

# Medical Applications of Artificial Intelligence

Group:13

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## **Agenda**

1. Challenges Brought by COVID-19
2. Social Media Analysis on COVID-19
3. Feasibility of Artificial Intelligence in COVID-19
4. Obstacles to Deployment in The Real World
5. Potential Benefit of AI in Medicine
6. Potential issues with AI in Medicine
7. The Future of AI in Medicine



# Challenges brought by COVID-19 pandemic

- Health: (WHO, 2021<sup>1</sup>)
  - Over 140 million confirmed cases with 3 million deaths globally
  - Cases and deaths show continuous increase over the past month
- Economic: (Jones, L., Palumbo, D., Brown, D., 2020<sup>2</sup>)
  - Unemployment rates increase across the world
  - Crumbling industries e.g. tourism, leisure, and retail shopping lead to GDP decrease in most countries in 2020
- Academia:
  - Changes of class format e.g. course delivery, conducting exams, etc.
  - Research activities and conferences

1. World Health Organization. (n.d.). *Weekly epidemiological update on COVID-19 - 13 April 2021*.  
<https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---13-april-2021>.

2. Jones, L., Palumbo, D., & Brown, D. (2021, January 24). *Coronavirus: How the pandemic has changed the world economy*. BBC News.  
<https://www.bbc.com/news/business-51706225>.



# How AI can help with COVID-19 pandemic

Individual level: (Vaishya R. et al., 2020)

- Early detection and differentiation of other diseases based on symptoms
- Contact tracing to identify spots with clusters of people
- Monitoring patients
  - Daily updates on the chance of recovery with visualization
  - Suggestions regarding the actions to take for recovery



# How AI can help with COVID-19 pandemic

Group and regional level: (Arora N., et al., 2020)

- Tracking a large region and prediction on morbidity and mortality
- Accelerating the discovery and validation of drug and vaccine development
- Identifying misinformation and stop its spread



## AI application: social media posts analysis

Ever since COVID-19 pandemic becomes a massive global event, people have described their status-quos and expressed their thoughts on social medias.

Researchers have utilized natural language processing techniques like text mining and sentiment analysis to collect and examine the Tweets from February 2020 to March 2020. (Lopez, C. et al., 2020<sup>1</sup>; Abd-Alrazaq, A. et al., 2020<sup>2</sup>)

1. Lopez, C. E., Vasu, M., & Gallemore, C. (2020, March 23). *Understanding the perception of COVID-19 policies by mining a multilanguage Twitter dataset*. arXiv.org. <https://arxiv.org/abs/2003.10359>.
2. Abd-Alrazaq, A., Alhuwail, D., Househ, M., Hamdi, M., & Shah, Z. (2020, April 21). *Top Concerns of Tweeters During the COVID-19 Pandemic: Infoveillance Study*. Journal of Medical Internet Research. <https://www.jmir.org/2020/4/e19016/>.



## Social media posts analysis - results

- The daily Tweets almost doubled from 106K to 205K from February to March, with English as the most prominent language (63.4%). (Lopez, C. et al., 2020)
- Tweets are categorized into four themes: (Abd-Alrazaq, A. et al., 2020)
  - Origin of COVID-19
  - Causes leading to the transfer of COVID-19 to humans
  - Impact of COVID-19 (most talked, 22.52% of Tweets are related)
  - Methods for decreasing spread (least talked, 3.24% related)
- The sentiment for the Tweets are positive in general except for two topics, deaths caused by COVID-19 and increased racism.



## Social media posts analysis - significance

- Social medias are convenient places for policy makers to collect feedbacks from people. They can think about ways to mitigate the pressures and prepare for better policies in the future based on the analysis of the posts. (Nguyen T. T., 2020<sup>1</sup>)
- Misinformation and fake news can be detected from the posts on social medias. The public agencies can stop their spread on time. (Lopez, C. et al., 2020<sup>2</sup>)

1. Nguyen, T. T. (2020). Artificial intelligence in the battle against coronavirus (COVID-19): a survey and future research directions. arXiv preprint arXiv:2008.07343.  
2. Lopez, C. E., Vasu, M., & Gallemore, C. (2020, March 23). *Understanding the perception of COVID-19 policies by mining a multilanguage Twitter dataset*. arXiv.org. <https://arxiv.org/abs/2003.10359>.

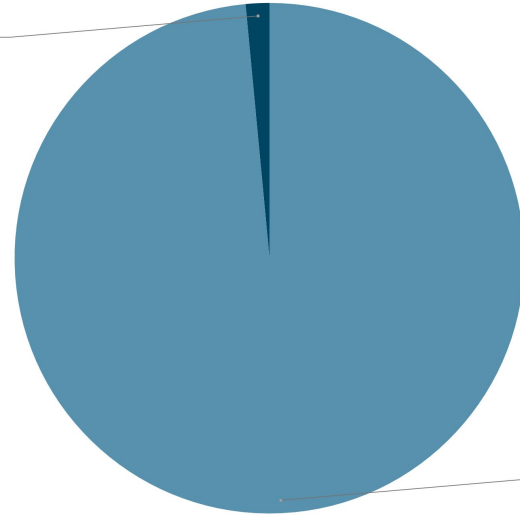


# Feasibility of Artificial Intelligence



Test Rate

Miss  
1.5%



Success  
98.5%



## AI Models detecting COVID-19

- The AI Models base off of Cell Phone recordings of an individual's cough. The tests are conducted and gives results regardless if an individual is asymptomatic or not.
- There's a significant difference in between individuals who are healthy and have a normal cough versus individuals who are infected with COVID-19.
- The sounds the vocal cords and surrounding organs create when each version of the cough are very different.

