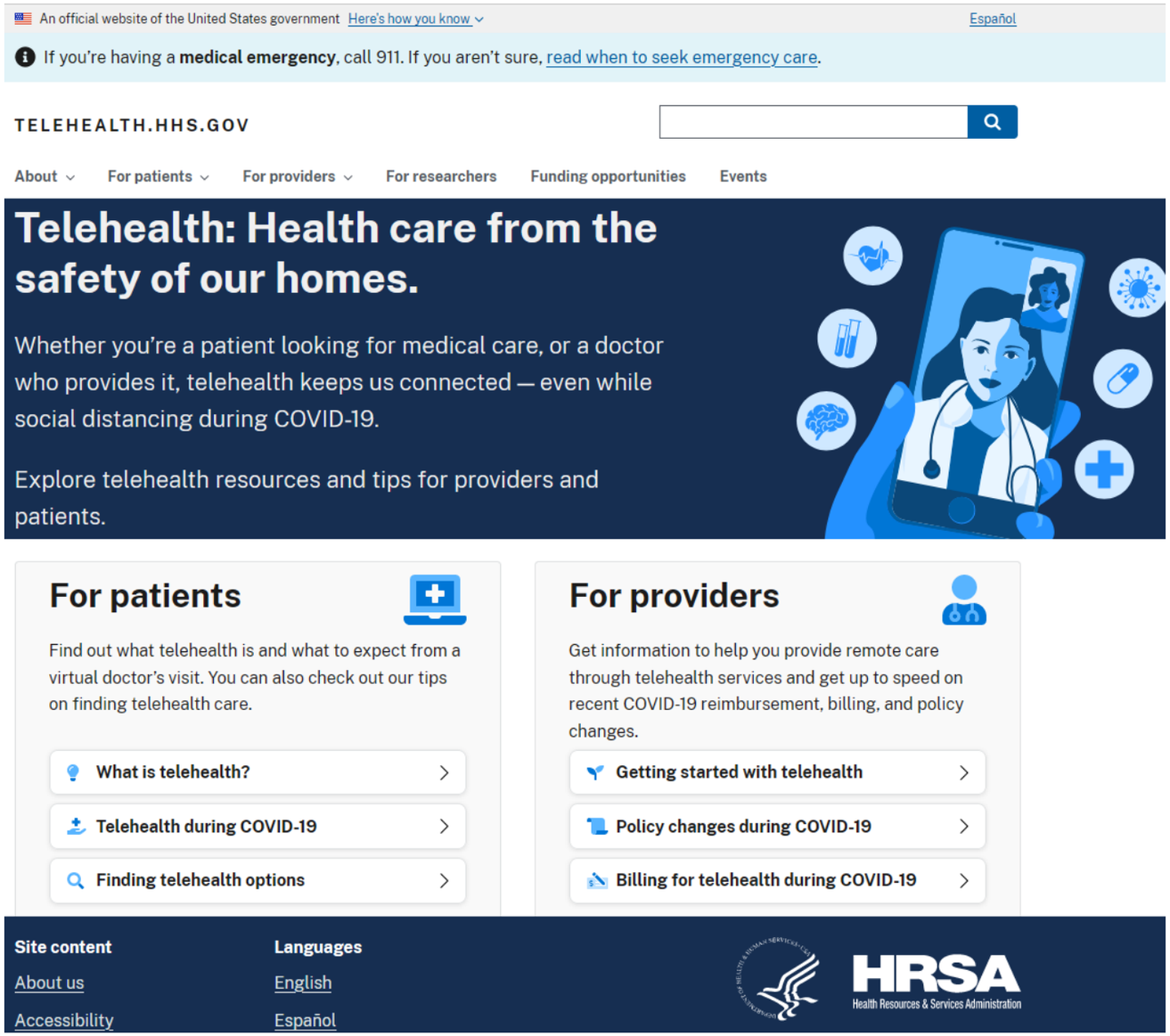
BizVibe Discover Compc

Top 10 Best Telemedicine Companies in the World in 2020

Who are the top 10 telemedicine companies in the world in 2020? This is the complete list of the top telemedicine companies.

Rank	Telemedicine Company	Revenue (USD millions)	Headquarters
1	Teladoc	553	Purchase, New York, USA
2	MeMD	5	Phoenix, Arizona, USA
3	iCliniq	10	Coimbatore, Tamil Nadu, India
4	MDLIVE	36	Miramar, Florida, USA
5	Doctor On Demand	135.5	San Francisco, California, USA
6	Amwell	122.3	Boston, Massachusetts, USA
7	LiveHealth Online	3	Indianapolis, Indiana, USA
8	Virtuwell	12.4	St Paul, Minnesota, USA
9	PlushCare	11	San Francisco, California, USA
10	HealthTap	62.4	Mountain View, California, USA

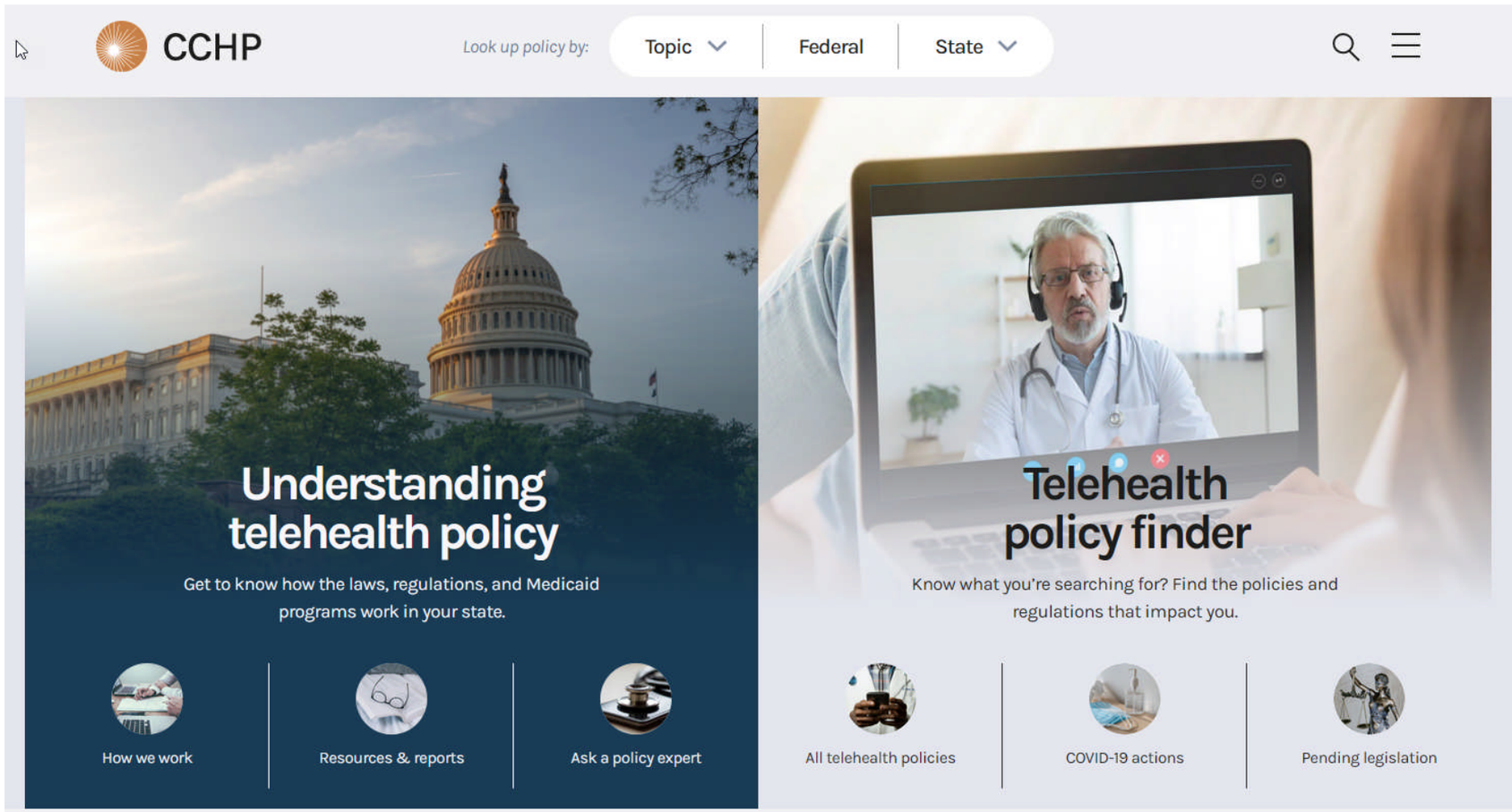
Federal



https://telehealth.hhs.gov/

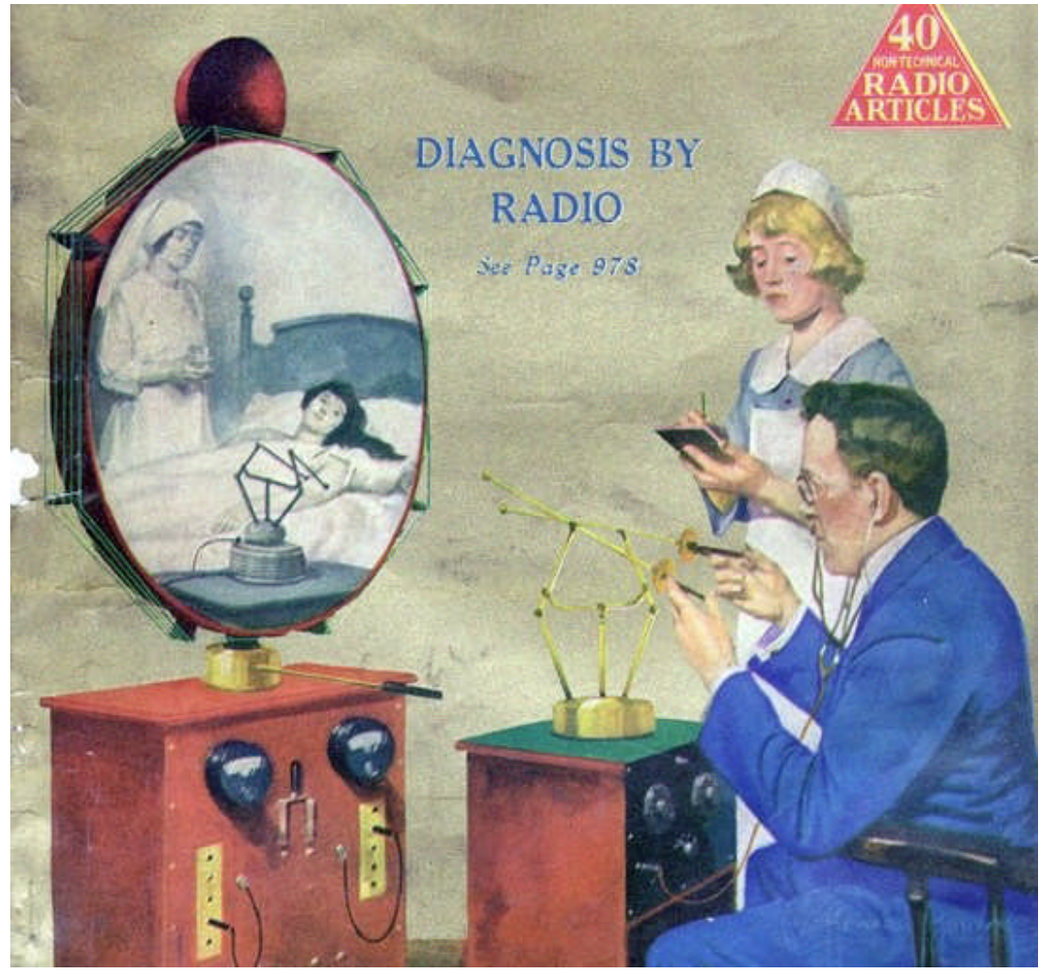
The Center for Connected Health Policy

- https://www.cchpca.org/ - CCHP is the National Telehealth Policy Resource Center. The Center for Connected Health Policy is a nonprofit, nonpartisan organization working to maximize telehealth's ability to improve health outcomes, care delivery, and cost effectiveness.



