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Opinion/Commentary

Turning Up the Volume for Precision Herbal Medicine in Africa in an Era of COVID-19 and Planetary Biodiversity Loss

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Abstract

What would it take in terms of the structural reforms in science, technology, and culture to cultivate sustainable therapeutic and preventive medicine innovations against zoonotic infections such as coronavirus disease 2019 (COVID-19) in the 21st century? In May 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services warned that ''around one million animal and plant species are now threatened with extinction.'' Biodiversity is essential for drug discovery and development. We are currently facing a dual challenge in therapeutics innovation with COVID-19 and loss in planetary biodiversity. Hence, there is an urgent need for new ideas and strategies for drug discovery as well as repurposed drugs for the COVID-19 pandemic. To these ends, the existing scholarship in, and the field of precision herbal medicine provide an alternative source for discovery of novel therapeutics against the novel coronavirus. We propose that the application of precision herbal medicine in Africa could usefully contribute to current efforts for therapeutics innovation for the COVID-19 pandemic, and beyond. The pandemic calls for interdisciplinary dialogue and turning up the volume for precision herbal medicine in Africa, and importantly, in ways informed by robust systems science as well as broad public engagement to codesign medicines in the 21st century.

Keywords: precision herbal medicine, COVID-19, African traditional herbal medicine, biodiversity, planetary health, drug discovery

Perspective

The coronavirus disease 2019 (COVID-19) pandemic caused by the novel coronavirus, officially known as the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), has spread across the globe with 675,060 deaths from 17,396,943 confirmed cases as of August 1, 2020, according to the World Health Organization (WHO). There is an urgent need for effective and safe vaccines as with novel drug discovery strategies and repurposed therapeutics to reduce morbidity and mortality of COVID-19. Hence, we begin this opinion piece with a question:

What would it take in terms of the structural reforms in science, technology, and culture to cultivate sustainable therapeutics innovations against zoonotic infections such as COVID-19 in the 21st century?

To answer, let us bring forward a broader and historical context.

First and foremost, until we examine through a critically informed lens, the human actions on the planet for the past centuries that have put wealth over planetary health, SARS-CoV-2 is unlikely to be the last zoonotic outbreak in the 21st century (Akar, 2020; Brabazon, 2020; Kickbusch et al., 2020). To this end, it is noteworthy that in May 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services warned that ''around one million animal and plant species are now threatened with extinction'' (Díaz et al., 2019). The COVID-19 pandemic signals, in part, the effects of biodiversity loss and the blurred boundaries between human and animal habitats that have created a fertile ground for zoonotic infections and pandemics. In contrast, a collective cognizance on planetary health, biodiversity loss, and design

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and implementation of strategic policies could turn the scale toward favorable biodiversity outcomes (Bull et al., 2020).

Biodiversity is essential for drug discovery and development particularly for antimicrobials as noted in the fungus *Penicillium chrysogenum* resulting in the discovery and isolation of penicillin in early 1940s (Newman and Cragg, 2016). Biodiversity has contributed immensely to the discovery of myriad compounds produced by the variety of species we share the planet with, including herbal plants with a notable success. Moreover, we have to bear in mind that COVID-19 is a zoonotic disease that jumped from animals to humans as noted earlier. It is estimated that 60% of known infectious diseases and ~75% new or emerging infectious diseases in people come from animals (Jones et al., 2008; Woolhouse and Gowtage-Sequeria, 2005). This indicates the need for real-time, vigilant, and planetary scale therapeutics innovation programs against zoonotic infections and new ways to buttress and empower planetary biodiversity.

Building a Systems Science Foundation for Precision Herbal Medicine

The pandemic has begun to spread in the global South including Africa by February 2020 (CDC, 2020; Massinga Loembé et al., 2020). As the scientific community continues to search for new or repurposed drugs for COVID-19, in contrast, there was an increased demand for herbal ''COVID-Organics'' by the Madagascar Institute of Applied Research in April 2020. However, there was and still lack of reliable pharmacological and efficacy data to substantiate the report that the herbal tonic cures COVID-19. Undoubtedly, herbal medicines including *Artemisia herba-alba*, *Catharanthus roseus, Pelargonium sidoides, Azadirachta indica, Moringa oleifera* and many more are used in folk medicine by many cultures. The current pandemic presents an opportunity for further dialogue and turning up the volume for precision herbal medicine in Africa in ways informed by robust systems science, omics technologies, and glocal (global + local) practices of herbal medicine in society.