# Benefits of cough based testing



- Cough sound based Covid-19 diagnosis would be lowest in cost related testing done possible. (Nasal Swab, Spit, Blood Tests)
- Diagnosed results back within seconds of submitting the record sound via Cell Phone Application with almost 100% effective rate on correct diagnosis.
- The safest way of testing as it is the first way of contactless testing and no exposure to anything.

## More Benefits of cough based testing

- Can identify infection in people who are asymptomatic
- Potential for pre-screening tool to slow the spread of virus preventing a pandemic
- Less lines at testing centers/no need for them



Line at COVID testing center in Florida June 29, 2020

# Application Interface Cough Based Testing

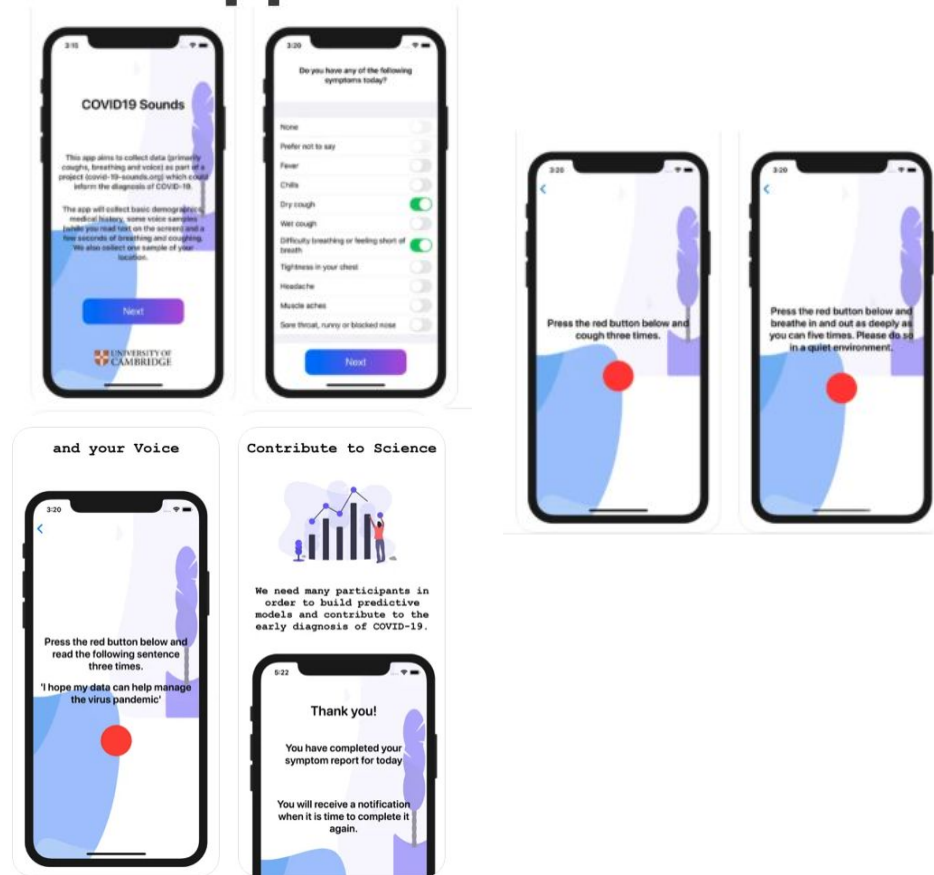
The image displays three sequential screenshots of the AI4COVID-19 application interface, which is designed for cough-based COVID-19 testing. Each screen has a blue header with the text 'AI4COVID-19' and a blue background with white text and icons.

- First Screenshot:** The top section contains an information icon (i) and a disclaimer: "At the moment, AI4COVID-19 does not offer medical grade diagnosis. Results are just an indicative pre-screening. In case of severe symptoms professional medical advice should be sought." Below this is a checkbox labeled "Please check to provide your e-consent for your cough samples to be used for medical research." which is checked. A large blue microphone icon with a diagonal line through it is centered. At the bottom, it says "Press Record Cough again to record 2 more samples." and shows a progress bar at 1/3. There are two buttons: "Record Cough" and "Diagnose Cough". The footer includes the website "ai4lyf.com - ai4networks.com - aison.co" and the AI4L4F logo.
- Second Screenshot:** Similar to the first, but the progress bar is now at 2/3. The text below the microphone icon says "Samples recorded successfully, please press Diagnose Cough to see results." The "Record Cough" button is disabled, and the "Diagnose Cough" button is active.
- Third Screenshot:** The progress bar is at 3/3. A white box with blue text says "COVID-19 not likely!". Below this is a question "Is this diagnosis correct?" with three radio button options: "Yes", "No", and "Not Sure". The "Record Cough" button is disabled, and the "Diagnose Cough" button is active.