What is ahead (Technology part)

This illustration is from the April, 1924 edition of Hugo Gernsback's Radio News. Gernsback was the prolific author and magazine publisher who is often called the Father of Science Fiction.



The TeleDactyl, as depicted by *Science and Invention* magazine in 1925.

History of telemedicne

- 1930s - The Royal Flying Doctor Service in Australia used radio
- 1960s – NASA
- 1977 – Daily consultation – intensevist
- 1988 - earthquakes in Armenia
- 1997 - John Hopkins affiliated hospital performed a study in surgical ICU using video conferencing equipment connecting to the intensivists' homes

MedPhone Corporation in 1989

- It was the first use of a device called the MDphone transtelephonic defibrillator. The device fits into a briefcase-sized case and can be plugged into a standard phone jack.
- The patient, Ada Evans, 54 years old, was one of two patients equipped with the portable electronic cardiac treatment systems in mid-May.
- On June 25, Mrs. Evans began experiencing an extremely rapid heartbeat. Her husband, Roscoe Evans, activated the MDphone, which automatically dialed the hospital's cardiac care unit.
- After he attached two electrode pads to his wife's chest, hospital workers activated the defibrillator, which restores the heart's normal rhythm with electric shock.

Feldstein JS, O'Connor RE, Henry J, Simmons B, Nitowski L. Transtelephonic defibrillation. Ann Emerg Med. 1990 Dec;19(12):1367-70. PMID: 2240746.

Born of Tele-ICU

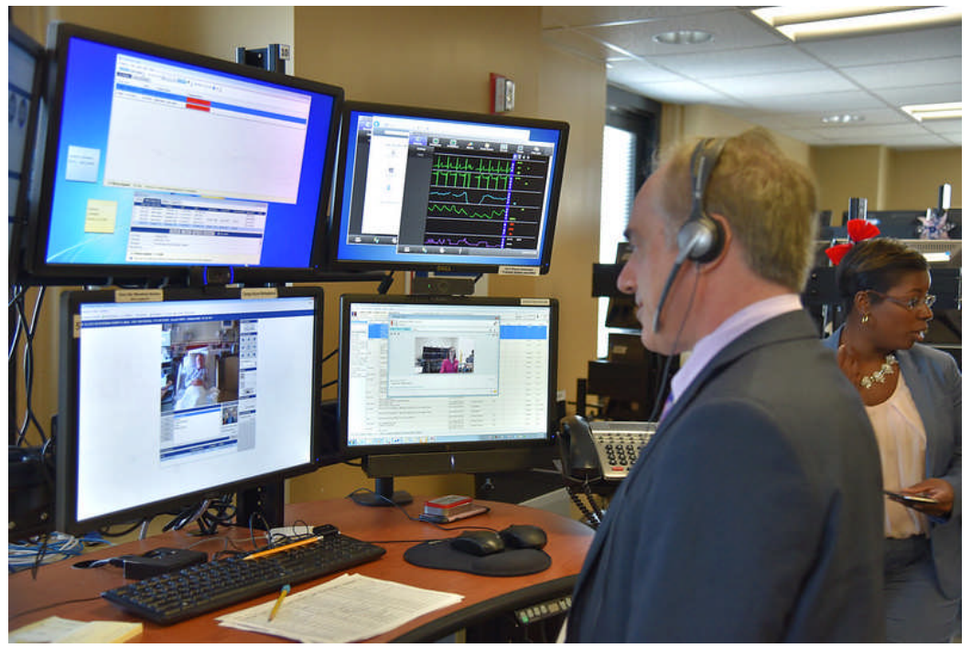
In 1977, a study by Grundy et al. demonstrated feasibility of tele-ICU from an academic medical center to a private hospital [1].

In 1998 home-based intensivists using advanced telemedicine tools for surgical ICU patients. Rosenfeld et al. showed reduced severity-adjusted ICU and hospital mortality, ICU complications, LOS, and cost savings from averted complications [2].

1) Telemedicine in critical care: an experiment in health care delivery. Grundy BL, Crawford P, Jones PK, Kiley ML, Reisman A, Pao YH, Wilkerson EL, Gravenstein JS JACEP. 1977 Oct; 6(10):439-44.)
2) Intensive care unit telemedicine: alternate paradigm for providing continuous intensivist care. Rosenfeld BA, Dorman T, Breslow MJ, Pronovost P, Jenckes M, Zhang N, Anderson G, Rubin H Crit Care Med. 2000 Dec; 28(12):3925-31.)

Tele-ICU

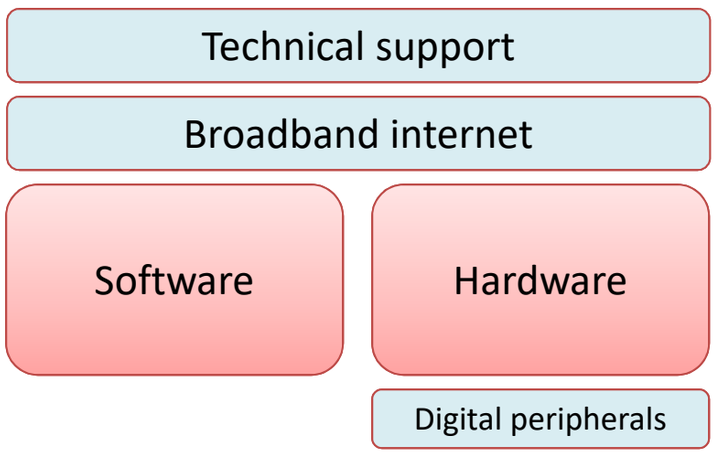
Classic Tele-ICU allows clinicians to remotely see patients, see bedside monitors, review the patient's past medical history, care plan, test results, and medications. Integrated video/high-quality audio links enable the remote clinician, in real-time, to interact with the patient, bedside nurse, clinician, and the patient's family.



Dr Shulkin in the Cincinnati VA TeleICU room pic 3
Under Secretary for Health, Dr. David J. Shulkin tours the Cinncinati, OH VA medical center.

Herasevich V, Subramanian S. Tele-ICU Technologies. Crit Care Clin. 2019Jul;35(3):427-438. PMID: 31076043

Key technical components of telemedicine

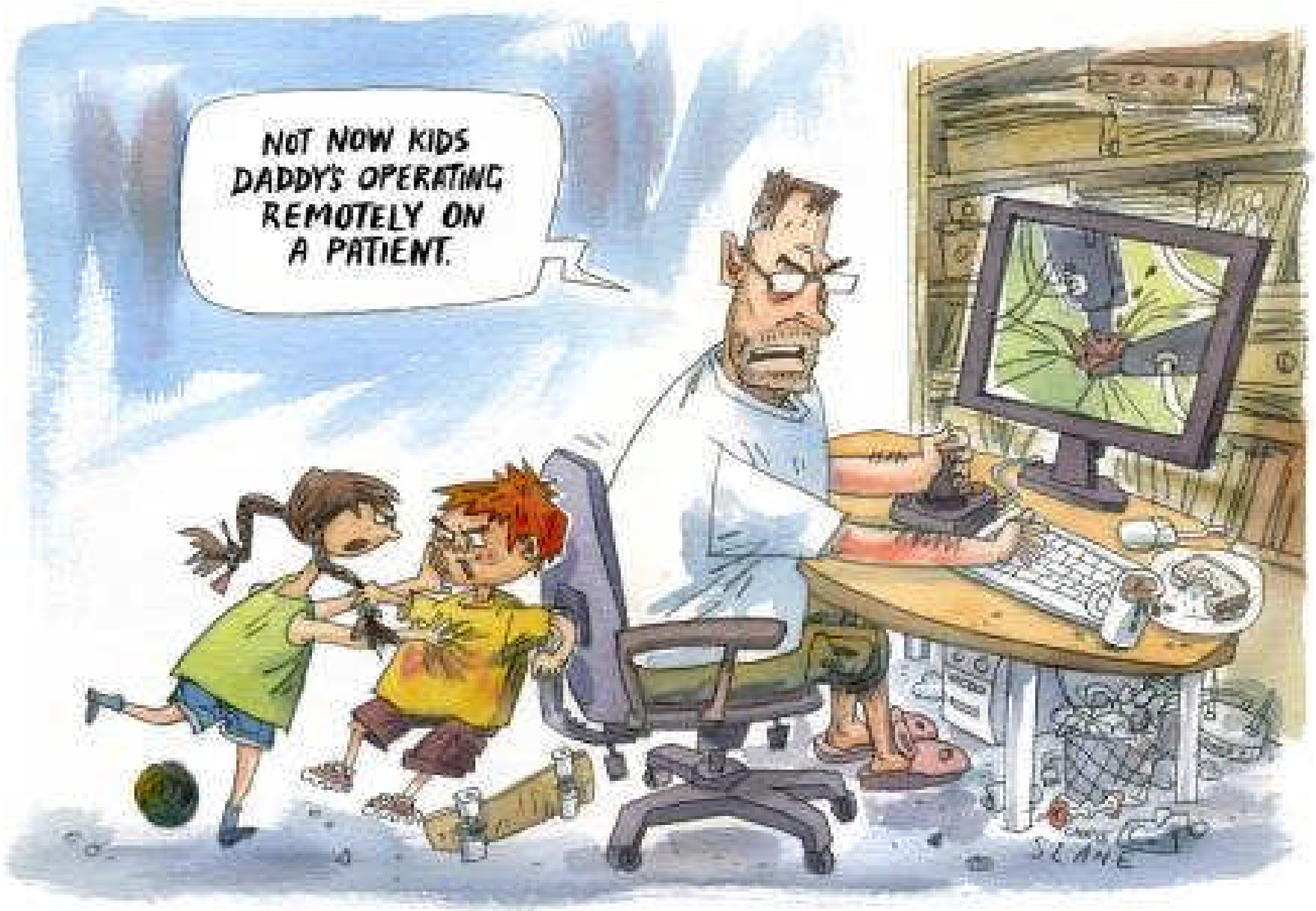


What Delivery Mechanisms Can Be Used?

- **Networked programs** link tertiary care hospitals and clinics with outlying clinics and community health centers in rural or suburban areas. The links may use dedicated high-speed lines or the Internet for telecommunication links between sites. ATA estimates the number of existing telemedicine networks in the United States at roughly 200 providing connectivity to over 3,000 sites.

- **Point-to-point connections** using private high speed networks are used by hospitals and clinics that deliver services directly or outsource specialty services to independent medical service providers. Such outsourced services include radiology, stroke assessment, mental health and intensive care services.