Precision herbal medicine that emphasizes the incorporation of biomarker and systems science research with herbal medicine with an eye to rational treatment algorithms can help leverage from the large body of scholarship in personalized medicine, molecular disease targets, and environmental factors (including microbiota and lifestyle) that are all needed as part of the glocal debates in finding new therapeutics and diagnostics solutions to the COVID-19 pandemic.

We propose that an ecological approach to drug discovery that takes into account local community knowledge base and one that deploys omics systems science technologies can enable precision herbal medicine in Africa and globally and thus empower the current efforts for therapeutics innovation for the COVID-19 pandemic and beyond (Sardas et al., 2020; Thomford et al., 2018a). A systems science and multiomics approach (Pirih and Kunej, 2018) to assess the mechanism of action, efficacy, and safety of African herbal medicine could help generate the much-needed robust evidence base that is crucial in discovery of new therapeutics against the COVID-19. African herbal medicine and its bioactive phytocompounds can be screened against the virus with modern multiomics technologies (proteomics, transcriptomics, genomics, and metabolomics) to decipher their potential molecular targets, clinical and planetary health effects.

The extent of the clinical severity of COVID-19 is strongly mediated by immune response that varies among infected patients. Defined bioactive compounds modulating the immune system and response offer prospects for therapeutics innovation (Florindo et al., 2020), whereas the idea of immune boosting remains contested and calls for future research on the complex ways in which immune system interacts with the virus and patients' recovery from COVID-19. Deciphering the molecular actions of defined bioactive compounds in herbal medicines with an eye to effects on the immune pathways remains an important focus area for precision herbal medicine as exemplified by artemisinin in herb *Artemisia annua* for treatment of fever, malaria, and respiratory tract infections in Africa and other continents (Cheong et al., 2020).

African countries have a long history of and engagement with African traditional herbal medicine that presents a dual opportunity for therapeutics innovation and buttressing ecosystem health especially considering the threats to planetary scale loss of biodiversity that was used to sustain novel drug discovery in the past.

Translational multiomics-based sciences and systems pharmacology offer a platform for identification of compounds through multilayered and interactive biological networks, biomarkers, and targets for innovative therapeutics for COVID-19 (Özdemir, 2015; Thomford et al., 2018b). COVID-19 being a multisystemic disease will also require novel therapeutic compounds to combat the disease over and beyond the current pandemic. Preclinical and clinical trials of mechanistically defined herbal medicines and other plant-based drugs, for example, artesunate that are currently known and used in African countries to have immunomodulatory and antiviral properties are urgently required to be undertaken as part of the precision medicine research that is necessary for COVID-19.

Similar efforts for therapeutics innovation using traditional and herbal medicines have been made against the complex and diverse clinical findings of COVID-19 around the world, including in China (Xiong et al., 2020; Xu and Zhang, 2020). Such efforts to bridge traditional therapeutics folklore in local communities would benefit from deploying systems science concepts and multiomics technologies so as to build a strong evidence base and independent replication of the findings essential for progress in global science.

It should be clear by now that addressing the COVID-19 pandemic is only a first step in the arduous and long-haul task of pandemics in the 21st century. While facing a serious biodiversity loss, we can harness a twin success by enhancing biodiversity on the planet and a deeper scientific understanding of the mechanism of action and clinical pharmacology of herbal medicines. Protecting and effective utilization of herbal medicine biodiversity (Yacoub et al., 2014) will be key to combating future diseases and pandemics. Nature in this regard cannot be continuously dismissed as it has always come to the rescue of humankind when it needed it most (Neergheen-Bhujun et al., 2017).

The success of precision herbal medicine in the COVID-19 era calls for an ''all hands-on deck'' approach and the collective efforts of the African scientists, local communities, health care workers, critical social sciences, and humanities scholars as well as governments. African countries have built a strong foundation in theory and practice of

systems science over the past several decades and are well poised to deliver on the scientific potentials of precision herbal medicine in a time of COVID-19 and threats to biodiversity in the current century.

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Abbreviations Used

COVID-19 = coronavirus disease 2019
SARS-CoV-2 = severe acute respiratory syndrome-coronavirus-2
WHO = World Health Organization