

# Innovative Ways to Improve and Expand the Telemedicine Experience

Nirmay Sonar<sup>1\*</sup> and Dominic Gaziano<sup>2</sup>

## Abstract

Telemedicine has seen a rapid growth in recent years, with constant augmentation to technologies used, and the application of these technologies in creative ways, creates new pathways in the practice of health care. While there are advantages and disadvantages of using this method, it also reflects on the versatility of the physicians and the health care community who are able to adapt to new changes, which ultimately have a real world impact, in terms of greater number of patients covered.

Telemedicine can act as a sentinel, a system of prospective triage in which patients can consult with health care practitioners whether they require hospital services or not. With the increased health awareness, increased availability of basic medical equipment at home, and a communication device, interactions between the patients and physicians have grown in many creative ways. We take a look at some ways these creative ventures can be explored, to the benefit of all.

In the future, it can be estimated that telemedicine can eclipse the physical visits in number, and in patient preference. This is further backed by a study done by Powell et al. in which patients were asked what type of visit they would prefer.

Now, a question arises of, how can we utilize the resources available, the technological advances of the internet and cellular devices to deliver a new standard of care? This brings us to the concept of using our senses creatively, and using new standards of doctor-patient communication to deliver health care.

Now, we have two distinct approaches to the practice of Medicine. One being the mainstream, good old tried-and-tested physical visits and the other being telemedicine, where healthcare professionals and patients, both are apprehensive about how to approach them. However, what we propose is not a sharp delineation, but rather a new 'hybrid' approach, that is a bilateral approach involving telemedicine and physical visits in combination, to deliver a new standard of healthcare.

It is also worth noting that Telemedicine is not here to replace the traditional methods of Medicine involving examination of the patient, but a new pathway to practice healthcare. We are witnessing this concept in its infancy stage, and it is expected that there are certain barriers and roadblocks along the way, but so many great technologies, such as the internet and e-mail, did face similar challenges.

1 Clinical Rotator at Capital Neurology and Sleep Center, Maryland

2 Physician at Body and Mind Medical Center, Illinois

**\*Corresponding author:**  
Nirmay Sonar

✉ nirmay9833@gmail.com

**Tel:** 8033701108

Clinical Rotator at Capital Neurology and Sleep Center, Maryland

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## Introduction

### An Update on Telemedicine

Telemedicine, put simply, is the practice of medicine, or the delivery of health care services, which includes making diagnosis, and management, by using information and communication

technologies [1]. This includes utilization of technologies, such as video calls, audio calls, emails, text messaging to encompass various aspects of health care, such as appointments, verification of patient details, the encounter itself, and other communication snippets between the health care provider and the patient.

Telemedicine should be differentiated from tele-health, which

is a broader concept, and involves services which give access to health assessment and other services [2]. For example, contact tracers practice tele-health, and a physician prescribing medication practices telemedicine.

There are many barriers to the full implementation of telemedicine in today's practice, but the continued development and availability of information and technology are key steps to the acceleration to a world, where telemedicine could be considered a suitable alternative to in office visits.

**Telemedicine is here to stay:** In the wake of the COVID-19 pandemic, the world truly realized the importance of telemedicine. By having this as an asset, contact can be minimized and health protection can be implemented. Moreover, a survey done by The Physicians Foundation in 2020 revealed that many physicians could not adapt to the telemedicine standard, and some even had to close down their clinics. Many physicians were able to adapt to these changes, and their versatility shined through, with their ability to retain their patients. As of writing, we continue to fight the COVID-19 pandemic. But it cannot be predicted what pandemic may present to us tomorrow. Pandemic or not, telemedicine is here to stay.

### The Hybrid Approach in Telemedicine

So what is this hybrid approach all about? How does this translate to real world benefits?

This idea comes from a very primitive question, that being, what makes a good practitioner? Is it someone who treats a lot of patients? Or goes through complex diagnostic algorithms to find something completely novel? Well, we believe that a good practitioner is a good listener, a perceptive individual who changes bad habits into good habits.