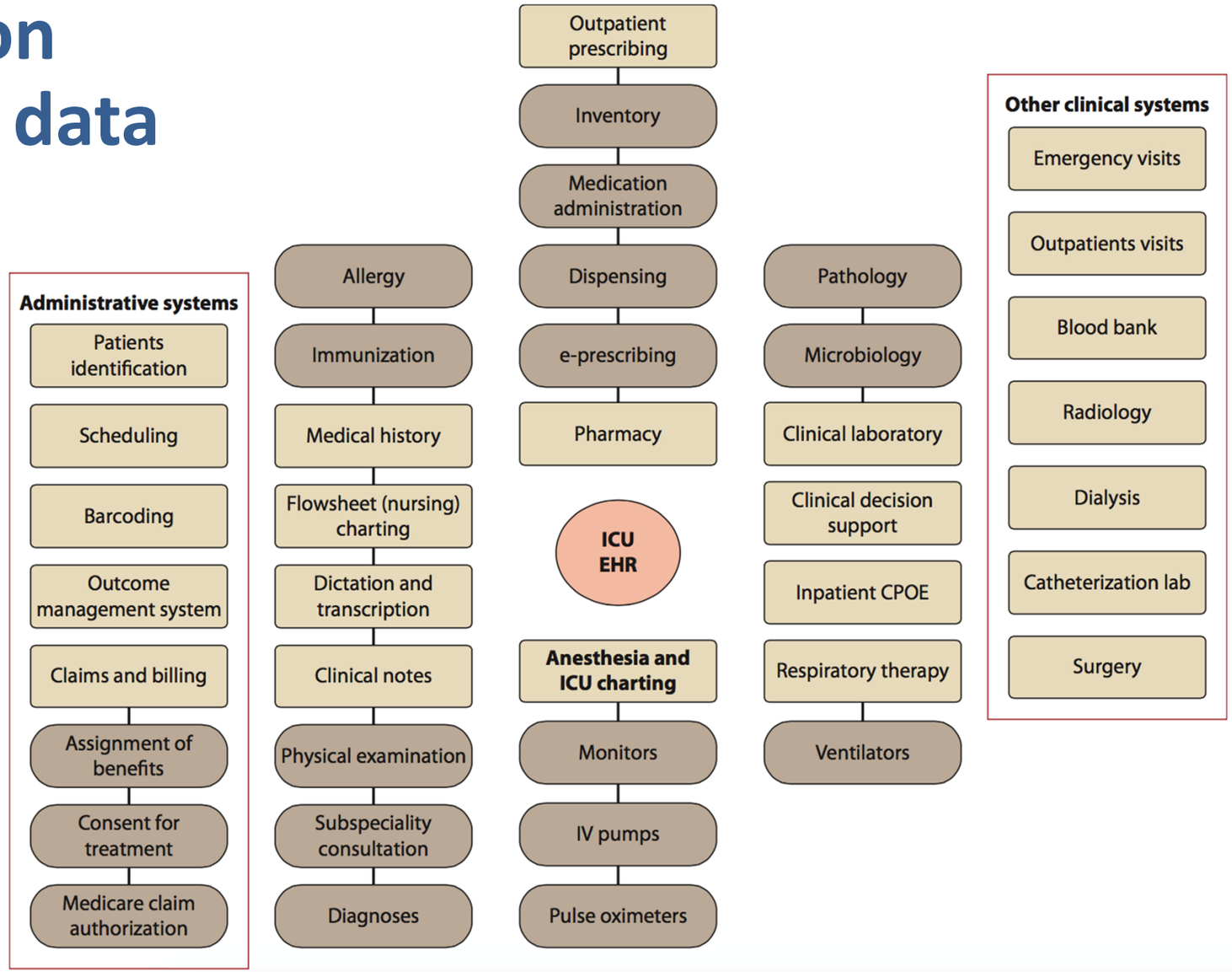
- **Monitoring center links** are used for cardiac, pulmonary or fetal monitoring, home care and related services that provide care to patients in the home. Often normal land-line or wireless connections are used to communicate directly between the patient and the center although some systems use the Internet.


NOT NOW KIDS
DADDY'S OPERATING
REMOTELY ON
A PATIENT.

Technologies barriers

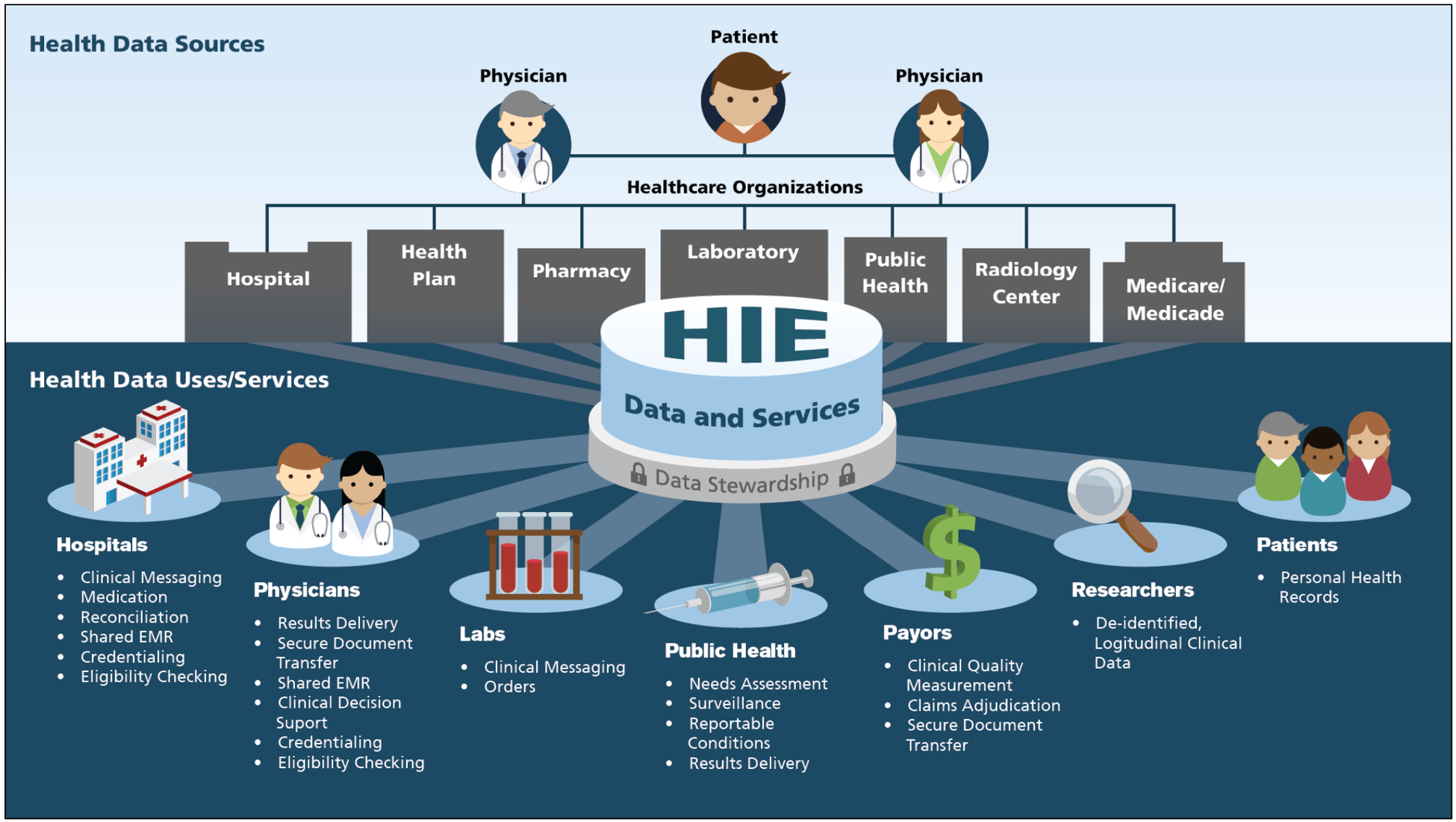
- Systems are too expensive to enable wide-spread diffusion
- Systems from independent vendors do not interoperate
- What can be done “over the wire” falls far short of what can be done in face-to-face encounters
- Most systems are sold as turnkey capabilities that are not easily customized to meet end user-specific needs

Clinical information system – complex data interaction

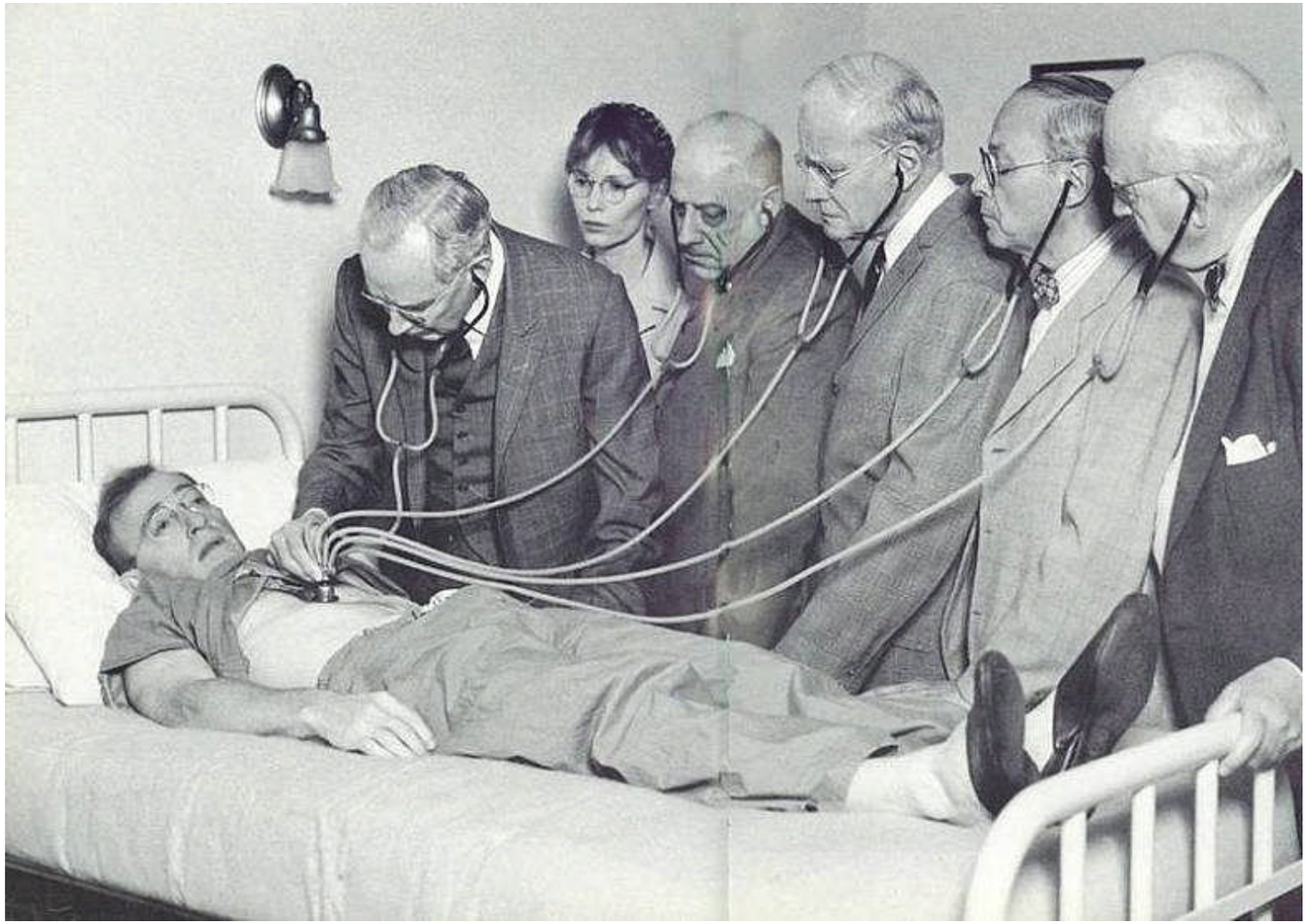


Herasevich et al. Medical informatics in ICU., in Principles of Critical Care, 4th, 2015

