Screening for COVID-19

The authors review COVID-19 screening and call for improvements to screening systems beyond the current pandemic

Screening patients is not a new idea, and the identification of a disease or disease process has mostly been the result of effective screening.[1] It was used in the identification of people with HIV in the early 1990s and the recent screening for COVID-19. WHO defined screening as the presumptive identification of an unrecognised disease in an apparently healthy, asymptomatic population by means of tests, examinations or other procedures.[2] A screening tool is not meant to be diagnostic, but this can change depending on its use.[3]

The article looks at the importance of screening, various types of COVID-19 screening tools and the importance of maintaining this in health facilities.

Why screen?
The resources for management of any health condition is limited. COVID-19 was a clear example of the limited resources available in health. The health system's resources will need to be prioritised to save on costs, time and other resources.

Is there any benefit in screening?
For a screening tool to be beneficial it needs to fulfill the criteria set by Rose and Barker, in 1978,[4] but does this hold for COVID-19?

Does earlier treatment improve the prognosis?
This question was raised by many at the height of the pandemic. Early detection does appear to increase the chances of survival and reduce the risk of transmission to others.[5]

How valid and repeatable is screening?
There are various screening tools that have been used for COVID-19 discussed later in this article. Screening tools always need to produce the same results.[4,5]

What is the yield of the screening service?
The yield of a screening is the number of cases detected in a given population.[4] A disease condition with low prevalence will have a low yield. The justification for screening for any disease does not rest with the prevalence only but with the effect of the disease. COVID-19

COVID-19 equipment in Ghana. Source: Prof. B.J.B Nyarko/GAEC (creativecommons.org/licenses/by/2.0)

has 279 per 100,000 population mortality worldwide, and although some countries have very low prevalence and mortality the need for screening cannot be over-emphasised.[5]

Types of screening
The race to stop the spread and effects of COVID-19 led to the development and re-establishment of many screening tools and test.[7,8,9,10] These ranged from simple questionnaires to complex laboratory investigations.[7]

Self-assessment
The most common basic community screening is the temperature check at all public institution which has become accepted in most parts of the world. High fever of ≥39 °C have been associated with likelihood of COVID-19 infection and increased severity of disease.

Self-assessment tool are tools used by individuals to assess for the likely hood of being infected with COVID-19 and offer guidance on when and where to seek medical treatment.[11] These have been in forms of questionnaire-based surveys, radio and television education, websites or with mobile applications.[10,11,12,13]

Health-worker-assisted screening
Theses screening tools and tests are conducted by health workers trained in with the knowledge of how to use and interpret the results.

Symptoms and signs questionnaire: These are tools used in the hospital to determine the likelihood of a person presenting to the health facility to have a chance of being infected with COVID-19. The questionnaire includes epidemiological data on travel history and

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Table 1. Progress of the CT imaging for COVID-19

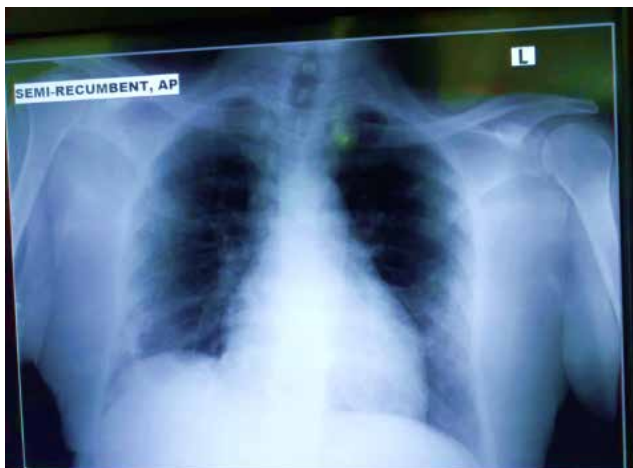| Stage	Features
Early (0-4 days)	Normal CT scan, bilateral peripheral/subpleural ground glass opacities
Progressive stage (5-8 days)	Increase in number and size of ground glass opacities Linear opacities leading to crazy paving appearance "reverse halo sign"
Peak stage (9-13 days)	Confluent ground glass opacities Superimposed Consolidation Traction bronchiectasis
Absorption stage (>14 days):	"Fibrous stripes" appear with resultant architectural distortion abnormalities resolve at one month and beyond
Rare features in the late stages of disease	Pleural effusion Lymphadenopathy Pericardial effusions Pneumothorax Cavitation

