



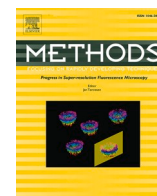
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Methods

journal homepage: www.elsevier.com/locate/ymeth

Editorial

Toward interdisciplinary methods appropriate for optimal epidemic control



Epidemics are life-threatening challenges known for more than two and a half millennia. Yet, they are not well understood. While Homer already used the word ‘epidemic’ in *The Odyssey*, the concept only acquired a personal and also collective meaning when, in 430–429 BCE, Athens experienced a war and an epidemic that decimated Athenians (which resulted in the death of Pericles and his sons) – events that appeared to announce the end of a recent double development: the emergence of democracy and science [1]. Some of the lessons then learned were reported, the following year, in Sophocles’ *Oedipus Rex* [2].



Pericles at the Assembly, at the beginning of the epidemic that started on 430 BC (‘Pericles’ funeral oration’, Philipp von Foltz, 1852). ‘Pericles’, *Wikiwand*, <https://www.wikiwand.com/en/Pericles>

COVID-19 is the first epidemic citizens and scientists have learned and are still learning about not from books and classrooms but from electronic media. Because this epidemic involves numerous disciplines and fields, there is an urgent need to integrate research findings.

Integrating a complex topic requires inter-/trans-disciplinary approaches. Unlike multidisciplinary research –which includes two or more disciplinary views but does not necessarily integrate knowledge across fields and, therefore, may lack overall validity–, inter-/trans-disciplinary methods explicitly seek cognitive integration and validation [3]. Accordingly, this special issue of *Methods* pursues two goals: (i) to report for the first time or review critical topics that may be considered in this or future epidemic(s), and (ii) to provide one methodological example on how to foster inter-/trans-disciplinary research methods.

To that end, the first paper provides a broad introduction, which includes both a review and an identification of methodological topics [4]. Following WHO’s recommended priorities (*test, treat, trace, isolate* or *TETRIS*), the first data-based paper addresses an unprecedented problem: how to identify a disease in which many (if not most) cases are asymptomatic. Such a challenge is addressed by Fasina et al who evaluate the use of a novel metric: test positivity [5].

In order to treat individuals infected by SARS CoV-2, Swatantra Kumar and Shailendra Saxena offer information on the structure of this virus [6,7]. This information is then considered when new therapies are developed, which require multi-targeting, massive screening, as reported by Sumit Kumar et al and Yash Gupta et al. [8,9].

Because data analysis is critical in all operations, new quantitative methods are also required. Such needs are explored by Hittner et al as well as Fair et al. who report both new statistical methods that consider geo-referenced epidemiologic data and approaches that address complex and dynamic epidemic environments [10,11].

Because isolation depends on economic and psychological needs of people exposed to epidemics, these social science-related topics are summarized by Thagard. They are further investigated with new methods developed and evaluated by Harrison et al. [12,13].

The last papers remind the readers about methodological challenges likely to remain [14,15]. Rivas and Hoogesteijn touch on educational, evaluation, and design-related aspects that may influence scientific methods. Van Regenmortel closes this special issue using vaccine development as the context that illustrates how assumptions and design issues, if not assessed, may lead to failures.

It is hoped that the topics here examined may be useful when fundamental questions are raised in this or future epidemic(s), such as vaccinating against or eliminating an epidemic (as pursued and, apparently, achieved by New Zealand [16]). The editors thank the authors and the anonymous reviewers who made this special issue possible.