- Each contains 3 samples of the cough that is used in the diagnoses.
- A diagnosis based on 3 cough samples with results in seconds

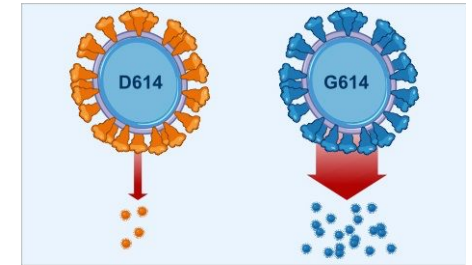
# Cough collection Based Application

- This application was developed by university of cambridge to collect cough samples to build a AI model
- Has a symptom checklist prior to the cough analysis
- First application that allows recordings from cough and breathing to help detect COVID-19



## Potential issues with AI Triage

- COVID-19 is Constantly Evolving
  - There are numerous different strains of COVID-19, which are rapidly evolving<sup>1</sup>
  - Different locations around the globe will have different dominant strains<sup>1</sup>



1. Daniele Mercatelli, Federico M. Giorgi. **Geographic and Genomic Distribution of SARS-CoV-2 Mutations**. *Frontiers in Microbiology*, 2020; 11 DOI: [10.3389/fmicb.2020.01800](https://doi.org/10.3389/fmicb.2020.01800)



## Potential issues with AI Triage

- COVID-19 does not affect people uniformly
  - Respiratory symptoms do not exist in everyone (perhaps there will be no cough to classify)<sup>1</sup>
    - This will make the disease difficult to track across multiple demographics and locations

1. Mueller, Amber L et al. “Why does COVID-19 disproportionately affect older people?.” *Aging* vol. 12,10 (2020): 9959-9981.  
doi:10.18632/aging.103344





## Combating issues with AI Triage

- It's all about the heuristics
  - Public health officials are able to track the dominant strain in their area
    - Our models should be able to account for more symptoms than just a cough
  - Triage centers should have location specific heuristics to match the symptoms experienced by their patients



## Combatting issues with AI Triage - Proof of Concept

- Researchers successful in detecting infection using cough
  - Tests have 98.5% sensitivity among those with confirmed cases of COVID-19<sup>1</sup>
    - All asymptomatic cases among test group of 2,500 were detected
  - When using cough screening with other symptoms, we can have better epidemic modeling



## Potential Changes to AI in Medicine in Next 5 Years

- Job replacement
- Privacy violations
- Algorithmic bias



## Potential Changes to AI in Medicine in Next 5 Years

- Job Replacement
  - Particularly jobs which are predictable and repetitive
  - Retail sales, market analysis, warehouse labor, and hospitality
  - AI should be an auxiliary tool but not a replacement



# Potential Changes to AI in Medicine in Next 5 Years

- Privacy Violations
  - A threat to private information
  - Facial recognition technology has a bias problem
  - COVID-19 diagnosis AI collects patients' information



## Potential Changes to AI in Medicine in Next 5 Years

- Algorithmic Bias
  - Commonly used algorithm is most likely have racially biased issue
  - Unnecessary money loss, or even medical malpractice
  - Collect balanced data from different races



# References

- <https://doi.org/10.1016/j.dsx.2020.04.012>
- <https://doi.org/10.2217/fvl-2020-0130>
- <https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---13-april-2021>
- <https://www.bbc.com/news/business-51706225>
- <https://arxiv.org/ftp/arxiv/papers/2003/2003.10359.pdf>
- <https://www.jmir.org/2020/4/e19016/PDF>
- <https://arxiv.org/pdf/2008.07343.pdf>
- <https://arxiv.org/abs/2005.10548>
- <https://arxiv.org/abs/2104.02477>
- <https://arxiv.org/abs/2006.15469>
- <https://arxiv.org/pdf/2006.05919.pdf?>
- Artificial intelligence and machine learning to fight COVID-19 Ahmad Alimadadi, Sachin Aryal, Ishan Manandhar, Patricia B. Munroe, Bina Joe, and Xi Cheng *Physiological Genomics* 2020 52:4, 200-202
- J. Laguarda, F. Hueto and B. Subirana, "COVID-19 Artificial Intelligence Diagnosis using only Cough Recordings," in *IEEE Open Journal of Engineering in Medicine and Biology*, doi: 10.1109/OJEMB.2020.3026928.
- Daniele Mercatelli, Federico M. Giorgi. **Geographic and Genomic Distribution of SARS-CoV-2 Mutations**. *Frontiers in Microbiology*, 2020; 11 DOI: 10.3389/fmicb.2020.01800
- <https://www.jmir.org/2020/12/e20756/>