# Using Artificial Intelligence for Hospital Screening



## In the COVID-19 pandemic

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# Summary

The SARS-CoV-2 pandemic has created many challenges, not the least of which is the inability to visit hospitalized friends and family members. Hospital staff and administrators are directed by the Centers for Disease Control to restrict visitation to protect both the staff and patients. The lack of vaccines, shortage of personal protective equipment, concerns about having enough hospital beds, equipment, and staff contributed to this decision.

As the pandemic dragged on, now into its thirteenth month, concerns about mental health and the implications of locking down hospitals are coming to the forefront. With over 400,000 deaths attributed to COVID-19 in the U.S., most people have lost a friend or family member to the disease. Social isolation and loneliness contribute to poor mental health, as does boredom and the constant onslaught of news and social media posts designed to increase stress and fear to garner headlines.

Large COVID-19 data sets are being used to generate algorithms that can lead to a faster and more accurate diagnosis of COVID-19. Using technology to screen healthcare workers and hospital visitors quickly and accurately, along with the promise of widespread vaccination, may provide the peace of mind necessary for hospital decision-makers to relax their visiting policies somewhat.

# Problem Statement

Healthcare facilities should minimize the risk of SARS-CoV-2 transmission to visitors of patients with suspected or confirmed COVID-19.

The risk of visitors introducing SARS-CoV-2 into healthcare facilities increases as community transmission becomes widespread.

Facilities should establish policies and procedures for managing, screening, educating and training all visitors.

Visitors to healthcare facilities should be limited during the pandemic regardless of the level of known community transmission.

All visitors should be aware of the signs and symptoms of COVID-19.

Restrict visitation to high-risk patients such as older-adults, people who live in a nursing home or long-term care facility and people of any age with underlying medical conditions.

Use administrative controls such as designating an entrance for visitors and facilitate alternative contact such as telephone calls and internet connections.

During outbreaks and where there is community spread restrict visitor access to healthcare facilities except essential visitors who provide patient care and for pediatric patients.

Screen visitors and require masks (Centers for Disease Control and Prevention, 2020)

As we enter the thirteenth month of the pandemic, maintaining a balance between limiting the spread of COVID-19 and protecting the mental health of patients, caregivers, family members, and support persons continues to be a concern. Hospital employees see the medical drama of COVID-19 played out daily, but they also see family members struggling to use technology to connect with their loved ones.

**How can artificial intelligence technology be used to build a better screening tool for hospital visitors and employees to identify those in the asymptomatic phase of COVID-19 and, therefore, who put patients at risk?**

Hospitals across the U.S. and Canada rapidly put into place a strict "no visitor" policy during the first wave of the pandemic.



Fear for the health of patients and health care workers and a lack of personal protective equipment justified this response. On the other hand, it is well-known that having a family member or support person available when admitted to the hospital has a beneficial impact on health (Munshi, Evans, & Razak, 2020).

Patients who cannot have visitors or a support person had delays in receiving medications, greater social isolation, difficulty meeting their personal needs, and inadequate discharge planning (Zeh, et al., 2020).

Delirium is common in older adults and patients in the Intensive Care Unit when a support person is not present (Helms, Kremer, & Merdji, 2020). The lack of environmental cues to signal day and night and being surrounded by strangers compounds the problem, especially when care providers are wearing personal protective equipment.

Communication can be difficult for some patients, especially those who cannot speak the same language as health care providers. The inability to communicate increases the risk of medical errors. Some people are used to having their physical and emotional needs met by a particular person. Not having access to that person can increase stress and hospitalization time. Dying alone is distressing for the family, the patient, and caregivers. (Munshi, Evans, & Razak, 2020). Attempts to use technology as a stand-in have merit but cannot replace the human touch. A study is underway in Canada to assess the risks and benefits of a COVID-19 restricted visitation policy (The University of Calgary, 2020).

In a KFF Tracking poll conducted in mid-July, 53 percent of adults reported that their mental health was adversely affected by the stress and worry brought on by the COVID-19 pandemic. Many adults report difficulty sleeping and eating, increases in alcohol consumption or substance abuse, and worsening chronic health conditions. More than one in three adults have reported feelings of anxiety and stress during the pandemic. Burnout is widespread among health care workers as they deal with an overwhelming number of critically ill patients daily (Panchal, et al., 2020).

