



***“Any sufficiently advanced technology
is indistinguishable from magic.”***

~ Arthur C. Clarke

How to Create Telemedicine Magic: HOCUS POCUS™ with Microsoft Teams and Augmented Reality During the COVID-19 Pandemic...and Beyond!

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Arthur C. Clarke, a noted science fiction author, said in his 3rd Law, “Any sufficiently advanced technology is indistinguishable from magic.” In many ways, HOCUS POCUS fits the bill. The acronym HOCUS POCUS stands for **H**olographic **O**nsite **C**are **U**nder **S**upervision with **P**oint **O**f **C**are **U**ltrasound. If you are intrigued to find out how holograms, Microsoft Teams, and point of care ultrasound can take telemedicine to another level while also helping with the diagnosis and management of COVID-19 patients read on....

What new reality has COVID-19 created for healthcare?

As countries, cities, and towns across the globe try to “flatten the curve” of COVID-19 spread through social distancing, hospitals are faced with an unprecedented influx of patients with severe respiratory symptoms. Many of them need admission to Intensive Care Units, and the worst-affected need to be placed on ventilators. Hospitals, which normally operate near full occupancy, are enacting plans to

increase their surge capacity dramatically...sometimes to more than double their normal state. There is an urgent need for even more nurses and doctors to care for these patients...especially in the critical care, infectious diseases, and hospitalist specialties. Personal protective equipment (PPE) is needed to keep these healthcare workers well and able to care for their patients. Yet, there are real shortages of PPE that have hospitals scrambling to figure out ways to disinfect and reuse supplies that were only designed with single use in mind.

Typically, care of hospitalized patients is multi-disciplinary involving a hospitalist or critical care specialist and any residents and students on the team, specialists such as cardiology or infectious diseases and their fellows and students, multiple nurses, nursing assistants, radiology techs, et al. All of these groups talk to and physically interact with the patient on a daily basis. To adhere to the principles of social distancing in the healthcare setting and reduce consumption of PPE we must decrease the entry of healthcare workers (HCWs) into patient rooms without compromising their care and making them feel isolated. This is where HOCUS POCUS can add value.

Microsoft Teams with point of care ultrasound = TelePOCUS™

Microsoft Teams is a cloud-based component of Microsoft Office 365 that allows chat, video meetings, file storage, and applications integration (similarities to Zoom and Slack). Video meetings can be between 2 people or an entire organization. Microsoft Teams works on Windows 10 devices, iPhones/iPads, and Android devices. Since March 5, 2020, during the COVID-19 pandemic, Microsoft is making Teams [available to everyone for free](#) from individuals to enterprises. Security-wise [Teams is HIPAA compliant](#). The HIPAA business associate agreement with Microsoft is available by default to any customers who use an in scope service of which Teams is one. So, for free, an individual practitioner or medical organization could utilize Microsoft Teams for telehealth visits right now. Why, you ask, would I want to go to the trouble of downloading and implementing Teams when I have Facetime on my phone and could see and talk to a patient that way? Well, if that's all you want to do, you certainly could stick with that. Some hospitals are using tablet form factors in each room to enable video visits of medical teams with the patients. However, how does one get around having members of the primary inpatient team and each consultant team enter the room and perform a physical exam? Couldn't care become compromised if examinations aren't done...and what about getting chest radiographs or CAT scans to monitor the progression of COVID-19 effects on the lungs? If all those people enter the room or the patient has to be transported to radiology, it creates a lot of potential exposure risk and burns through a lot of PPE! Maybe we can do things differently...

The growth and development of telemedicine has been a great addition to our healthcare toolbox. We use it a lot where I practice, because there are many patients who live in rural areas far away from the larger urban areas of Omaha and Lincoln. A 4-hour drive from North Platte for a 20-30 minute follow-up appointment is not all that appealing to most! Although there are electronic stethoscopes designed for telehealth, my cardiologists complain about the sound quality that is transmitted, and a remote clinician is completely unable to use palpation and percussion to examine the abdomen or, for example, assess for flank tenderness in someone with a possible kidney infection. While the inspection part of the physical exam can be accomplished over video, most clinicians consider routine telehealth visits somewhat inferior to a face to face physical exam. This is where point of care ultrasound or POCUS can help.