A change in behaviour will result in positive lifestyle changes. Let's take an example of a case we saw in our clinic. A 43 year old female, let's call her Susan, was diagnosed with hyper-lipidemia. Now, out of the three events, one being making the diagnosis, two being starting a statin (treatment) and three being making sure Susan changes her diet and activity, which would be the one that a practitioner would struggle the most with? It's the one which involves the patient's compliance, being number three. So, we scheduled Susan for regular telemedicine call visits, where

we would interact with her regularly, give her small targets to achieve weekly, and motivate her to give her best.

As many countries come out of the pandemic, and countries that still remain under the grip of the virus, this is the 'ticket', or a pathway to advancing healthcare in this new era. A hybrid or a combination approach that can actively switch between physical visits and telemedicine consultations. This will also negate the attrition between physicians and patients, as a constant open communication line will remain, and will make patients feel more secure about their health.

### Medical Approaches used in Tandem

It is obvious that there are aspects where physical visits are overtly better than telemedicine for some diseases. Conversely, there are some places where Telemedicine can do better. We have compiled a list of common diagnoses that could demonstrate how each system can do in different situations. These examples depict the role of three approaches while managing some of the common diseases. We note that in some places, the role of physical visits cannot be overlooked, for example emergencies and severe inflammatory processes, while in some conditions, for example those requiring chronic maintenance and monitoring, we can use a hybrid of telemedicine and physical visits in tandem, for example, an hypertensive can daily record blood pressure, and can come in on a regular basis for a metabolic profile (Table 1).

### Novel Methods in Telemedicine

In discussing a few of the innovative ways of using telemedicine, the question arises of what we are trying to achieve. So, the goal of any objective examination is always to obtain this high yield information, which influences our decision toward a specific diagnosis. Usually we perform a myriad of clinical tests, and when we combine them all together, they point toward a diagnosis, or provide us with the next step.

Let's take an example of a case, seen in Chicago, IL by our team. This patient, a 45 year old female, had a weeklong runny nose and a sinus headache. Now, how do we rule in acute bacterial sinusitis? The importance of this question is, how do we elicit a useful sign when a patient is at home, because if they do have the diagnosis, it cannot be missed out and needs prompt treatment.

**Table 1.** Comparative Table showing the usage recommendations of the three approaches.

Diagnosis	Physical Visits	Telemedicine Consults	The Hybrid Approach
Upper Respiratory Tract Infections (URIs)		✓✓	✓
Lower Respiratory Tract Infections (LRIs)	✓✓		
Diabetes Mellitus, initial diagnosis	✓✓		
Diabetes Mellitus, maintenance therapy		✓	✓✓
Chronic Low Back Pain (LBP), initial diagnosis	✓✓		✓
LBP, maintenance		✓	✓✓
Abdominal Pain and Acute Abdomen	✓✓		
Diarrheal disease and Acute Gastroenteritis (AGE)		✓✓	✓
Psychiatric Disorders		✓	✓✓
Urinary Tract Infections (UTIs)	✓		✓✓

✓✓ : Denotes highest recommendation, or one with most benefit  
 ✓ : Denotes moderate recommendation  
 A Blank field denotes lowest recommendation, or least benefit obtained

So we looked at the likelihood ratios. What signs can diagnose sinusitis, according to the evidence? Well, it turns out that the best clinical exams would include, Pain in maxillary teeth (LR +2.8 LR-0.76), and the presence of sinus tenderness (LR +1.8, LR-0.71) [3].

Just for reference, the more positive the value above 1, the higher it is specific for that diagnosis.

By using these evidence based criteria, as a supplement to clinical history, and by having good interpersonal communication with the patient, we could explain the patient to do the test over the telemedicine consult, and ask the patient if there was any pain, i.e positive sinus tenderness.

### General Exam in Telemedicine

Aspects of the general exam, while not all can be covered, but a few of them can be performed over the telemedicine visit.