# Background

COVID-19, caused by a coronavirus named SARS-CoV-2, was first discovered in December 2019 and has since become a global pandemic that has caused 2,133,542 deaths worldwide and 427,635 in the U.S. (Worldometer, 2021). The pandemic has put an unprecedented strain on the health care system, caused economic disaster especially for small businesses, forced schools to close for extended periods, and increased demand for mental health services as people cope with anxiety and depression.

## COVID-19 Symptoms

The typical symptoms of COVID-19, fever and cough, can be difficult to distinguish from other respiratory illnesses. The range of symptoms continually grows, and the clinical symptomology varies from asymptomatic carriers of infection to critically ill and dying. Symptoms can present anywhere from 2 to 14 days after exposure. The variability and variety of symptoms, the extended duration of contagiousness that begins before symptoms present, and the potential for the disease to be fatal have led hospitals across the country to enforce stringent policies for visitation.

## Vaccines

The Emergency Use Authorization of vaccines to protect against COVID-19 provide hope that by the end of 2021, life will slowly return to normal. In the meantime, there is a constant barrage of news, forecasts, and predictions that threaten the emotional and mental health of all, but especially seniors who may be living alone and afraid and children who do not have the security of a daily school schedule to provide some normality in their lives.

## Forecasts

The Institute of Health Metrics forecasts that 600,000 U.S. citizens will die by May 21, 2021, from COVID-19 (The Institute of Health Metrics, 2020). This number is painful to hear and difficult to process. The threat is real, and the need to limit the spread of COVID-19 and protect the most vulnerable is necessary and everyone's responsibility. However, COVID-19 is not our only threat. There is a serious mental health crisis as well. Families have lost loved ones. People are feeling lonely and isolated. The lack of social contact leads to depression and anxiety. There is no doubt

### COVID-19 Symptoms

- Fever
- Chills
- Shortness of breath
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Nasal congestion
- Runny nose
- Nausea
- Vomiting
- Diarrhea (Centers for Disease Control and Prevention, 2020)

**Artificial Intelligence in Disease Diagnosis**

- Pattern recognition on CT and X-Ray scans
- Identify transmission trends and dynamics
- Faster and Better Clinical Decision Making
- Complements clinical decision making

**Artificial Intelligence in Drug Design**

- Identify candidate drugs
- Used to develop a database of candidate drugs
- Identify drug targets
- Identify target inhibitors
- Generate potential ways to repurpose drugs

**Artificial Intelligence in Epidemiological Trends**

- Predict susceptible populations
- Predict disease course
- Identify localized infection prone areas
- Susceptible-Exposed-Infectious-Removed Model

**Artificial Intelligence in Disease Spread and Forecast**

- Provide accurate information and news
- Identify trends in early phases of disease
- Use apps for tracking infected individuals
- Identify susceptible populations

**Artificial Intelligence in Disease Outcome**

- Predict patients who will require the most intensive care
- Resource allocation
- Predict Disease probability
- Predict likelihood of future spread (Malik, et al., 2020)

that vaccines are the way out of this pandemic, but in the meantime, we need to consider how technology, especially using artificial intelligence, can help us open the doors to our hospitals, schools, and places of business.

# Using Artificial Intelligence in Hospital Screening

A two-pronged approach is needed to slow the spread of COVID-19, vaccinations to limit the number of potential hosts for the virus, and effective screening to recognize and isolate those who are already infected. Digital screening devices that utilize artificial intelligence have the potential to meet this screening need.

Artificial intelligence emulates human decision making using either supervised or unsupervised machine learning.

Supervised machine learning is characterized by using regression or classification methods to develop a predictive algorithm. Computers using algorithms and after being trained on large data sets are used to approximate human performance. Computers can use supervised learning to automatically interpret an EKG tracing or estimate a person's risk of cardiovascular disease.

Unsupervised machine learning synthesizes large amounts of data to discover patterns or a novel approach to therapy (Duo, 2015).

There are drawbacks to using artificial intelligence for medical screening in that it requires large amounts of data to generate accurate predictive algorithms (Santosh, 2020).

The quality of data is also important. Noise and bias are difficult to separate from clean data, especially early in a pandemic (Crawford, 2013). In a report published in Morbidity and Mortality Weekly by the CDC, when data was collected on comorbid health conditions, a known risk factor for COVID-19, only 5.8 percent of patients had complete and accurate data. Incomplete data devalues research efforts (Centers for Disease Control and Prevention, 2020).

