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Incessant threat of COVID-19 variants: Highlighting need for a mix of FDA-approved artificial intelligence tools and community pharmacy services

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A B S T R A C T

Seamless integration of artificial intelligence (AI) technology, especially FDA-approved AI tools, in community pharmacies can build increasingly effective and easy care pathways, thereby minimizing burden on the healthcare system, and ensuring compliance to preventive measures through limiting hospital visits. In this regard, the WHO needs to enlist and provide guidance on the most promising AI tools that can be implemented in community pharmacy settings.

Most recently, the World Health Organization (WHO) and the International Pharmaceutical Federation (FIP) have published a guidance and a survey report, respectively, in view of the emerging evidence-based potential of digital technologies, especially artificial intelligence (AI), in enhancing the delivery of quality health care and medicine, increasing patient safety and reducing healthcare costs. However, the WHO has also highlighted the high implementation cost, safety concerns, and the need for expert supervision, robust technologies, and training. This clearly implies that the integration of AI in major patient-related decisions or specialty areas demands a lot of evidence and monetary resources. But we are of the opinion that easily available AI tools, especially approved by the US Food and Drug Administration (FDA), could be beneficial beyond expectations in strengthening collapsed healthcare systems of developing countries, if employed wisely. This editorial is intended to highlight the urgent need for the use of AI in community pharmacies to deliver healthcare services in a more organized and timely manner in resource-deprived nations, as pandemics are now near finished and community pharmacies are the only healthcare entities that can empower patients and communities to undertake control of their healthcare while maintaining social distancing protocols.

The Delta variant of SARS-CoV-2, classified as variant of concern (VOC) by the WHO, and COVID-19 associated opportunistic infections among patients with co-morbidities have highlighted the importance of management of chronic disease patients, such as diabetes, hypertension, and cardiovascular diseases. Under such catastrophic conditions, community pharmacies can be upgraded using AI tools. For instance, improved accuracy of cardiovascular risk prediction among patients with heart disease was reported in clinical settings using Electronic Health Record (EHR) data. Likewise, FDA-approved AI tools, such as DreaMed AdvisorPro (analyzes blood glucose and insulin pump data), and the guardian™ connect system (predicting blood glucose changes) can be used to manage diabetic patients, as they are vulnerable to COVID-19 associated mucormycosis and other complications.

Treatment adherence is a cornerstone of patient health outcomes management. However, the World Health Organization has deemed medication non-adherence an epidemic and has called for effective, patient-specific approaches. The COVID-19 lockdown has further suppressed healthcare consultations, thereby potentially hindering patient-centered care. With the integration of computer-aided patient medication review system, community pharmacists can assess patient compliance to the prescribed treatment and nudge patient practices. According to reports, the incidence of non-adherence to treatment was lowered considerably with the aid of Express Scripts, “Vik” (chatbot), and intervention of community pharmacist using big data analysis techniques.

Given the fact that immunization and vaccination programs around the globe have been greatly influenced due to ongoing bleak situation,
### Table 1

List of FDA approved and other artificial intelligence (AI) tools for community pharmacies.

| Artificial Intelligence tool | Description | Benefit of implementation in community pharmacy |
|------------------------------|-------------|--------------------------------------------------|
| FDA approved AI tools | | |
| AI-ECG Platform | • This AI-ECG Platform is designed to assist healthcare professionals in measuring and interpreting ECG | • Easy routine monitoring of cardiac patients |
| RhythmAnalytics | • RhythmAnalytics platform helps healthcare professionals to detect cardiac arrhythmia, or irregular heartbeat | • Minimize hospital referrals |
| FerriSmart Analysis System | • This automated system is for measuring liver iron concentration. | • Useful in home-base pharmacy services, especially in case of emergency situations |
| Current Wearable Health Monitoring System | • Current Health is all-in-one wireless wearable which sits on the upper arm of patients and continuously measures a patient’s respiration rate, oxygen saturation, heart rate, temperature and movement with intensive care unit accuracy. | • Can be used by community pharmacist to monitor patients discharged from hospitals by home visits |
| Guardian™ connect system | • This system predicts blood glucose changes | • Can be used for determining parameters in COVID-19 suspected patients |
| DreaMed Advisor | • Analyzes blood glucose and insulin pump data to generate recommendations for optimizing insulin pump dose ratios. | • Can help community pharmacist detect anemia in children, pregnant, lactating and women with child-bearing age. |
| BriefCase by Aidoc | • This assists radiologist with prioritization of time-sensitive and potentially life-threatening cases through analyzing scanned images. | • Avoid complications due to early detection of low iron levels. |
| Everion | • It is a device, which is a multi-sensor platform, worn on the arm capable of measuring 22 parameters in real time. Collected physiological data can include heart rate, inter-beat interval, respiratory rate, blood oxygenation, skin temperature and actigraphy (rest/activity cycles)—all gathered non-invasively. | • Risk prediction in diabetic patients, especially COVID-19 survivors |
| Electronic health record (EHR)data | • Up-skill community pharmacists in terms of clinical decision making | • Useful in home-base pharmacy services, especially in case of emergency situations |