The Health Information Exchange



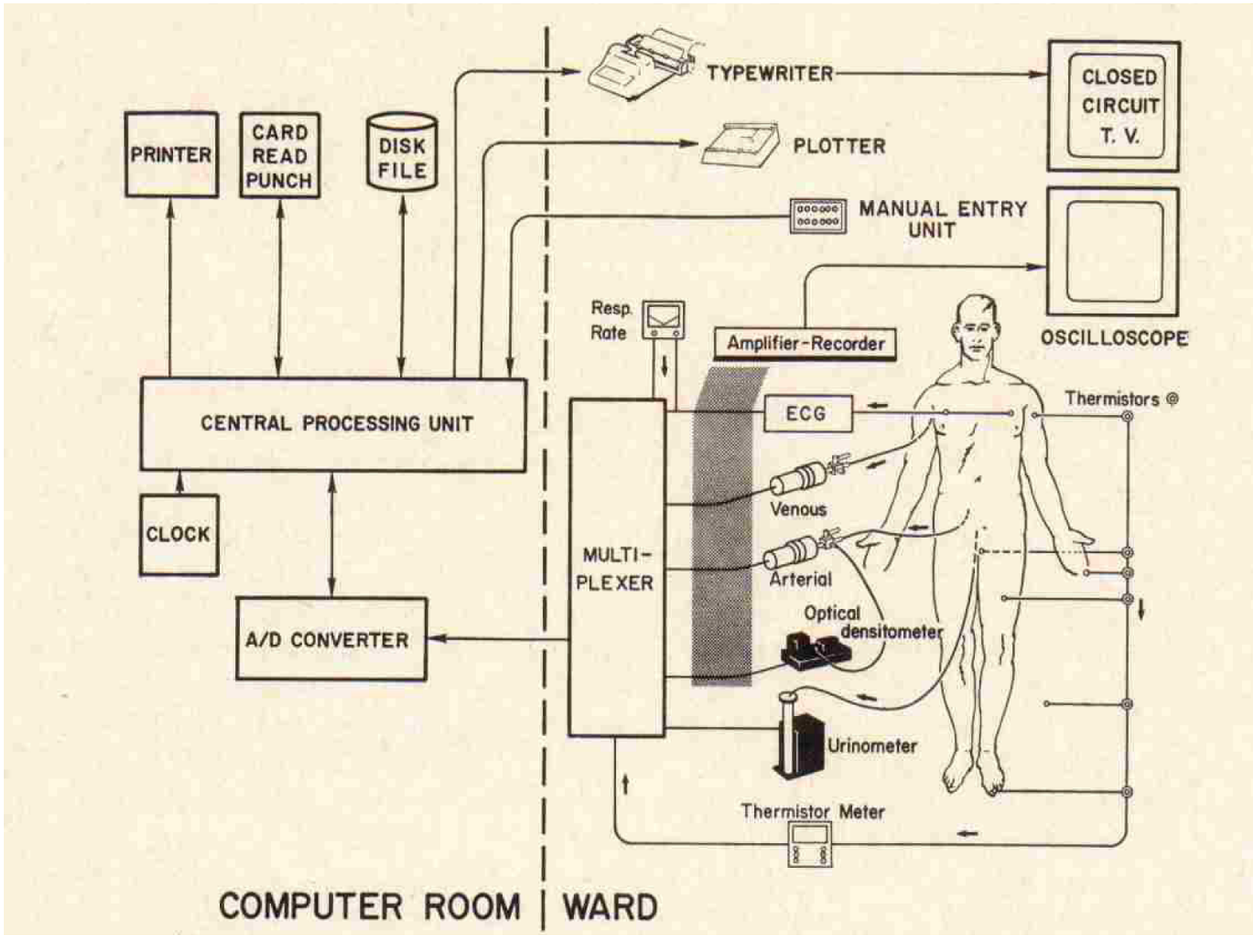
Progress and Innovation



One variation of the contemporary binaural stethoscope allows for multiple clinicians to listen simultaneously

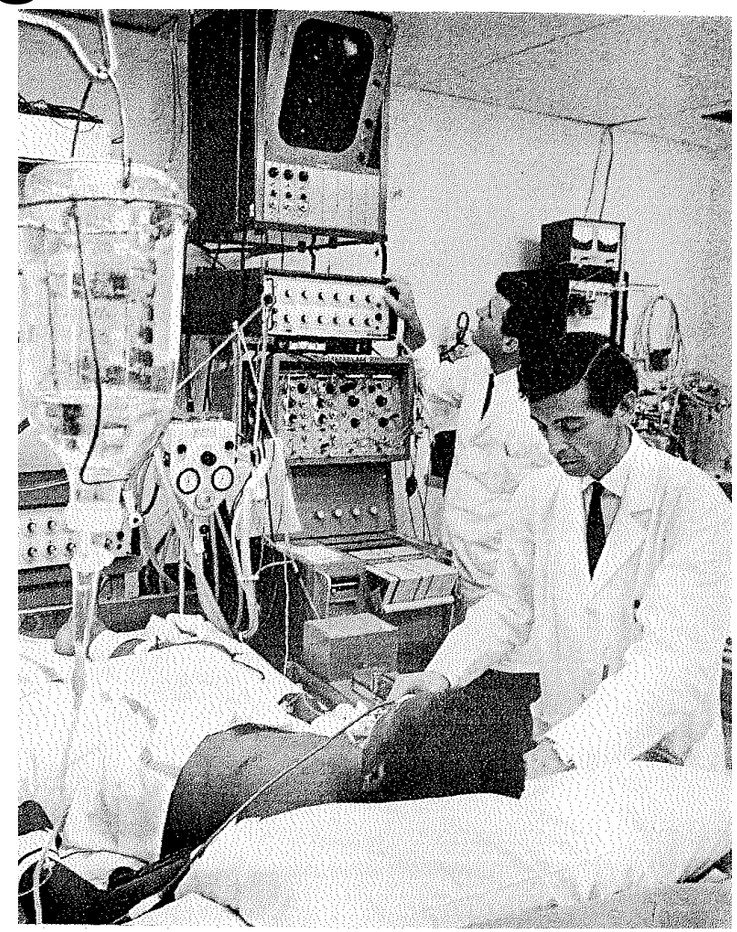
D. John Doyle Acoustical Respiratory Monitoring: Historical and Modern Aspects // *The Open Anesthesia Journal, 2019, Volume 13 P. 53-58* DOI: 10.2174/2589645801913010053

First generation ICU computer system – 1961 - 1977

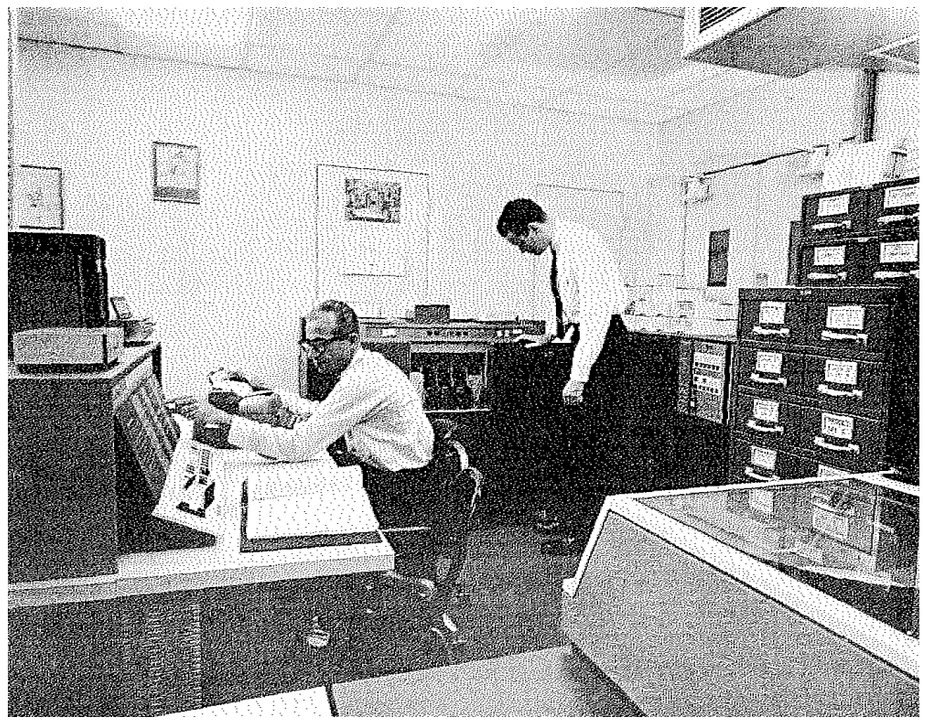


Shubin, H, and M H Weil. 1966. “Efficient monitoring with a digital computer of cardiovascular function in seriously ill patients.” *Annals of internal medicine* 65 (3) (September): 453-60. http://www.ncbi.nlm.nih.gov/pubmed/5911742.

First generation ICU computer system – 1961 - 1977



Bedside



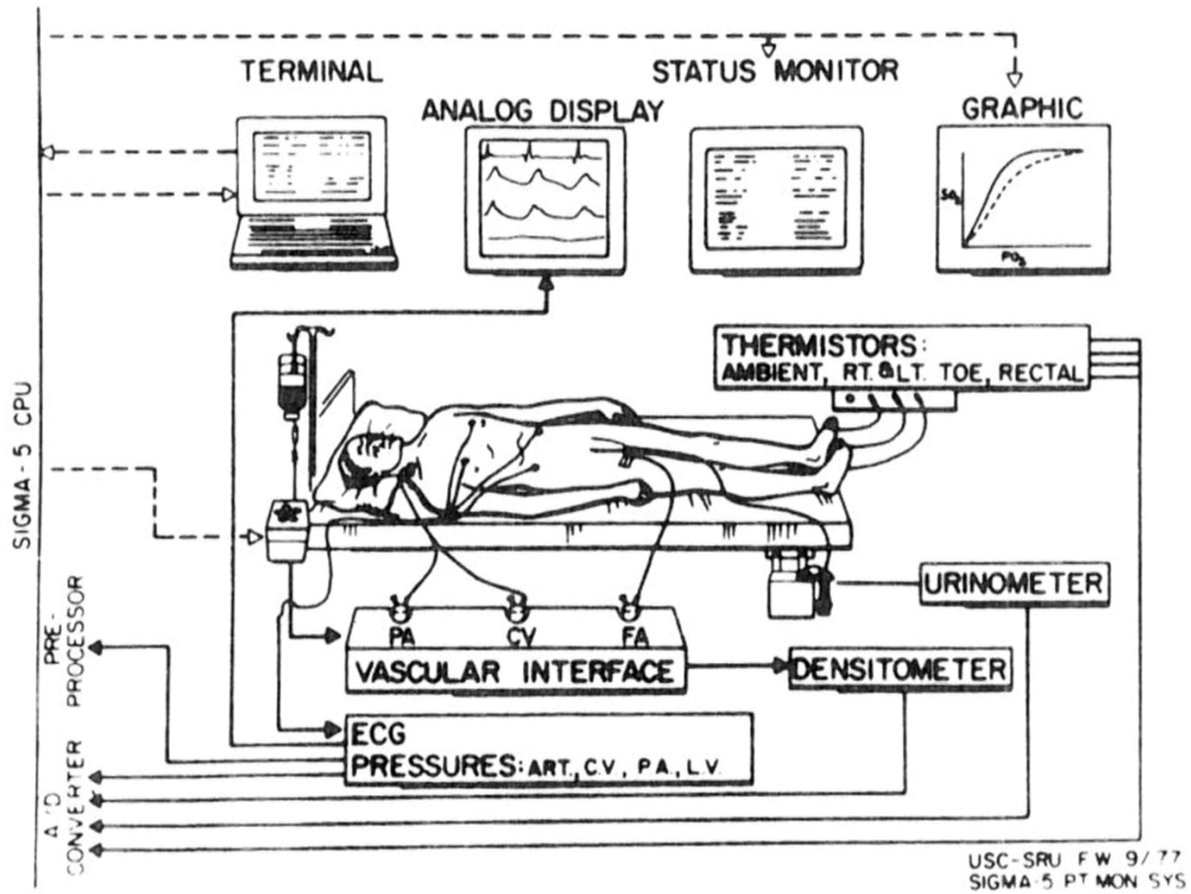
Computer room

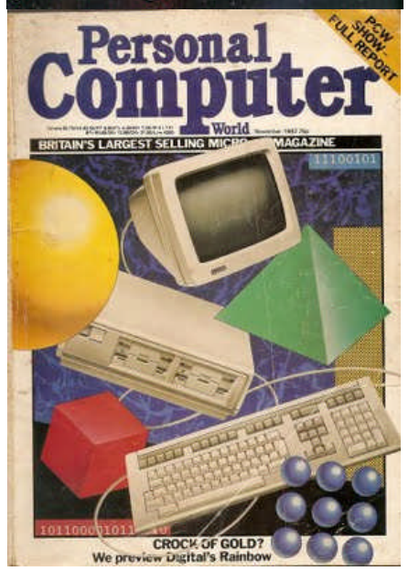
First Japan ICU Monitor (1967)

The Nihon-Kohden ICU-80 monitor from 1967 - the monitor is almost as big as the patient bed.