For those of you outside of healthcare you may be wondering how medical ultrasound works. Ultrasound imaging transducers are placed on the skin and project sound waves into the human body. The reflections of those sound waves are detected by the transducer and used to construct an image of the structures that the sound waves encountered. Although traditional diagnostic ultrasound equipment is mounted on large carts, advancements in technology have led to the development of transducers that can be carried in one's pocket and plugged into a smartphone or tablet to visualize images in real time at the bedside. Hence, they are called "point of care." [Research](#) has shown that POCUS is markedly

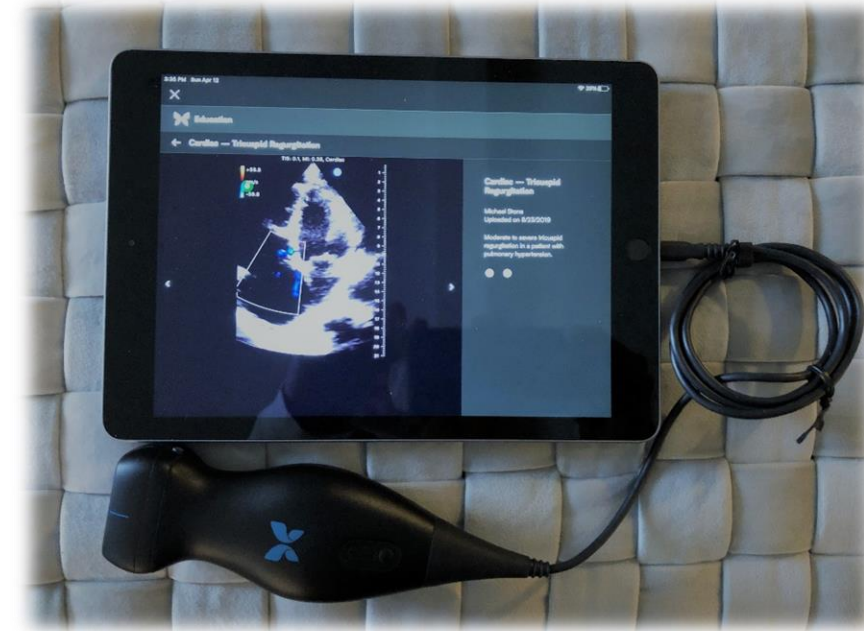


Figure 1. Butterfly IQ point of care ultrasound probe with iPad application.

better than auscultation of the heart and lungs with a stethoscope or hand palpation of the abdomen to detect tumors or internal organ abnormalities. In fact, a study of medical students given 18 hours of point of care ultrasound training showed they were able to detect and diagnose heart abnormalities better than a cardiologist with a stethoscope! Many hospitalists and emergency room physicians are already using POCUS in their day to day work.

Here is an overview of how TelePOCUS™ works: 1. Healthcare worker (e.g. technician, CNA, LPN, RN, or physician) is in the room with the patient. 2. A group Teams meeting is set up between an expert at another location who is using a PC or tablet (in the hallway, across town, in another city, etc.) and the healthcare worker in the patient room who is using an iPhone, iPad, or Android device. 3. The healthcare worker in the room facilitates medical history-taking by the remote expert with the patient and any video inspection components of the exam much as one would with a standard video call. 4. The healthcare worker then toggles on screen-sharing in Teams on the handheld device in the room. 5. The handheld ultrasound transducer is connected to the device, and the ultrasound app is started. 6. The healthcare worker in the room places the transducer in the appropriate anatomic locations to acquire ultrasound video images of the heart, lungs, abdomen, and/or other relevant areas. 7. The remote expert evaluates the ultrasound video in real time effectively replacing a physical exam with something better...detailed anatomic and physiological function information about the patient.

Incidentally, [POCUS has been used effectively](#) in the lung evaluations of patients with COVID-19 and shows some characteristic findings.

Typically, POCUS images or videos can be archived. By having one person perform POCUS on the patient, other clinicians need not enter the room to examine the patient. In fact, the clinician doesn't even need to be in the same city. Other doctors and specialists can review the POCUS studies no matter where they are and interview the patient remotely. Compared to a written description of how the heart and lungs

sound with the aid of a stethoscope, POCUS provides infinitely more information when it is reviewed by others. In this way healthcare workers' exposure to COVID-19 is reduced, more detailed anatomic and functional information is stored, and personal protective equipment is conserved. The latter is especially important when the amount of PPE in stock may only allow entry of one physician per day. Moreover, if you lack certain specialists at your hospital or your hospitalist or critical care specialist is out sick, you now have an e-ICU or remote specialty consult that is as good as having them right there in your facility. **The great thing about this approach is that many organizations have implemented conferencing solutions with screen sharing capability already, and point of care ultrasound products are already in the hands of many ER, ICU, and hospitalist physicians.** Although some POCUS vendors are beta-testing or have tele-options, connections are limited to others who subscribe to their products. The solution described above could be shared with any member on the team, and if guest access is enabled people outside the organization could participate in a TelePOCUS session.