#### FDA approved AI tools

- **AI-ECG Platform**:  
  - Developed by [AI-ECG Platform](#).  
  - This AI-ECG Platform is designed to assist healthcare professionals in measuring and interpreting ECG.

- **RhythmAnalytics**:  
  - Developed by [Biofourmis](#) and [Singapore Pte. Ltd](#).  
  - RhythmAnalytics platform helps healthcare professionals to detect cardiac arrhythmia, or irregular heartbeat.

- **FerriSmart Analysis System**:  
  - Developed by [Everion](#).  
  - This automated system is for measuring liver iron concentration.

- **Current Wearable Health Monitoring System**:  
  - Developed by [Current Health Ltd](#).  
  - Current Health is all-in-one wireless wearable which sits on the upper arm of patients and continuously measures a patient’s respiration rate, oxygen saturation, heart rate, temperature and movement with intensive care unit accuracy.

#### Other AI tools

- **Guardian™ connect system**:  
  - Developed by [Guardian™](#).  
  - This system predicts blood glucose changes.

- **DreaMed Advisor**  
  - Developed by [DreaMed Advisor](#).  
  - Analyzes blood glucose and insulin pump data to generate recommendations for optimizing insulin pump dose ratios.

- **BriefCase by Aidoc**:  
  - Developed by [BriefCase by Aidoc](#).  
  - This assists radiologist with prioritization of time-sensitive and potentially life-threatening cases through analyzing scanned images.

- **Everion**:  
  - Developed by [Everion](#).  
  - It is a device, which is a multi-sensor platform, worn on the arm capable of measuring 22 parameters in real time. Collected physiological data can include heart rate, inter-beat interval, respiratory rate, blood oxygenation, skin temperature and actigraphy (rest/activity cycles)—all gathered non-invasively.

- **Electronic health record (EHR)data**:  
  - Developed by [Electronic health record (EHR)data](#).  
  - Up-skill community pharmacists in terms of clinical decision making.

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the utilization of AI equipped community pharmacies seems extremely value-added in preventing other public health crisis. In addition, lack of vaccine acceptance and non-compliance to complete course of vaccination are major challenges due to cultural, psychological and poor self-care behaviors. This makes the populations vulnerable to increased morbidity and mortality. For instance, partial vaccination with a single dose of the COVID-19 vaccine has been reported to cause an outbreak of a more complex SARS-CoV-2 Delta in the United Kingdom. In this regard, community pharmacists can use AI tools to convince through sharing information and ensuring administration of complete course of COVID-19 vaccine as well as track any adverse drug event followed by administration of COVID-19 vaccine.

Imposed lockdowns as well as public anxiety about COVID-19 have results in fewer visits to healthcare facilities. As a result, self-medication and inappropriate use of medicines have escalated to threatening levels in developing nations with low health literacy. As such, AI can help up-skill community pharmacists and help them play role in prevention, documentation and alleviation of medication errors, and deterring drug and disease-related problems. There are also reports that the consumption of antibiotic has increased manifold in the wake of COVID-19, which is well-known to contribute to disquieting high rates of antimicrobial resistance. The prescription approval & prospective audit and feedback have been recommended as most promising antibiotic stewardship interventions to halt the irrational use of antibiotics. A community pharmacist can use an AI tool not only to seek approval from a general physician before prescribing or dispensing antibiotics for self-medication, but can also monitor patient treatment course.

In sum, bearing in mind the emerging variants of COVID-19 and deadly opportunistic infections, there is a need to revamp healthcare systems of developing nations with collapsed healthcare systems. Seamless integration of AI technologies, especially FDA approved AI tools in community pharmacies can build increasingly effective and easy care pathways, thereby minimizing burden on healthcare system and ensuring compliance to preventive measure through limiting hospital visits. In this regard, the WHO needs to enlist and provide guidance on most promising AI tools that can be implemented in community pharmacy settings. Thereafter, they will need to compel governments to provide monetary support required to address a number of barriers to establishment of community pharmacy services in developing nations and AI technologies on priority basis. A list of AI tools along with their benefits has been provided in Table 1.

### Funding
None.

### Declaration of competing interest
We declare no competing interests.

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