The main roadblock here is that of the vitals. Temperature, pulse, respiration, and blood pressure are exclusively objective signs that are conventionally recorded in-person. But here's the interesting fact. Similar to how the COVID-19 pandemic accelerated the role of telemedicine, so did the rates of people having basic medical equipment such as a pulse oximetry device, and a thermometer. In fact, Research and Markets' recent report on infrared thermometers' sales predicted that by 2027, the global market size of these 'temperature guns' would reach a predicted 1.4 billion United States Dollars (USD). Now this means, more people will be having basic medical equipment, with numbers bound to rise in the near future.

So with these, some basic measurements of patients can be obtained. With respect to the head to toe exam, it is recommended that these should be driven by the diagnosis in mind. For example, a diabetic general exam would involve things like inspection of the neck to look for acanthosis nigricans (a sign of insulin resistance), then a foot exam for complications such as vascular occlusion. It's obvious that a sensory exam cannot

be done in these cases, but a sharp eye can look for multiple abrasions and lacerations, which may predict a sensory loss.

### Disease Specific Exams

Whereas the systems examination includes a protocol for examination of a system, for example, exam of upper airways, lower airways and then lung parenchyma for the respiratory examination, real life medicine is more of specific complaints, a comprehensive history, and after this data has been obtained, we have a list of differentials, which are narrowed down based on more clinical findings. This method increases the pre test probability (chances) of accurately making a diagnosis. It's essentially clue hunting.

Here, we go through some common diseases, and how telemedicine examinations can be envisaged in these patients. Here we discuss three examples, first on chronic back pain, then on upper respiratory infections, and then on diabetes mellitus.

### Chronic Back Pain

Chronic Back Pain sits at the number two spot of the commonest reason for visiting the hospital. This is a huge burden, from the patients to the health care system, as chronic low back pain accounts for the greatest number of years lived with disability for patients [4].

Now, one can imagine the causes ranging from superficial to deep, from the back muscles, to the vertebra, with the spinal column to the pancreas and aorta for the causes of back pain. The question arises, what can be done by telemedicine means.

As far as etiology 'hunting' goes, back tenderness, for example, can point toward vertebral causes such as vertebral fracture quite accurately (LR+=6.7, LR-=0.44) [5]. Patients or their caretakers can be asked to simply move their hand vertically over the midline for this exam. This diagram visually depicts the role of telemedicine in examination of chronic back pain (Figure 1).