Second generation ICU computer system – 1977- 1992

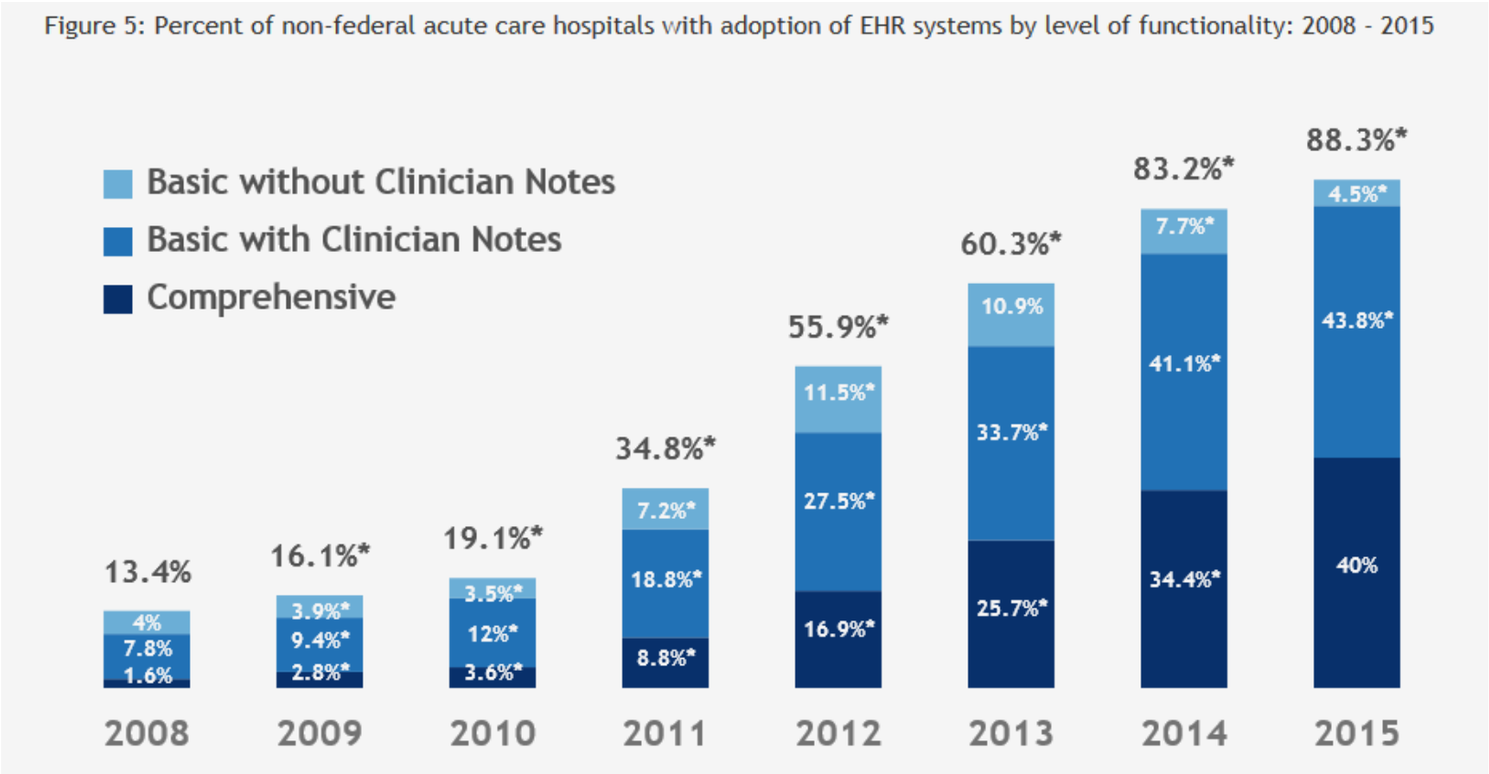
almost ready for TeleICU





Wiener F, Weil MH, Carlson RW. Computer systems for facilitating management of the critically ill. Comput Biol Med. 1982;12(1):1-15. PubMed PMID: 7075162.

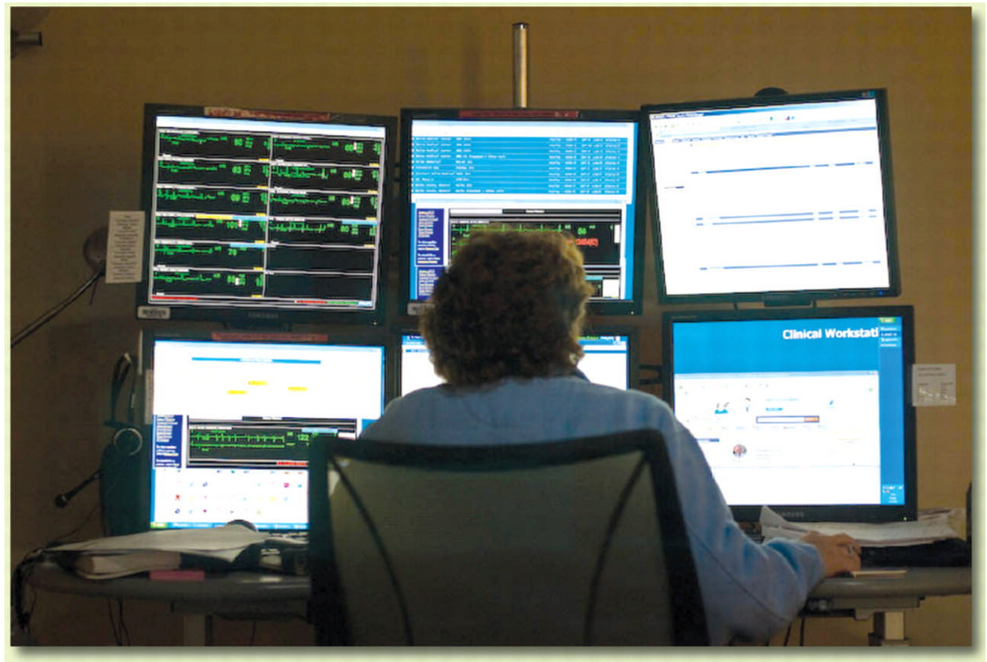
EMR adoption statistics



- A **2009** survey of American Hospital Association (AHA) members found just **1.5%** of hospitals had a **comprehensive EHR** system… increased to **40%** in **2015**

Henry, J., Pylypchuck, Y., Searcy Y. & Patel V. (May 2016). Adoption of Electronic Health Record Systems among U.S. Non-Federal Acute Care Hospitals: 2008-2015. ONC Data Brief, no.35. Office of the National Coordinator for Health Information Technology: Washington DC. http://dashboard.healthit.gov/evaluations/data-briefs/non-federal-acute-care-hospital-ehr-adoption-2008-2015.php#citation

Tele ICU



Patients who receive their ICU care from a hospital with an eICU program were:

- 26% more likely to survive the ICU.
- Discharged from the ICU 20% faster.
- 16% more likely to survive hospitalization and be discharged.
- Discharged from the hospital 15% faster.

Lilly CM, et al. A Multi-Center Study of ICU Telemedicine Reengineering of Adult Critical Care. CHEST. 2014 Mar 1; 145(3): 500-7.

Functional structure of Tele ICU

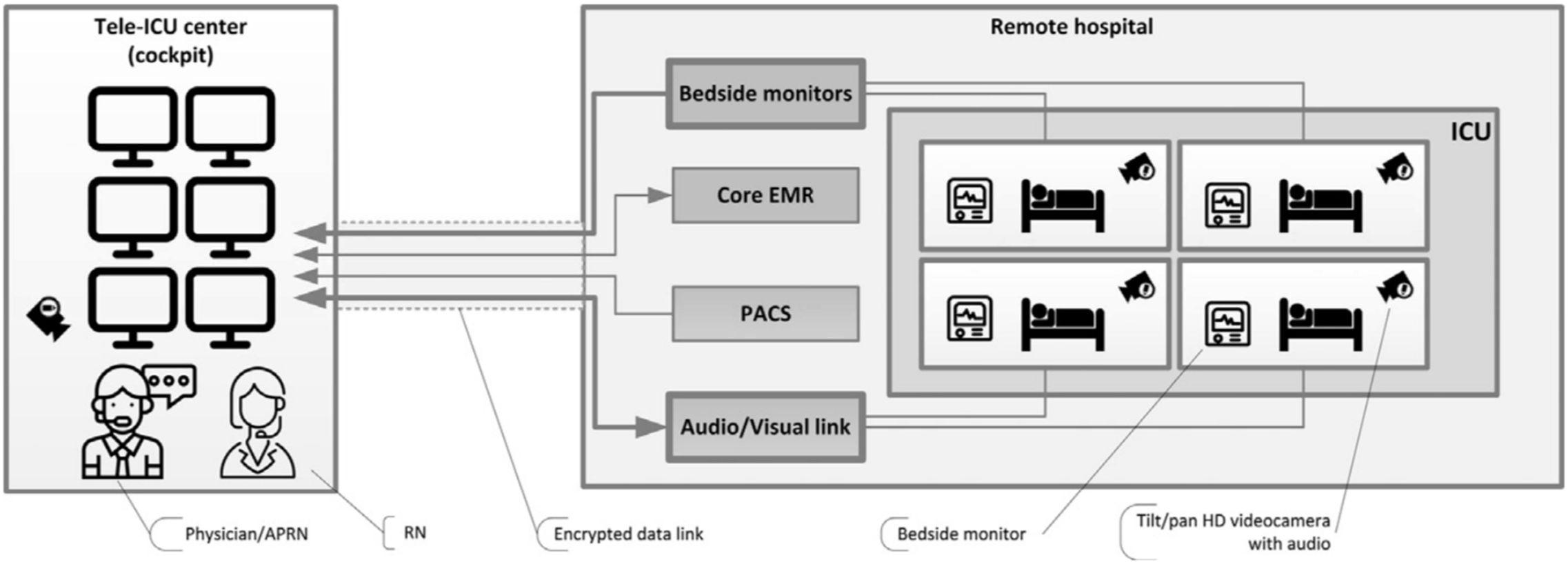


Fig. 1. Schematic technical outline of a comprehensive Tele-ICU system.

Herasevich V, Subramanian S. Tele-ICU Technologies. Crit Care Clin. 2019Jul;35(3):427-438. PMID: 31076043

Active patient monitoring vs. tele-consultation

- Almost every EMR vendor such as EPIC, GE Healthcare offers their own telemedicine solutions in general by adding video communication link on the top of EMR software.
- However, these are on-demand telemedicine solutions and cannot be considered as Tele-ICU **Active patient monitoring (ARM)** systems.
- FDA has guidance regarding differentiating ARM from medical device data systems (MDDS).
- Devices (including software devices) used for **APM must be FDA class II certified**. MDDS is not intended to be used in connection with active patient monitoring.

- *Code of Federal Regulations 21 Part 880. Docket No. FDA-2008-N-0106. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=880. Published 2008.*
- *Medical Devices; Medical Device Data Systems. FDA rule 76 FR 8637 , FDA-2008-N-0106. https://www.federalregister.gov/documents/2011/02/15/2011-3321/medical-devices-medical-device-data-systems.*

2014

In 2014 - Formal ICU telemedicine programs now support 11% of nonfederal hospital critically ill adult patients.

There is increasingly robust evidence of association with lower ICU (0.79; 95% CI, 0.65-0.96) and hospital mortality (0.83; 95% CI, 0.73-0.94) and shorter ICU (-0.62 d; 95% CI, -1.21 to -0.04 d) and hospital (-1.26 d; 95% CI, -2.49 to -0.03 d) length of stay.