References

- [1] P. Martin, E. Martin-Granel, 2,500-year evolution of the term epidemic, *Emerg. Infect. Dis.* 12 (6) (2006) 976–980, <https://doi.org/10.3201/eid1206.051263>.
- [2] A.A. Kousoulis, K.P. Economopoulos, E. Poulakou-Rebelakou, G. Androutsos, S. Tsiodras, The Plague of Thebes, a historical epidemic in Sophocles’ *Oedipus Rex*, *Emerg. Infect. Dis.* 18 (1) (2012) 153–157, <https://doi.org/hods.2021.10.3201/eid1801.ad1801>.
- [3] J.B. Hittner, A.L. Hoogesteijn, J.M. Fair, M.H.V. van Regenmortel, A.L. Rivas, The third cognitive revolution, *EMBO Rep* 20 (2019). <https://doi.org/10.15252/embr.201847647>.
- [4] A.L. Rivas, M.H.V. van Regenmortel, COVID-19 related interdisciplinary methods: preventing errors and detecting research opportunities, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.05.014>.

<https://doi.org/10.1016/j.ymeth.2021.09.006>

Available online 17 September 2021

1046-2023/© 2021 Elsevier Inc. All rights reserved.

- [5] F.O. Fasina, M.A. Salami, M.M. Fasina, O.A. Otekunrin, A.L. Hoogesteijn, J. B. Hittner, Test positivity – Evaluation of a new metric to assess epidemic dispersal mediated by non-symptomatic cases, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.05.017>.
- [6] S. Kumar, S.K. Saxena, Structural and molecular perspectives of SARS-CoV-2, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.03.007>.
- [7] A. Gupta, A. Pradhan, V.K. Maurya, S. Kumar, A. Theengh, B. Puri, S.K. Saxena, Therapeutic approaches for SARS-CoV-2 infection, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.04.026>.
- [8] S. Kumar, P.P. Sharma, C. Upadhyay, P. Kempaiah, B. Rath, Poonan, Multi-targeting approach for nsp3, nsp9, nsp12 and nsp15 proteins of SARS-CoV-2 by Diosmin as illustrated by molecular docking and molecular dynamics simulation methodologies, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.02.017>.
- [9] Y. Gupta, D. Maciorowski, S.E. Zak, K.A. Jones, R.S. Kathayat, S.-A. Azizi, et al., Bisindolylmaleimide IX: A novel anti-SARS-CoV2 agent targeting viral main protease 3CLpro demonstrated by virtual screening pipeline and in-vitro validation assays, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.01.003>.
- [10] J.B. Hittner, F.O. Fasina, Statistical methods for comparing test positivity rates between countries: Which method should be used and why? *Methods* (2021) <https://doi.org/10.1016/j.ymeth.2021.03.010>.
- [11] J.M. Fair, R.J. LeClaire, L.R. Dauelsberg, M. Ewers, D. Pasqualini, T. Cleland, R. W. William, Systems dynamics and the uncertainties of diagnostics, testing and contact tracing for COVID-19, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.03.008>.
- [12] P. Thagard, Paul The cognitive science of COVID-19: Acceptance, denial, and belief change, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.03.009>.
- [13] G.W. Harrison, A. Hofmeyr, K. Kincaid, B. Monroe, D. Ross, M. Schneider, J. T. Swarthout, Eliciting beliefs about COVID-19 prevalence and mortality: epidemiological models compared with The Street, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.04.003>.
- [14] A.L. Rivas, J.T. Hoogesteijn, Biologically grounded scientific methods: the challenges ahead for combating epidemics, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.09.00>.
- [15] M.H.V. van Regenmortel, Design in Biology and rational design in Vaccinology: a conceptual analysis, *Methods* (2021), <https://doi.org/10.1016/j.ymeth.2021.07.010>.
- [16] COVID-19: Elimination strategy for Aotearoa New Zealand (<https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-response-planning/covid-19-elimination-strategy-aotearoa-new-zealand>).

Ariel L. Rivas^{a,*}, Marc H.V. van Regenmortel^{b,*}

^a Center for Global Health, School of Medicine, University of New Mexico, Albuquerque, NM, United States

^b Medical University of Vienna, Austria

* Corresponding authors.

E-mail addresses: alrivas@unm.edu (A.L. Rivas), vanregen@unistra.fr (M.H.V. van Regenmortel).