While the diagram here does depict most of the signs here,

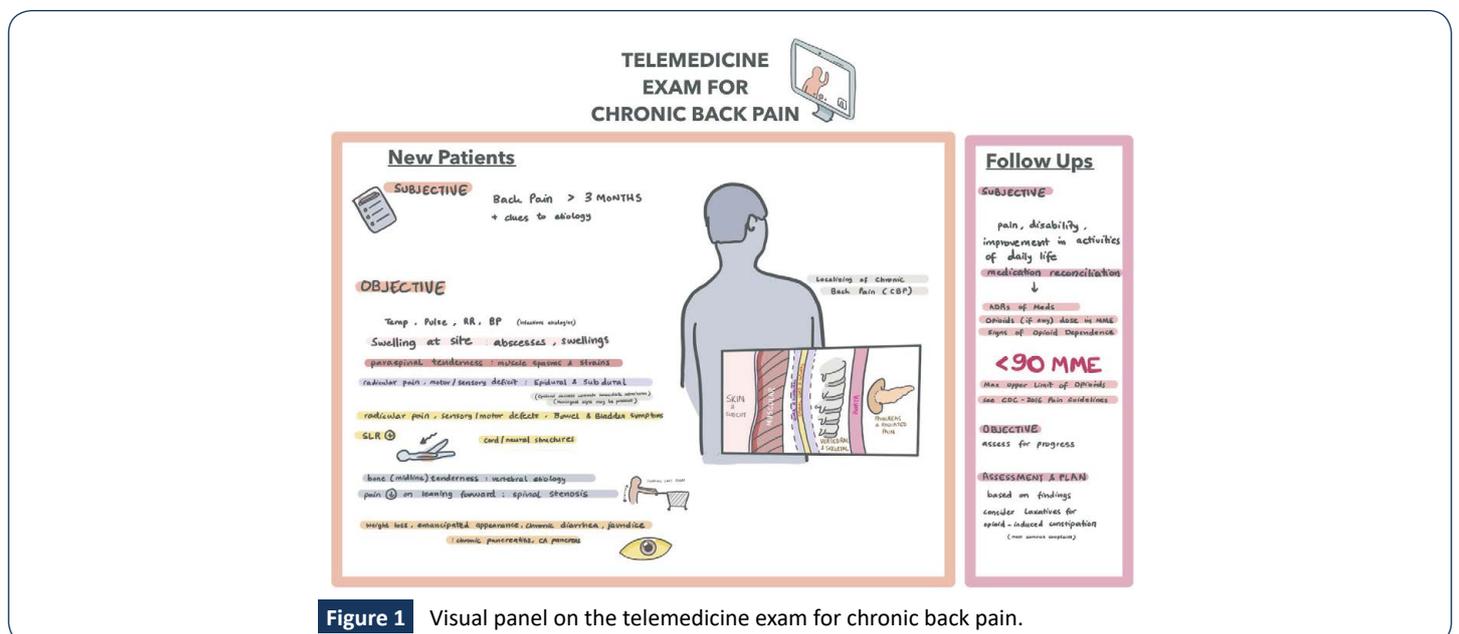


Figure 1 Visual panel on the telemedicine exam for chronic back pain.

it is really important to understand the accuracy of these in diagnosing the specific Etiology. While an accurate diagnosis may require additional imaging, a preliminary guide, or so, the clue to the hunt can be obtained here. Tests like the Straight Leg Raising (SLR) have great sensitivities (91%) but a weak LR (+0.35) for disc herniation [6]. The bend-forward sign, or the shopping cart sign has a good LR for spinal stenosis (+13.0) [7]. Some causes of referred pain are notoriously difficult to investigate, with vague symptoms of weight loss, and emaciation. Jaundice has a LR of +2.89 for pancreatic cancer [8].

It is also important, in follow up cases, to pay attention to the patient's pain management protocols, as well as signs of opioid dependence.

### Upper Respiratory Infections

Upper Respiratory infections range from common colds (coryza), rhinitis, to sinusitis. Although not a part of the respiratory tract, tonsillitis, otitis, and swollen lymph nodes are also considered as differentials due to their close proximity and overlap of symptoms. Put together, the burden of URIs leads to a burden of 20 million missed work/school days [9]. The etiologies are so varied, depending on the season, the presence of a viral dominant strain (such as in a pandemic), age, immune status, and exposure level.

For an objective exam in telemedicine, a few findings can be noted, such as Temperature, Pulse and respiration. Respiratory rate may be challenging, over video call as well. So mainly visibly fast/tachypneic patients are looked for. Many patients also may have a saturation probe at home, which can help with pulse and SpO<sub>2</sub> values.

Inspection of the nose can reveal the Darier's line, a feature seen in allergic rhinitis, though not very commonly (7%) [10]. Erythema of the skin over the nose and cheeks also points towards nasal congestion of any etiology. Patients can also perform the Cottle

Test (lateral traction of the cheek opens the nasal valve), which points toward a Deviated Nasal Septum (another cause of recurrent URIs) [11]. Rash on the nose post amoxicillin is quite specific to Infectious Mononucleosis. While the incidence ranges wildly from 27.8% to 69%, it is a highly specific finding [12].

Now, Inspection of the oral cavity is difficult, and requires good understanding between the physician and the patient. While the patient won't be able to pick up details like pharyngeal erythema, and visualization over video call will be difficult, tonsillar enlargement may be easier to detect. Also ask if they are able to see any pus on the surface of the tonsils. Correlation with the Centor criteria can help in the diagnosis of acute pharyngitis [13].

In correlation to that, the para nasal air sinuses, as mentioned previously as well, can be tested by asking the patient to first understand the point where to palpate, and if they experience any tenderness. The sinus tenderness and maxillary tenderness are quite useful in diagnosing sinusitis.