Lilly CM, et al. Society of Critical Care Medicine Tele-ICU Committee. Critical care telemedicine: evolution and state of the art. Crit Care Med. 2014 Nov;42(11):2429-36. PMID: 25080052.

2019

Tele-Critical Care: An Update From the Society of Critical Care Medicine Tele-ICU Committee

Sanjay Subramanian, MD, MMM[1]; Jeremy C. Pamplin, MD, FCCM, FACP[2,3]; Marilyn Hravnak, PhD, RN, ACNP-BC, FCCM, FAAN[4]; Christina Hielsberg, MA[5]; Richard Riker, MD[6]; Fred Rincon, MD, MSc, MB.Ethics[7]; Krzysztof Laudanski, MD, PhD, FCCM[8,9]; Lana A. Adzhigirey, MSN, RN, CPHQ[10]; M. Anas Moughrabieh, MD, MPH[11]; Fiona A. Winterbottom, DNP, MSN, APRN, ACNS-BC, ACHPN, CCRN[12]; Vitaly Herasevich, MD, PhD, FCCM[13]

Objectives: In 2014, the Tele-ICU Committee of the Society of Critical Care Medicine published an article regarding the state of ICU telemedicine, one better defined today as tele-critical care. Given the rapid evolution in the field, the authors now provide an updated review.

Data Sources and Study Selection: We searched PubMed and OVID for peer-reviewed literature published between 2010 and 2018 related to significant developments in tele-critical care, including its prevalence, function, activity, and technologies. Search terms included electronic ICU, tele-ICU, critical care telemedicine, and ICU telemedicine with appropriate descriptors relevant to each sub-section. Additionally, information from surveys done by the Society of Critical Care Medicine was included given the relevance to the discussion and was referenced accordingly.

Data Extraction and Data Synthesis: Tele-critical care continues to evolve in multiple domains, including organizational structure, technologies, expanded-use case scenarios, and novel applications. Insights have been gained in economic impact and human and organizational factors affecting tele-critical care delivery. Legislation and credentialing continue to significantly influence the pace of tele-critical care growth and adoption.

Conclusions: Tele-critical care is an established mechanism to leverage critical care expertise to ICUs and beyond, but systematic research comparing different models, approaches, and technologies is still needed. (*Crit Care Med* 2019; XX:00–00)

Key Words: critical care; tele critical care; tele intensive care unit; telehealth; telemedicine

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[12]Advanced Practice Provider, Pulmonary Critical Care Evidence-Based Practice Facilitator, The Center for EBP and Nursing Research Ochsner Health System, New Orleans, LA.
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DOI: 10.1097/CCM.0000000000004190

In 2014, the Tele-ICU Committee of Society of Critical Care Medicine (SCCM) published a review of tele-ICU services (1) and now provides updates on its evolution. Today, clinicians use tele-ICU technologies and services in ways not previously considered. Consequently, the committee recommends a new term to describe technology-enabled critical care services to replace existing terms such as tele-ICU, ICU telemedicine, and others—tele-critical care (TCC). This term accommodates the concept that TCC services can be provided to locations beyond the physical confines of an ICU, or even a hospital. This article provides insight into TCC's evolving prevalence, functions, emerging trends, technologies, new applications, outcomes, and barriers. To clarify terminology, the entity providing TCC services is referred to as the "remote site," and the connected services recipient where care is physically provided as the "local site," regardless of geographic proximity.

TABLE 3. Types of Technologic Interaction With Off-Site Support for 363 Unique Centers Reporting No Formal Tele-Critical Care Program[a]

Type of Technology Used	*n* = 363, *n* (%)
Tele-radiology (films reviewed off-site)	242 (67)
Tele-consult (consult without transfer)	63 (17)
Tele-stroke (neurologist off-site)	95 (26)
Cellphone (e.g., photographs to dermatologist)	161 (44)
Tele-electroencephalogram (off-site neurologist review)	111 (31)
Tele-transfer (hospitals requesting transfer)	77 (21)
Skype or FaceTime for family meetings	74 (20)
Tele-electrocardiogram	96 (26
Tele-psychiatry	16 (4)
Telephone-only laboratory review	46 (13)
Telephone-only vital sign review	34 (9)
Telephone-only radiograph review	35 (10)
Telephone-only patient examination with camera	16 (4)
Other	57 (16)

[a]Responses of the 363 institutions that did not have formal tele-critical care programs. Note that each center could respond to multiple variables.

Subramanian S, Pamplin JC, Hravnak M, Hielsberg C, Riker R, Rincon F, Laudanski K, Adzhigirey LA, Moughrabieh MA, Winterbottom FA, Herasevich V. Tele-Critical Care: An Update From the Society of Critical Care Medicine Tele-ICU Committee. Crit Care Med. 2020 Apr;48(4):553-561. PMID: 32205602.

What are the barriers?

Although tele-ICU deployment is increasing, it continues to cover only a small proportion of ICU patients. This is primarily due to expense. Studies suggested combined implementation and first year of operation costs for a tele-ICU of $50,000 to $100,000 per monitored ICU-bed.

Telehealth skeptics have long argued that there are not enough data on telehealth's impact on outcomes and costs to support expanding its use. This bill (Rep. Robin Kelly new telehealth bill) comes as providers and patients worry that recent federal and state policies making telehealth easier to access and bill for will be rolled back once the emergency period ends.

Kumar G, Falk DM, Bonello RS, Kahn JM, Perencevich E, Cram P. The costs of critical care telemedicine programs: a systematic review and analysis. Chest. 2013 Jan;143(1):19-29. PMID: 22797291

Key Telemedicine Technology Needs

A New Generation Of Devices	Interoperability	Mechanisms for Knowledge Diffusion
1. Less expensive 2. Usable in more places by broader range of people 3. Rich set of clinical capabilities 4. Integration with EHRs	1. Vendor neutral station-to-station 2. Plug-and-play devices 3. Dynamic federation of distributed components 4. Self-configuring 5. Self-calibrating	1. Education and training for non-traditional actors 2. Tech-embedded, process-specific decision aides 3. Intelligent devices 4. Standardized user interfaces to allow portability of skills

ICU
MANAGEMENT & PRACTICE
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The Future ICU

PLUS

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Will Artificial Intelligence Change ICU Practice?

An AI-enabled ICU is coming in the not-too-distant future, but it requires strong partnerships between clinicians and engineers.

Spoiler alert. The short answer to this question is **yes!**

Artificial Intelligence (AI) is not new. The Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI) took place in 1956 (Moor 2006). In Europe, the "Conference on Artificial Intelligence in Medicine" has been taking place biannually for the past 28 years (Patel et al. 2009).

What is new, however, is the cross-industry exponential growth in awareness of, and interest in, AI over the past decade. In addition to the stimulus provided by our ability to generate, gather, organise, store and access enormous amounts of digital data, the growth of AI in medicine has been facilitated by three major developments:

1. The proliferation of electronic medical records (EMRs) is the most obvious manifestation of the use of AI in medicine. Although EMR adoption is visible, by far the largest growth in the healthcare field is occurring in the realm of digital imaging and genomic sequencing. The wealth of data available has driven a need for innovation in the analytics space, while simultaneously fueling AI development which is highly dependent on the availability of large quantities of training data to produce reliable algorithms.
2. Advanced analytic methods demand significant computational resources. Increasing standalone computer power combined with the availability of state of the art cloud computing services from providers such as Google and Amazon puts the necessary computational resources to get started in AI within reach of anyone who is interested. The impact of this has been felt most obviously in the consumer space but in medicine, this resource is increasingly being applied to the enrichment and analysis of the glut of medical data flowing from #1.
3. Data transmission methods using mobile technologies such as 5G, smartphones and consumer wearables are advancing rapidly. These technologies enable in situ data capture/analytics, data sharing, knowledge delivery, synchronous and asynchronous communication and extended reality interactions with profound implications for traditional healthcare delivery models.

However, because of patient privacy issues, healthcare presents significant barriers to entry for those outside the health system firewall. Those driving innovation in the three areas outlined above have mostly remained outside of healthcare. Because of the firewall, AI development has started as a cottage industry run largely under the direct or close supervision of the healthcare stakeholders that collect and store the data. Efforts through this approach have, to date, produced little in the way of meaningful impact on patient outcomes. For example, despite an explosion of AI-related academic output, a recently published systematic review shows "no performance benefit of machine learning over logistic regression

Figure 1: Control tower platform

In 2012 we published an article "The hospital of the future - building intelligent environments to facilitate safe and effective acute care delivery." This described an alignment of people, processes, technology and incentives to serve the interests of the patient (Pickering et al. 2012). We would like to revisit some of technologies in an attempt to demonstrate how we might harness the developments in AI for the benefit of patients and providers while avoiding some of the potential harms. Our prediction for the near future is that three AI-based ICU tools might be transformational:

Control Tower Platform

The modern EMR adds to information overload by overwhelming EMR "inboxes" and generating unnecessary alerts (nytimes.com/2019/11/01/health/epic-electronic-health-records.html). Clinical Control Tower is a newly-developed central alert-screening and implementation system developed at Mayo Clinic. The concept behind Clinical Control Tower is to serve as a centralised non-life-threatening alert and prediction "cockpit." This unified screening system is managed by a designated capsule communicator or "CapCom," analogous to the US National Aeronautics and Space Administration ground-based astronaut who maintains contact with astronauts during space missions. The CapCom in the healthcare context is the clinician responsible for screening incoming alerts and notifications. As no alerts have 100% accuracy it is essential to perform initial validation of notifications before activating specific workflows with bedside providers.

When the CapCom decides that an alert is valid, he or she communicates "down to the ground" to a bedside clinician and guides them through necessary and recommended tasks. Each step may be captured electronically in the control tower application. Workflow and actions are captured and analysed using a feedback loop tool. Deviations from intended care processes may be identified. Control Tower is a tool designed to minimise errors and information overload in hospital practice (**Figure 1**).

Computer Vision

Platforms such as Control Tower will help deal with data management and representation, but will not change the fact that a significant portion of a clinician's time is spent on data entry to computers.