Table 2. Different testing modalities

Nucleic Acid Tests Manual laboratory-based nucleic acid tests	Real-time quantification RT-PCR Nested RT-PCR Droplet digital PCR
Nucleic Acid Tests Rapid and point-of-care nucleic acid tests	Loop-mediated isothermal amplification Nanoparticles-based amplification Portable benchtop-sized analyzers
Antigen tests	Immunochromatographic assay
Antibody tests Manual laboratory-based antibody tests	Enzyme-linked immunosorbent assay Immunofluorescence assay Chemiluminescence immunoassay
Antibody tests Rapid and point-of-care antibody tests	Lateral flow assay Microarray and microfluidic chip
Virological tests	Culture-based virus detection

contact. Vital signs serve as adjuncts for most of these tools. A standard WHO form has been widely used with modification to suit the environment and hospital structure for which it is used.[14]

Full Blood Workup: The blood workup for patients presenting to the hospital differs based on the presenting condition. Work by Fanand Gaohave shown the likelihood of COVID-19 and its related severity in patients with reduced white cell count mostly lymphopenia, organ and coagulation dysfunction: higher lactate dehydrogenase, D-dimers, makers of inflammation; ESR, CRP and ferritin.[15,16,17] Review of patients with COVID-19 has also shown the sudden impairment of

glycaemic control in non-diabetics has been a common presentation.[18,19,20] The test for blood sugars and HBA1C can be good indicators for COVID-19.

Imaging: Chest x-rays are readily available in most areas around the world and commoner than CT Scan and PCR testing. The finding on chest x-ray might not be exclusive for COVID-19 but can be supportive in the screening of a patient with symptoms.[21,22,23]

CT scan is the gold standard for imaging of COVID-19 radiologically as it has a high sensitivity (about 97%) but low specificity. When available CT Scans can be a great screening and diagnostic tool for COVID-19. The findings on the CT Scans vary from Normal CT scan

Figure 1. Ground glass or hazy opacities in a peripheral distributionother rare symptoms

Figure 2. Bilateral patchy asymmetrical airspace opacities in middle and lower zones
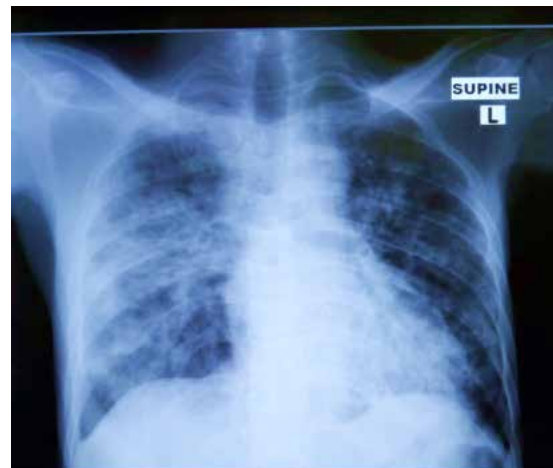
to Traction bronchiectasis. Table 1 shows the progress of the imaging for COVID-19 and other rare symptoms.

Viral Testing for COVID-19: Acceptable specimens for COVID-19 testing and screening include upper and lower respiratory tract specimens which are the most frequent. The less frequent samples for testing include stool specimens, whole blood specimens, and serum specimens.[25]

There are many different testing modalities used the most common being the PCR testing. A list of these is provided in Table 2.[25]

Screening among healthworkers

The risk of exposure is high among healthworkers.[26] The reality of the inadequacy of healthworkers around the world require the justification for 14-day quarantine which exposed to COVID-19. The use of the Risk Assessment and Management of Exposure of Health Workers served as a tool for screening health workers as being high risk or low risk. A summary of the tool is provided on the WHO website.[27]

Is screening enough?