All local examinations conclude with the lymphatic examinations, so inspection of the face can reveal any enlarged lymph nodes or swelling. Patients can be asked to palpate the neck areas, the anterior medial and lateral neck, as well as the posterior portions. While not exactly accurate in terms of levels or the chains, they can give an idea of the lymph node group involved.

### Diabetes Mellitus

Organizations such as the ADA, IDF, and WHO estimate that the prevalence of diabetics worldwide by the year 2030 will be about 366 million [14].

Staggering numbers like these only mean that the disease burden will continue to grow, and chronic care and management for diabetes must keep pace with the growing numbers.

The following is a panel, a guide of sorts on how telemedicine can be explored with Diabetes in Mind [15,16] (Figure 2).

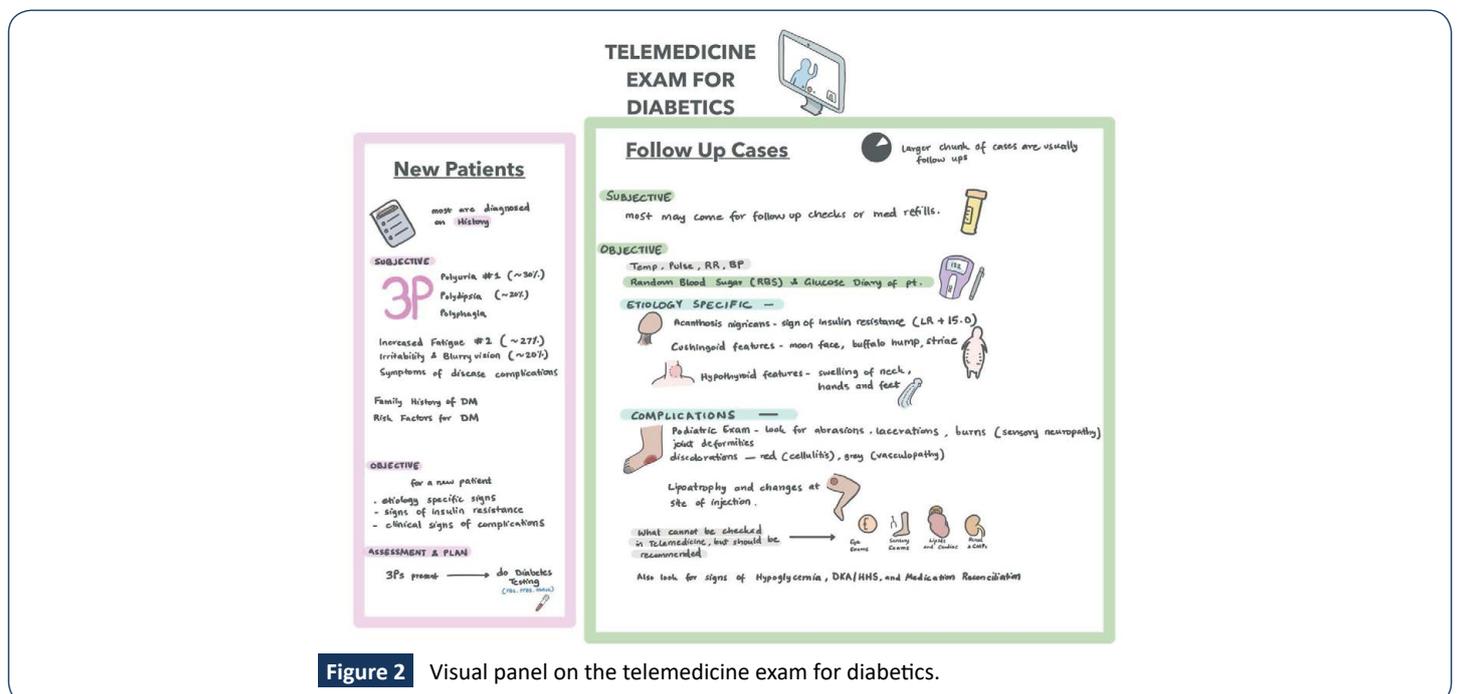


Figure 2 Visual panel on the telemedicine exam for diabetics.