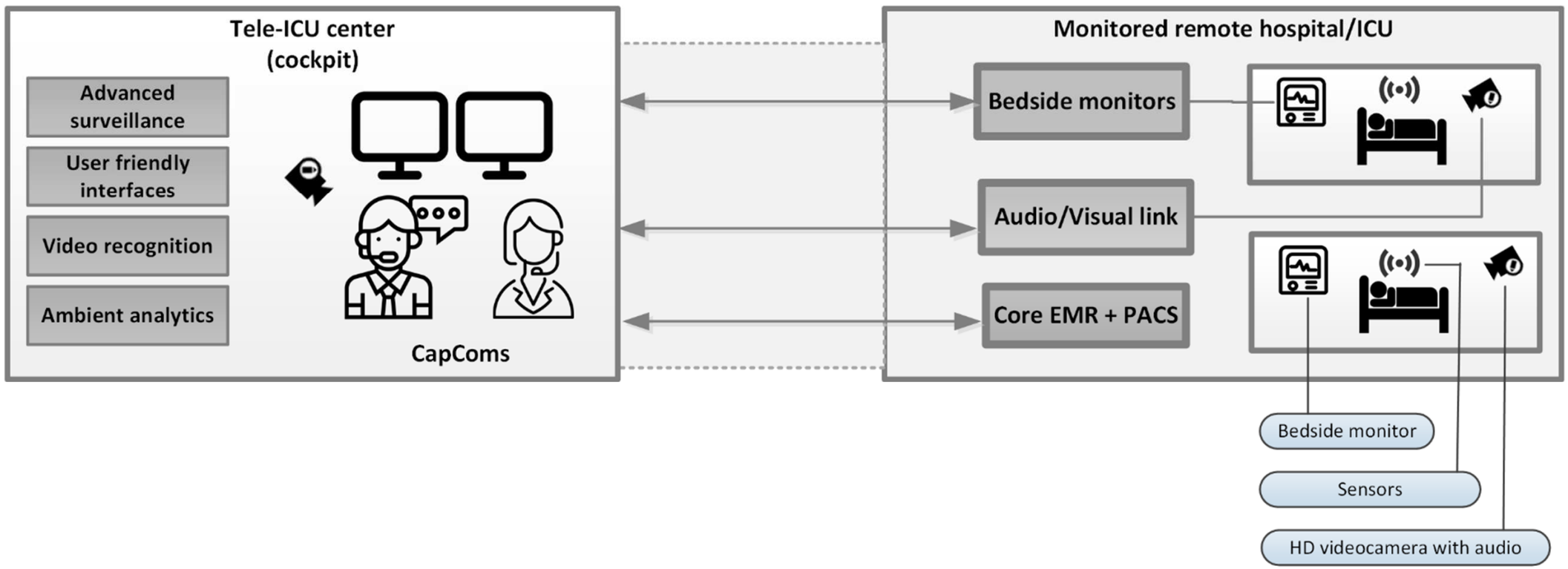
Computer vision is an area of AI development with a goal of enabling computers to gain high-level understanding from videos or digital images. Image reasoning and computer vision may be applied to healthcare environments to enhance diagnostic processes and optimise and automatise workflows. But computer vision alone will not be able solve challenging clinical

Next generation of hospital patient monitoring (Tele ICU)

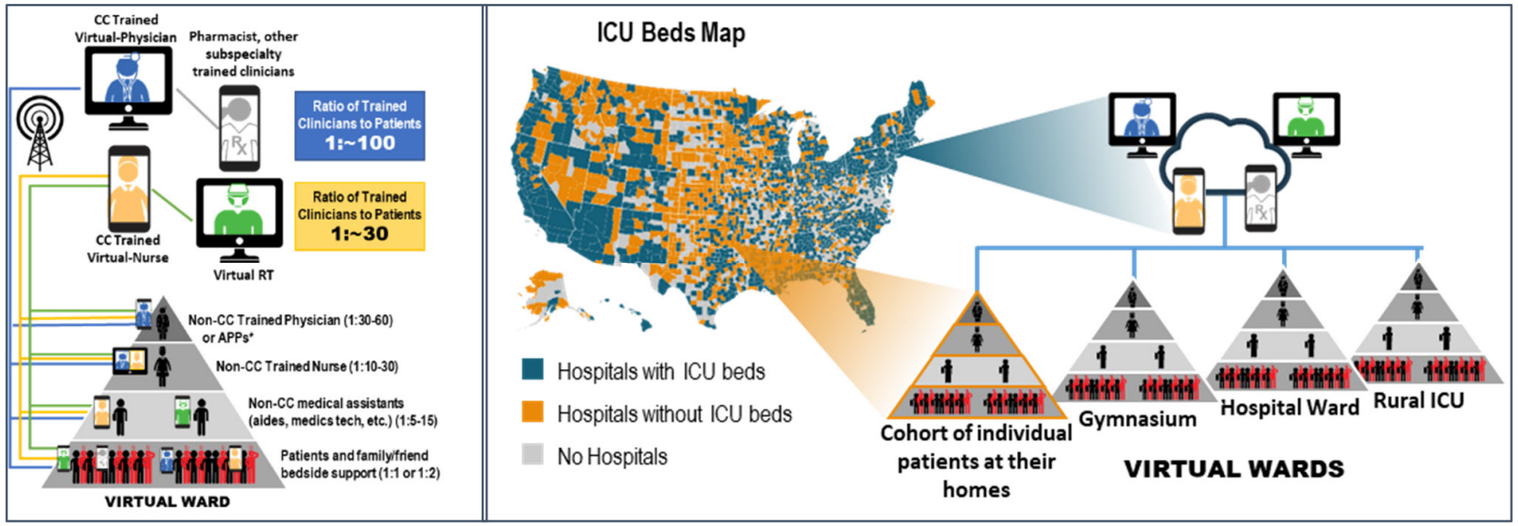
Electronic system will be able to handle the following:

- Effectively monitor all hospital beds in addition to the ICU
- Tracking patients from admit to discharge (continuity of care)
- Detect and manage deterioration (Sepsis, ARDS, etc)
- Support patients prioritization mechanism
- Automatization of routine tasks
- Human centered design

Functional structure of Tele ICU



National Emergency Tele Critical Care Network - NETCCN



Fundamentally, NETCCN is designed to be rapidly deployed, easy to use, and intended to help with tiered staffing models where local, non-critical care trained clinicians can have a critical care trained expert in the palm of their hand

https://www.tatrc.org/netccn/index.html

The Intelligent ICU: Using Artificial Intelligence Technology for Autonomous Patient Monitoring

Anis Davoudi[1], Kumar Rohit Malhotra[2], Benjamin Shickel[2], Scott Siegel[1], Seth Williams[3,4], Matthew Ruppert[3,4], Emel Bihorac[3,4], Tezcan Ozrazgat-Baslanti[3,4], Patrick J. Tighe[5], Azra Bihorac[3,4,+], and Parisa Rashidi[1,2,4,+,*]

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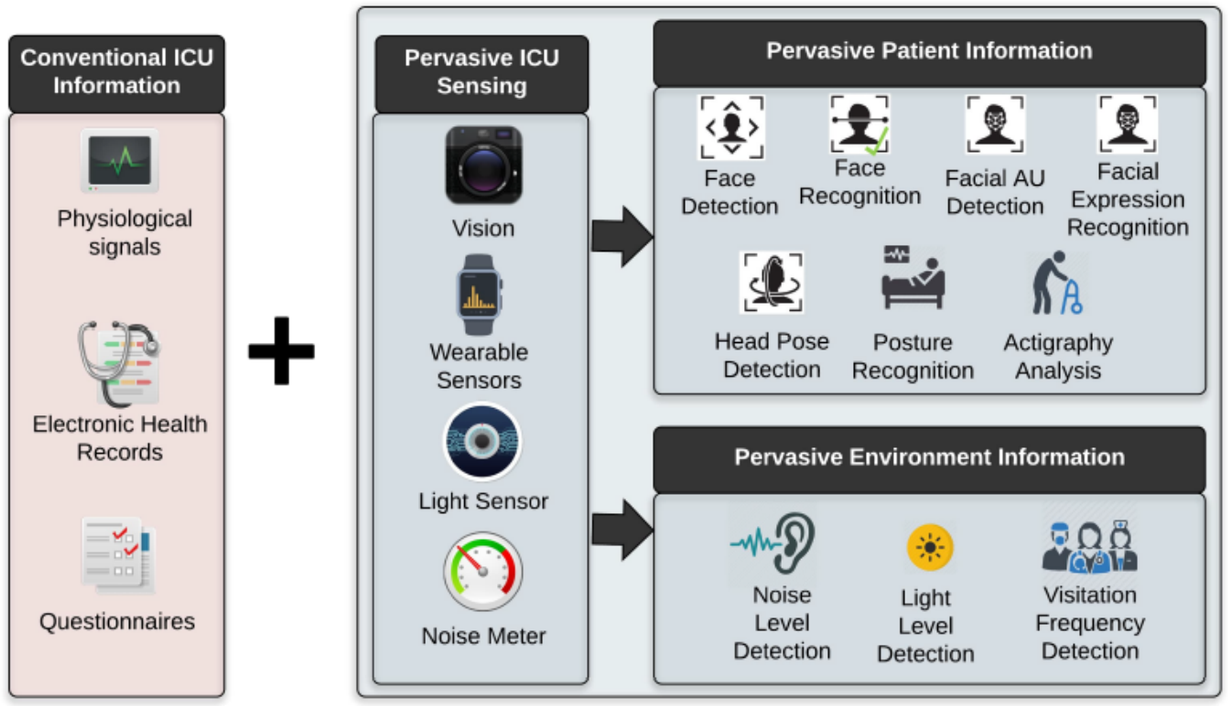
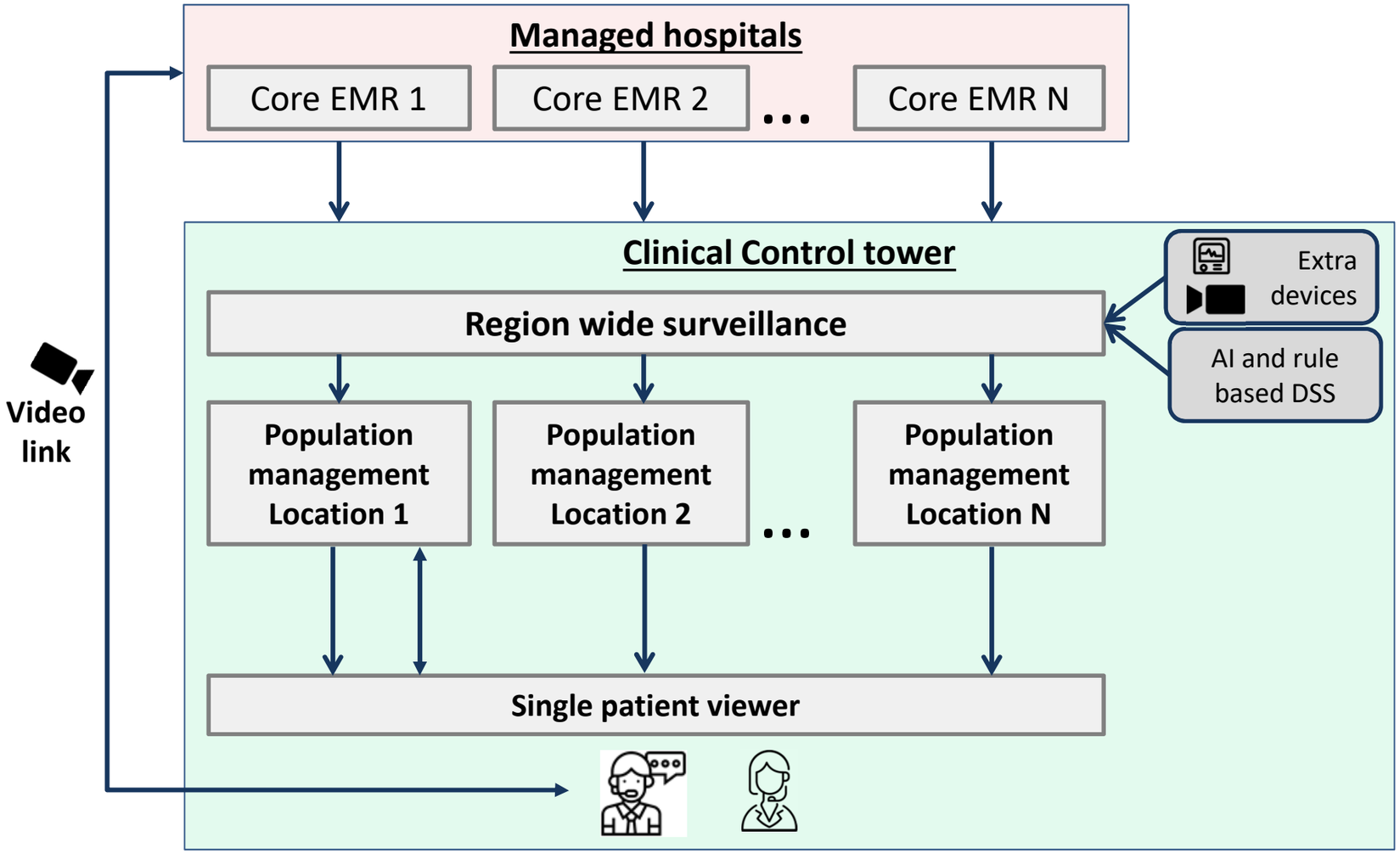