The list of possible screening tools stated should make it easy for COVID-19 to be detected and controlled but this is not the case. Screening tools are not enough to protect against COVID-19 but need to be supported by other interventions.[24] In hierarchy of control of hazards for COVID-19, elimination and substitution are not possible as the host of the disease are human beings. Screening provides the advantage to institute engineering controls, serves as a strong part of administrative control, and supports the advantages of the use of Personal Protective Equipment.[28]

Screening should be incorporated into the normal working flow of the health institution to make this beneficial, sustainable, and efficient.

How long will we be screening?

The COVID-19 pandemic declared on 11 March 2020 has spanned over 8 months and is now having reported re-emerging infections in USA, Europe, and Asia.[29] That the disease will disappear seems unlikely. A vaccine is nearer than initially anticipated but the acceptance, wide distribution, administration, and efficiency will take some more years to understand.

The screening tools adapted by health facilities, communities and institutions will need to be re-organised into normal workflows and not an adjunct ad hoc measure. All health facilities should be in the position to consider how to move from pandemic response to lasting systems improvement for the management of COVID-19.

Reference
1. Hu Z, Song C, Xu C, Jin G, Chen Y, Xu X, Ma H, Chen W, Lin Y, Zheng Y, Wang J. Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. Science China Life Sciences. 2020 May;63(5):706-11.
2. https://www.who.int/cancer/prevention/diagnosis-screening/screening/en/
3. Corrigan JD, Bogner J. Screening and identification of TBI. The Journal of Head Trauma Rehabilitation. 2007 Nov 1;22(6):315-7.
4. Rose G, Barker DJ. Epidemiology for the uninitiated. Screening. British medical journal. 1978 Nov 18;2(6149):1417.
5. Stoate HG. Can health screening damage your health?. The Journal of the Royal College of General Practitioners. 1989 May 1;39(322):193-5.
6. https://www.worldometers.info/coronavirus/
7. Gostic K, Gomez AC, Mummah RO, Kucharski AJ, Lloyd-Smith JO. Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. Elife. 2020 Feb 24;9:e55570.
8. Reeves JJ, Hollandsworth HM, Torriani FJ, Taplitz R, Abeles S, Tai-Seale M, Millen M, Clay BJ, Longhurst CA. Rapid response to COVID-19: health informatics support for outbreak management in an academic health system. Journal of the American Medical Informatics Association. 2020 Jun 1;27(6):853-9.
9. Wynants L, Van Calster B, Bonten MM, Collins GS, Debray TP, De Vos M, Haller MC, Heinze G, Moons KG, Riley RD, Schuit E. Prediction models for diagnosis and prognosis of COVID-19 infection: systematic review and critical appraisal. bmj. 2020 Apr 7;369.
10. Ting DS, Carin L, Dzau V, Wong TY. Digital technology and COVID-19. Nature medicine. 2020 Apr;26(4):459-61.
11. Judson TJ, Odisho AY, Neinstein AB, Chao J, Williams A, Miller C, Moriarty T, Gleason N, Intinarelli G, Gonzales R. Rapid design and implementation of an integrated patient self-triage and self-scheduling tool for COVID-19. Journal of the American Medical Informatics Association. 2020 Jun 1;27(6):860-6.