## Systems Exam in Telemedicine

With no ability to do palpation, percussion, auscultation, or most of the special tests, this is the area where examination in telemedicine struggles, but with the help of good patient communication, there are a few workarounds. It's obvious that examination of the respiratory sounds, cardiac murmurs, abdominal fluid signs is not practical, at the time of writing this (impractical as of now, but a workflow involving electronic stethoscopes is possible), so let's look at what's possible.

Some examinations, such as psychiatric mental state examination, dermatological examination, and many parts of the neurological examination can be done through video calls, which in fact many

physicians and specialists have already begun adapting. (Put reference of their numbers)

Here is a **Table 2** with some possible methods to perform some aspects of the clinical examination.

So these are the few ways telemedicine can be used for systemic examination, but where we can really target examination, is the disease specific exam.

## Merits and Barriers to Care

Now, while telemedicine continues to grow, and becomes more versatile than ever, there are merits and barriers, advantages

**Table 2:** Table for Points on Systems Examination, with some novel strategies on integrating Telemedicine.

System	Inspection	Special Tests	Remarks
<b>General</b>			
	Weight and height	--	--
	Temp from thermometer	--	Can be done if patients have a temp gun.
	Pulse and O <sub>2</sub> sat (from probe)		Can be done if patients have pulse oximeters at home. A low saturation should be managed emergently.
	BP from portable BP machine		Most hypertensive may have a BP measurement cuff at home.
	RBS		Most diabetics have glucometers at home for regular measuring.
	Pallor, icterus(yellowing of eyes and skin), cyanosis(blue color of nails and fingertips), clubbing(bulky fingernails), edema(swelling), lumps in neck		Presence of these signs acutely may warrant urgent visit.
	Skin striae		
	Foot examination		
<b>Nervous</b>			
Higher functions	Conscious, coherent, cooperative		If these parameters are acutely deranged, an urgent visit to the ER may be warranted.
	Speech normal	Kernig's Sign (signs of meningeal irritation)	If these parameters are acutely deranged, an urgent visit to the ER may be warranted.
Cranial nerves (other)	Vision and eye movement normal, swallowing, eye blinking, shrugging shoulders normal	----	-----
Facial nerve	smiling/grimacing, drooling	-----	-----
Motor	Raise arms	----	----
	Raise legs, changes in walking	----	----
Sensory	Look at arms for signs of burns/bruises	----	----
	Look at feet for signs of burns/bruises	Straight Leg Raising Test (SLR), Lhermitte Sign (electric shock sensation on neck flexion)	
<b>Respiratory</b>			
Upper airways	Discharge from nose	Sinus tenderness	Sinus tenderness may be difficult to elicit.
Lower Airways	Audible respiratory sounds	----	Presence of audible wheezes should be managed emergently.
<b>Cardiovascular</b>			
Cardiac	Palpitations, chest pain radiating		Correlate clinically, may require urgent ECG.
Vascular	Xanthelasma, arcus		
<b>Abdominal</b>			
GI tract	Bowel sounds, constipation, obstipation, blood in stool	Tenderness, guarding	Can suspect an acute abdomen case, such as perforation.
Visceral organs	Change in size(clothes not fitting)/ striae over abdomen/spider nevi (blanchable radiating marks)		

and disadvantages to the use of telemedicine.

**Merits:** The merits or advantages of using telemedicine today are, first being an increased availability of the internet, 90% of Americans using the internet, 81% of Americans owning a smartphone, and 75% owning desktop or laptop computers, and numbers in rural areas are around 85% for internet usage [17]. These numbers point toward an increasing availability of connective technologies, which point to overall increase in telemedicine usage.

With technology advancing, and recent changes regarding the public's awareness have boomed the sales of basic medical equipment, such as thermometers, pulse oximeters, blood pressure cuff, and glucometers. In fact, with the advent of some new smartwatches (ex. The Apple Watch), 1<sup>st</sup> lead ECG, and blood oxygen saturation may be measured. These technologies definitely help in gaining vital measurements [18].