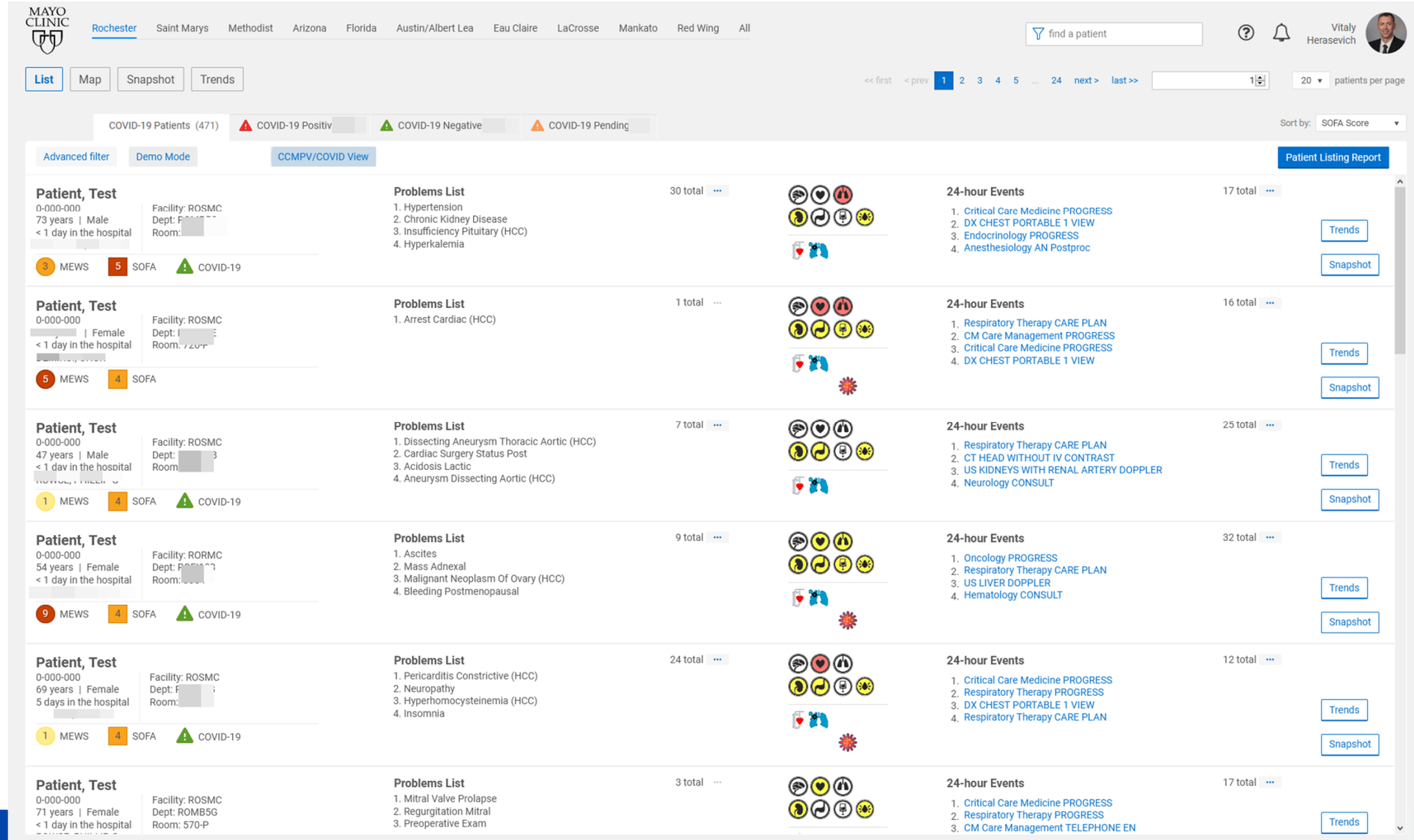
(b)

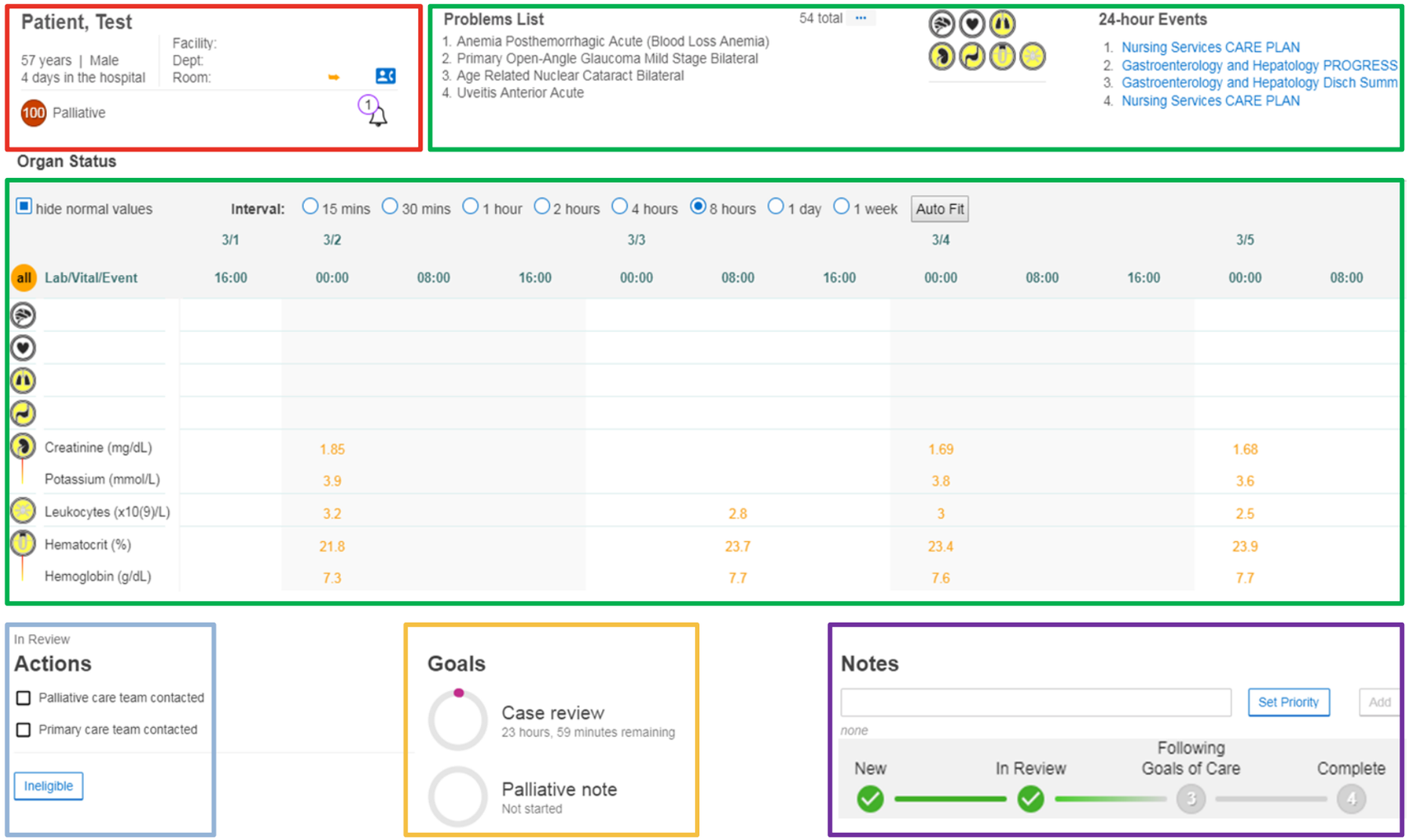
gure 1. (a) Intelligent ICU uses pervasive sensing for collecting data on patients and their environment. The system

Global monitoring (clinical control tower)



Clinical control tower- surveillance





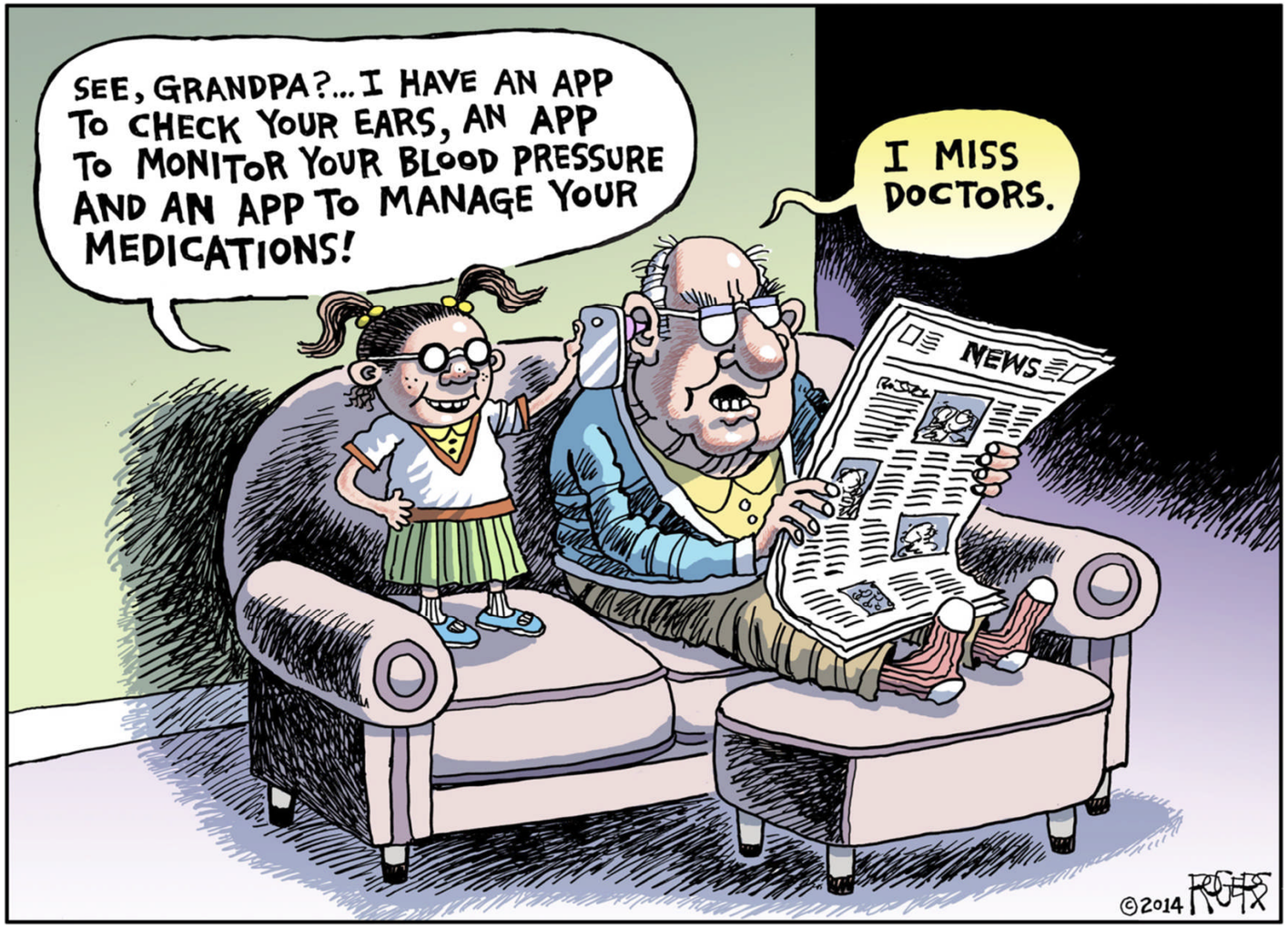
Artificial Intelligence High Value Data – Eliminate Noise Defined Process Defined QI Goals Communication

What could be improved in Tele ICU technically?

1. Better cameras/communications (8K)
2. Video recognition technologies
3. Better surveillance/alerting functionally
4. Better presentation of data from EMRs

In Conclusion

- Licensing
- Reimbursement
- Interoperability
- Better systems
+ Patients acceptance



Chest. 2014; 145(6):1190. doi:10.1378/chest.145.6.1190

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