12. Timmers T, Janssen L, Stohr J, Murk JL, Berrevoets MA. Using eHealth to Support COVID-19 Education, Self-Assessment, and Symptom Monitoring in the Netherlands: Observational Study. JMIR mHealth and uHealth. 2020;8(6):e19822.
13. Liu S, Yang L, Zhang C, Xiang YT, Liu Z, Hu S, Zhang B. Online mental health services in China during the COVID-19 outbreak. The Lancet Psychiatry. 2020 Apr 1;7(4):e17-8.
14. www.who.int/publications/i/item/clinical-management-of-COVID-19
15. Fan BE, Chong VC, Chan SS, Lim GH, Lim KG, Tan GB, Mucheli SS, Kuperan P, Ong KH. Hematologic parameters in patients with COVID-19 infection. American journal of hematology. 2020 Jun;95(6):E131-4.
16. Gao Y, Li T, Han M, Li X, Wu D, Xu Y, Zhu Y, Liu Y, Wang X, Wang L. Diagnostic utility of clinical laboratory data determinations for patients with the severe COVID-19. Journal of medical virology. 2020 Mar 17.
17. Terpos E, Ntanasis-Stathopoulos I, Elalamy I, Kastritis E, Sergentanis TN, Politou M, Psaltopoulou T, Gerotziafas G, Dimopoulos MA. Hematological findings and complications of COVID-19. American journal of hematology. 2020 Apr 13.
18. Unsworth R, Wallace S, Oliver NS, Yeung S, Kshirsagar A, Naidu H, Kwong RM, Kumar P, Logan KM. New-Onset Type 1 Diabetes in Children During COVID-19: Multicenter Regional Findings in the UK. Diabetes Care. 2020 Aug 13.
19. Bode B, Garrett V, Messler J, McFarland R, Crowe J, Booth R, Klonoff DC. Glycemic characteristics and clinical outcomes of COVID-19 patients hospitalized in the United States. Journal of Diabetes Science and Technology. 2020 May 9:1932296820924469.
20. Brufsky A. Hyperglycemia, hydroxychloroquine, and the COVID-19 pandemic. Journal of Medical Virology. 2020 Apr 15.
21. Bandirali M, Sconfienza LM, Serra R, Brembilla R, Albano D, Pregliasco FE, Messina C. Chest radiograph findings in asymptomatic and minimally symptomatic quarantined patients in Codogno, Italy during COVID-19 pandemic. Radiology. 2020 Jun;295(3):E7-.
22. Wong HY, Lam HY, Fong AH, Leung ST, Chin TW, Lo CS, Lui MM, Lee JC, Chiu KW, Chung T, Lee EY. Frequency and distribution of chest radiographic findings in COVID-19 positive patients. Radiology. 2020 Mar 27:201160.
23. Ng MY, Lee EY, Yang J, Yang F, Li X, Wang H, Lui MM, Lo CS, Leung B, Khong PL, Hui CK. Imaging profile of the COVID-19 infection: radiologic findings and literature review. Radiology: Cardiothoracic Imaging. 2020 Feb 13;2(1):e200034.
24. GeurtsvanKessel CH, Okba NM, Igloi Z, Bogers S, Embregts CW, Laksono BM, Leijten L, Rokx C, Rijnders B, Rahamat-Langendoen J, van den Akker JP. An evaluation of COVID-19 serological assays informs future diagnostics and exposure assessment. Nature communications. 2020 Jul 6;11(1):1-5.
25. Li C, Zhao C, Bao J, Tang B, Wang Y, Gu B. Laboratory diagnosis of coronavirus disease-2019 (COVID-19). ClinicaChimicaActa. 2020 Jul.
26. Nguyen LH, Drew DA, Graham MS, Joshi AD, Guo CG, Ma W, Mehta RS, Warner ET, Sikavi DR, Lo CH, Kwon S. Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. The Lancet Public Health. 2020 Sep 1;5(9):e475-83.
27. World Health Organization. Risk assessment and management of exposure of health care workers in the context of COVID-19: interim guidance, 19 March 2020. https://apps.who.int/iris/handle/10665/331496
28. Manuele FA. Risk assessment & hierarchies of control. Professional Safety. 2005 May 1;50(5):33-9.
29. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. Acta bio-medica: AteneiParmensis. 2020 Mar 19;91(1):157-60.