The premise of remote care, and the concept of 'some specialist care better than no care'. For patients in remote health care areas, telemedicine can be a good alternative. One of the reasons why Telemedicine gained attention in the COVID-19 pandemic was the no-contact nature. By avoiding contact, a step towards public health safety is taken [19].

Also to be noted are the benefits in terms of cost incurred and time spent are also noted, with an average of 19\$ to 121\$ spent on each visit (ranging from just a follow up to an ER visit), and upto two hours(123 mins) saved in travelling time, wait times and other procedures [20].

The AAMC (Association of American Medical Colleges) reports that in the US, by 2032, a shortage of 122,000 physicians may be noted [21]. With a pandemic, it is expected that the doctor-patient gap may widen, which is a void that telemedicine can fill.

Finally, some real life evidence of the merits were demonstrated in a study where post appendectomy surgical wounds were followed up using email imaging and patient questionnaires [22]. It was found that the detection of surgical wound complications was 100% by images, and 91.67%, by questions.

**Barriers:** For the disadvantages, or the barriers to telemedicine today, one of the biggest limitations of telemedicine is the inability to perform a physical exam. The inability to gain vital parameters and perform objective signs is still one of the biggest drawbacks.

Telemedicine cannot have a direct role in emergent management, however it can be a guide to triage. While some specialities can utilize telemedicine, some most likely cannot, as seen by their low utilization rates. For example, Allergists/Immunologists utilize telemedicine at a rate of 6.1%, and obstetrician/gynecologists at 9.3% [23]. Another potential cause of concern is the deterioration of the physician patient relationship [24]. Telemedicine is quite new, and many patients are not aware if their health system offers telemedicine services [25]. Technology too, comes with its downsides. Poor internet connection, network lag, poor or no knowledge of using a new interface are issues faced commonly.

It is also a cause of concern that Telemedicine, as of now, does not have a supportive payment structure. Medicaid has no significant reimbursement program for telemedicine, and this lack of adequate support structure creates a lack of incentive for physicians. Medicare, on the other hand, went through a major change in 2018, through the Bipartisan Budget Act [26]. Even though the legislation supports telemedicine, the fine prints show variations in all states' policies on telemedicine [27]. This affects parameters such as patient information handling, privacy of interactions, insurance, co-pays, reimbursements and prescribing

Privacy is a major issue, especially in accordance with HIPAA rules and regulations. Telemedicine software needs to be end to end encrypted to protect the patient's privacy at all costs [28].

As we did for merits, we also look at some real life examples. In 2015, a court case in Iowa banned the prescribing of abortifacient medications through telemedicine. The ACOG did express their concerns at this time, stating that telemedicine can allow the prescribing of drugs to women who are unable to access health care, in remote areas [29].

In the end, we want to quantify the merits of telemedicine with the disadvantages. Due to the limited data on this, it is difficult to quantify these things. A method of reasoning here used is Bayesian reasoning. Now this just implies that we hypothesize the probabilities of two events occurring and compare them. Put plainly, the question can be asked, what is the predictive value of a physical exam for a disease? And the question that contrasts it is, what is the predictive value of an incorrectly performed, or poorly performed physical exam?

## Conclusions

In a world where the landscape of communication frequently changes, where awareness and accessibility to new technologies continually rises, it is vital for health care providers to be able to adapt to new changes. Telemedicine provides a new pathway for continuing care for patients.

Telemedicine has come a long way, since its inception, to the 1950's where some real world usage was seen, to 2020's, where it picked up pace, due to a global pandemic. It was likely an eye opener for many health care systems all over the world, who realized that pandemic or not, telemedicine will be here to stay.

While having a list of merits and demerits, it is something that can be continually worked upon, and by ameliorating the barriers, in the future, it can become an extremely versatile tool for physicians all over the world.

We've focussed on how physicians can use their extraordinary communication skills, their interpersonal relationships with patients, and analytical thinking to devise panels on how to gain objective information through telemedicine. While this novel way still has a long way to go, it can be instrumental in opening a new door for telemedicine in the future.

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