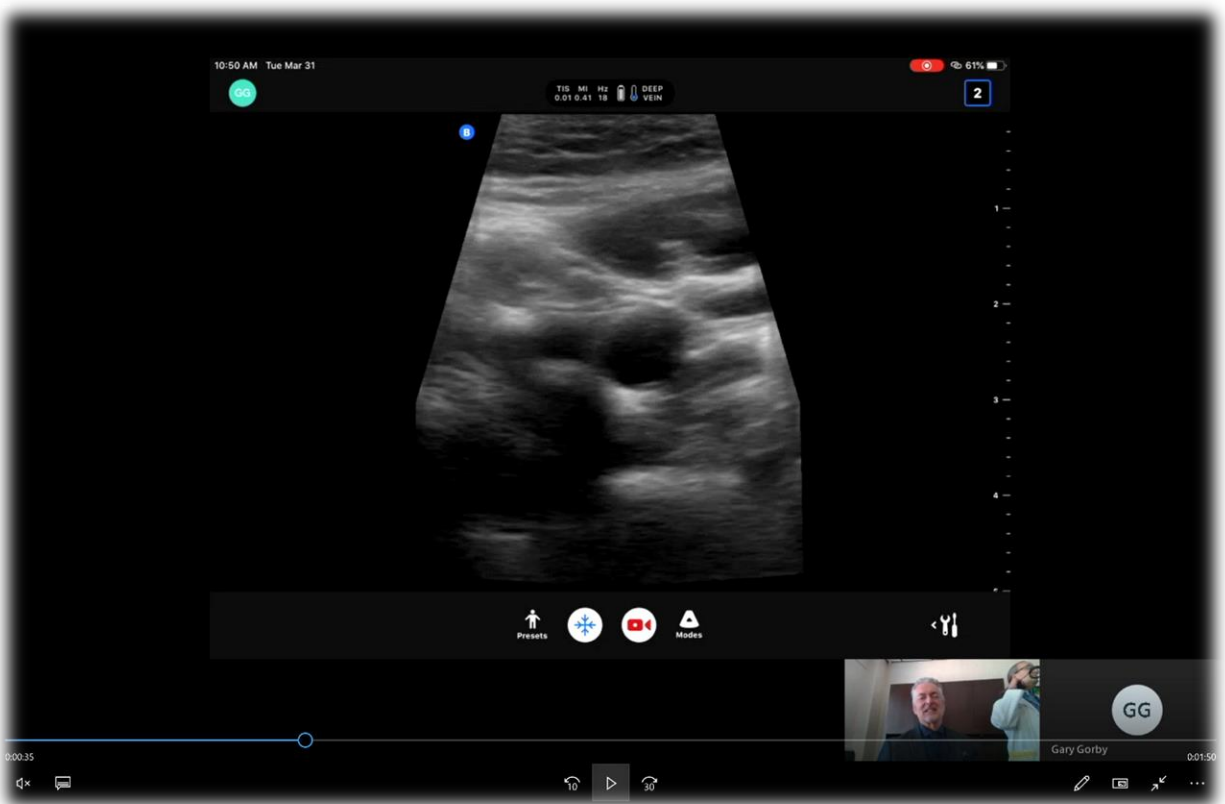


Figure 2. TelePOCUS view of neck vessels as seen on remote laptop shared from Butterfly IQ interface with iPad within Microsoft Teams meeting.

Okay, I get the POCUS part, but where does HOCUS come in?

TelePOCUS solves a number of challenges related to geography and the current PPE/exposure COVID-19 issues, but you're probably thinking, "Didn't he mention something about holograms and augmented reality at the beginning of this article?" Yes, I did. I started with a description of HOCUS POCUS in reverse order, because a lot of physicians and healthcare systems already have the components in place to implement TelePOCUS immediately. However, the inclusion of AR telepresence raises the "magic factor"

of HOCUS POCUS significantly!



Figure 2. Components of full HOCUS POCUS setup. Microsoft HoloLens (L); Butterfly IQ POCUS probe with iPad (Middle); Microsoft Surface Book 2 (R).

To review, HOCUS stands for **H**olographic **O**nsite **C**are **U**nder **S**upervision. Let's start with the holographic part. In the digital spatial computing world, hologram has come to mean the superimposition of a digital image or 3D object on top of the real world. The most sophisticated systems have transparent head-mounted displays such as [Microsoft HoloLens 2](#) or [Magic Leap 1](#). This digital enhancement of the real world is called Augmented Reality or AR. Microsoft HoloLens 1 and 2 work with Microsoft Teams in conjunction with [Dynamics 365 Remote Assist](#) software. With Remote Assist, a remote expert can see exactly what the HoloLens-wearing healthcare worker is seeing in a patient's room, and conversely the healthcare worker in the patient's room sees a Teams video screen floating in mid-air in front of them with the remote expert's video displayed. If the screen of the tablet which is connected to the POCUS probe is brought in as a third "participant" in the meeting, the tablet screen can be shared with the participants. The Healthcare worker in the patient's room can see the POCUS video displayed in real time as a floating screen in front of them, and the remote expert can see it too on their monitor (Figure 3).