> Technology has transformed the way we live our lives, ranging from the way we interact with friends and loved ones to what and how we purchase and seek out information. Social media is everywhere and unavoidable and is designed to be compelling largely because of AI-based attention capturing algorithms.
>
> Dr Zubair Shah

Previously, health departments collected data. Today crowdsourced, large-scale, publicly available, self-reported data from social media, blogs, opinions, and other sources seem to be just as reliable at producing results as the health department data (Yassine & Shah, 2020). Social media supports the dissemination of large amounts of data quickly, but it can also be used to propagate fake news and misinformation. Studies with poor clinical evidence are shared more on social media than studies with high-quality evidence (Selvaraj, Borkar, & Prasad, 2014). Fake news, rumors, and misinformation that taint data make it difficult to identify trends, and lead to chaos, mental health issues, and even death (Yassine & Shah, 2020).

# Diagnostic Screening Challenges for COVID-19

COVID-19 is characterized by having a wide range of disease manifestations from asymptomatic to fatal. The wide range of symptoms makes designing a comprehensive symptom tracker a challenge. Current artificial intelligence-based symptom trackers allow users to input a binary response to a specific question about the disease. The inability to accept alternative answers limits a screening application's comprehensiveness, but allowing these types of answers makes building an algorithm difficult (Malik, et al., 2020).
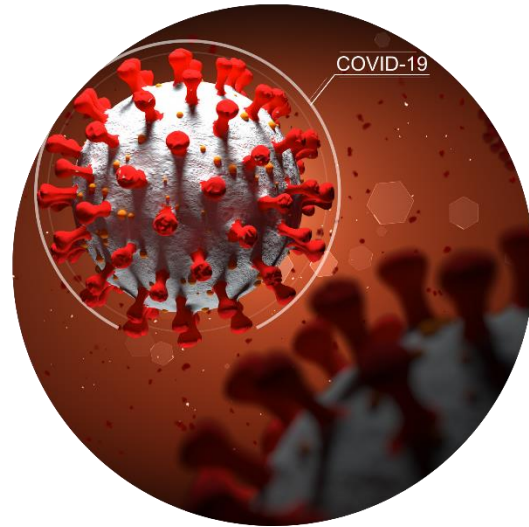
# Novel Approaches

A comprehensive solution for screening visitors to a hospital may not yet be attainable, but pieces are falling into place. Using combinations of these technologies may provide a fast and accurate screening method that will make visitors and health care providers alike feel more comfortable interacting and caring for patients and their loved ones.

## Internet Connected Thermometers

Kinsa Health has developed internet-connected thermometers that allow users to record their temperatures at home and then report them along with any accompanying symptoms. Kinsa reports they could detect COVID-19 spread three weeks before the illness swept throughout New York. Data is distributed across communities, workplaces, or schools using online interactive maps, allowing organizations to work together to stop the spread of infection. Clusters of fever spikes provide valuable information about allocating scarce resources and when lockdowns or other restrictions would yield the greatest benefits.



## Cameras to Detect Fever



Care.ai has developed a camera embedded facial scanner that scans for facial attributes and records temperature. Memorial Hermann-Texas Medical Center uses A.I.-powered screening cameras at its visitor entrances. The cameras are used to analyze sweat patterns, areas of skin discoloration, and temperature. Over or under- dressing can adversely impact the effectiveness of these cameras. Still, they allow for faster screening that can be done from a distance, decreasing risk to visitors and hospital employees (Joy, 2020)

Category 5 in Canada has installed thermal cameras in public areas such as malls and workplaces. Users step up to the camera for non-contact temperature screening. Screeners are alerted if anyone has an elevated temperature.



## Using Cough Data for Screening

MIT researchers evaluated coughs to stratify the risk of carrying COVID-19 in symptomatic carriers. The difference in a cough between an asymptomatic carrier of COVID-19 and a healthy person is not discernable by humans. However, an A.I. model trained on over 70,000 coughs could accurately identify 100 percent of coughs from asymptomatic carriers of COVID-19 and 98.5 percent of coughs from people confirmed to have COVID-19. The MIT team is working on incorporating the model into a user-friendly app. A user could access the app, cough, and instantly get information on whether they might be infected (Laguarta, Hueto, & Subirana, 2020).