Naturally, the remote expert and healthcare worker can talk. The remote expert can give instructions on where to place the POCUS transducer on the patient and how to angle it, and can even place AR arrows and draw lines overlying the patient. The HCW with the patient can perform the ultrasound

with the tablet/phone in their pocket leaving one hand free. So, the remote expert can supervise the onsite healthcare worker from a distance using holograms, i.e. HOCUS. The digital connections can work via WiFi or by using a cell phone as a WiFi hotspot.

The holographic doctor makes housecalls!



Figure 3. View of HOCUS POCUS session through the HoloLens; Note holographic screen of POCUS video floating above the couch cushions.

Up until now, I have described how Microsoft Teams can enable and augment novel TelePOCUS visits between clinicians and patients. We've demonstrated how the addition of Microsoft HoloLens can enhance the visual inspection part of a physical examination and enable hands free communication between a remote expert and HCW who is present in the room with a patient. With remote sharing of POCUS images, the combination of these modalities can surpass a conventional face to face physical examination, but to the patient...things don't seem all that different from telehealth video visits they've experienced previously. However, if a hologram of the remote expert could be right in the room with the patient, THAT would be different!

Remote telepresence, or in this case having the remote doctor appear as a hologram in the room with you, is not science fiction. Admittedly, it does conjure up visions of Princess Leia saying, "Help me Obi Wan Kenobi..." and the holographic Jedi Council meeting straight out of the Star Wars

movies!



Figure 4. Jedi Council meeting with holographic participant.

Solutions put out by [Spatial](#), Valorem Reply's [Holobeam](#), and Mimesys are a few examples of working telepresence applications. Spatial's product is [avatar-based](#), while Valorem Reply's [Holobeam](#) uses [volumetric video](#). Both work on HoloLens 1 and 2, but Spatial is cross-platform to include Oculus Quest VR headsets, Magic Leap, and nReal AR glasses. Also, Spatial can be [integrated with Microsoft Teams](#). In order to see one another as holograms the patient and the remote clinician each wear an AR/VR headset.

If implemented now, holographic rounds in the hospital could make patients feel less isolated, since the COVID-19 pandemic has led hospitals to prohibit visitors, and the medical team enter the room holographically. In addition, if headsets were available for family members and the patient, they could enjoy holographic visiting hours.

How will HOCUS POCUS facilitate access to care now and in the future?

Many physicians and hospitals have the ability to implement TelePOCUS immediately. It can be used inside the hospital to markedly reduce the number of healthcare workers who must interact face-to-face with a COVID-19 patient on a day to day basis. This conserves PPE, and the social distancing that results lowers the risk that healthcare workers will become infected. This is critical for the healthcare system in being able to respond to the large surge of patients who are falling victim to the pandemic. In addition, instead of needing to have physicians relocate temporarily to respond to this surge, out of town experts could lend their expertise from their current location. Instantaneous reinforcements are very appealing! It is a solution that is available now.

In the long term, development of the HOCUS POCUS model could profoundly alter the dynamics of medical care. One could literally stand up a multi-specialty clinic in almost any location with decent WiFi or cellular service. All one would need is a technician to collect the POCUS images on an iPad/iPhone during a 3-way meeting in Microsoft Teams and the remote medical specialist on the

other end.



Figure 5. Housecall visit with a holographic patient; This session utilized Spatial's collaborative telepresence software. Patient was on Oculus Quest. Physician was wearing HoloLens 1.

One of the main limiting factors in the holographic component of the HOCUS POCUS model is the relative shortage of AR and VR headsets that currently exists. However, the expansion of low-latency, high speed 5G cellular service and the proliferation of companies entering the AR and VR headset market should drive the solution to this deficit. If it weren't for the scarcity of HoloLens 2 devices or other AR headsets, the full HOCUS POCUS model could be implemented widely now, too.

Yes, the holographic doctor makes housecalls...to the room from the hallway outside, from your city to a critical access hospital in another part of the state, from your city to another state, or from your city to another country. The potential to create access to diverse, top notch medical care no matter where someone lives...as if it was right there in the room with them is technology that is indistinguishable from magic. I venture to say it is HOCUS POCUS enabled by Microsoft Teams, point of care ultrasound, and holographic telepresence....

Disclaimer

The content and opinions of this article are Dr. Gorby's alone and do not represent VA Nebraska/Western Iowa Healthcare System, Creighton University School of Medicine, University of Nebraska Medical Center, or The Center for Preparedness Education within the University of Nebraska College of Public Health.