## Chatbots



Chatbots, computer programs found on many websites to allow humans to interact with computers as though they were having a conversation, have been used by many employers, including hospitals, to do symptom screens for COVID-19. Chatbots for COVID-19 screening are typically built using CDC guidelines. Like the one by Buoy Health, most symptom checkers ask a series of questions or use a checkbox. Buoy says that their chatbots are based on medical information and data to simulate a conversation with a health care provider.

Apple has released a COVID-19 screening tool using resources from the White House Coronavirus Task Force and public health officials. After completing the screen, users can navigate to their state health department website for further guidance. Apple also provides COVID-19 testing guidelines, updates on the virus, as well as information on how to protect others and care for mental and physical health.
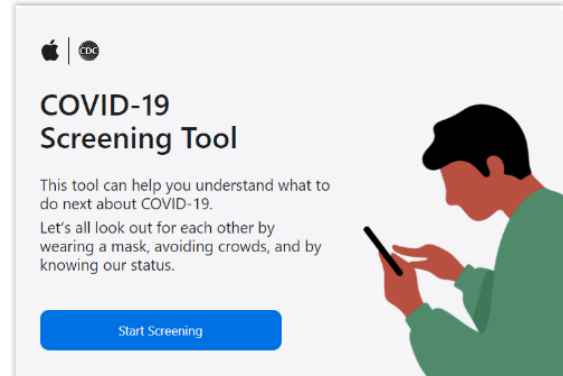


## Rapid Screening Tests

Infectious disease specialists and clinical machine learning experts at the University of Oxford used routine healthcare data extracted from the electronic health records of 115,394 patients to gather data points for their rapid screening tests. The researchers collaborated with University Hospitals Birmingham to validate the A.I. test's performance. The test correctly identified COVID-19 in 92.3 percent of patients and correctly ruled out COVID-19 97.6 percent of the time when compared against standard lab tests.

Traditionally, screening tests for COVID-19 are done using RT-PCR, a machine that amplifies genetic sequences and compares them to known sequences for COVID-19. RT-PCR sequences can take up to 72 hours for results and require specialized lab equipment and expertise. The University of Oxford's lab can be done quickly in a screening area or the emergency department to rule-out COVID-19 within an hour and allow visitors and employees to enter a hospital and visit comfortably, knowing that they are not putting patients at risk (Soltan, et al., 2020).

## Wearables

Scripps Research is inviting participants using wearable devices made by Apple, Fitbit, Garmin, Withings, and others to submit their data so researchers can look for trends that may provide insight into personal health and spot potential viral outbreaks. Scripps Research collects resting heart rate, sleep, and steps and encourages users to add symptoms as part of their health study, DETECT. Researchers from the University of California, San Francisco, are doing similar research using the Oura smart rings. They are feeding data from health care workers into an algorithm to see if it can identify upticks in temperature or heart rate that may provide an alert that a healthcare worker is ill (Brodwin, 2020).
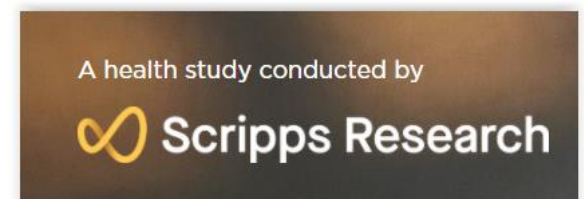
# Conclusion

Balancing the need to protect patients and healthcare workers from COVID-19 with the mental and physical needs of patients and their families is a challenge. The Coronavirus Aid, Relief, and Economic Security Act (CARES ACT) provides financing that may be used to address the need for increased mental health services that will be required to treat anxiety, depression, and substance abuse that will undoubtedly occur as a result of the pandemic (Panchal, et al., 2020). Perhaps, some of this money can be used to finance the development and deployment of A.I.-powered technologies that can screen

> If you don't really know how good the tool is, it's hard to understand if you're actually helping or hurting from a public health perspective.
>
> ANDREW BEAM, ARTIFICIAL INTELLIGENCE RESEARCHER reported in StatNews.com.

health care workers and hospital visitors so that visiting policies can be somewhat relaxed. We can eagerly await studies that compare pre-lockdown and post-lockdown infection rates. An investment in testing hospital screening tools and verifying their validity will go a long way towards improving health care for COVID-19 patients and mental health for both patients and their support persons.

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