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Reproducible research in the fields of epidemiology and public health

Abstract

This mini-review briefly discusses the importance of reproducible research in the fields of epidemiology and public health. Advantages of reproducible research as well as pitfalls and shortcomings of failure to conduct reproducible research in these two important fields are discussed.

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Reproducible research

The main idea of reproducible research is the ability to replicate research findings by multiple investigators independently. In most experimental science fields, it is standard that investigators expect research findings to be reproduced while applied to independent data by independent laboratories using independent tools and methods. For instance, in the fields of computational biology and physical sciences reproducibility is essential to insure credibility of research methods and findings. Reproducible research insures transparency while conducting scientific research. For the advancement of science and knowledge, it is of utmost importance to advocate for reproducible research, not only in the fields of experimental and physical sciences, but also in the fields of behavioral, public health, biomedical and social sciences. Minimum requirement for reproducible research is to make the datasets and computational software codes available.

The advent of massive computing in almost all fields of scientific research warrants even more the need for reproducible research. Advancement of computational sciences is hampered by the inability of independent researchers to reproduce and verify the published results. The minimum standard for reproducibility in the fields that require massive computing is the availability of data and source codes to regenerate the computation. It is the long-standing goal of any scientific discovery to produce verifiable knowledge.

Reproducibility lets each generation of scientists to build upon the previous generations' achievements. The need for greater transparency in computational and related fields is even more of pressing issue as we see controversies such as ClimateGate, the microarray-based drug sensitivity clinical trials under investigation at Duke University, and prominent journals' recent retractions due to unverified code and data suggest a pressing.[1] The scientists, funding agencies, and the journal editors have critical roles to play to insure replication of research findings.

Reproducible research in epidemiology and public health

Reproducible research is critical in epidemiology and public studies, asthese are normally used to quantify small health effects of important, but subtle, risk factors. Replication in epidemiologic and public health studies insures credibility in results that often shape substantial policy decisions.[2] Thus scientific evidence obtained from epidemiologic and public health studies should be held to the standard of full replication and the confirmation of important findings by independent investigators. A full replication of all results may not be feasible to the context to epidemiologic studies due to various constraints. One major constraint is that the investigators may not be able or willing to release their data. However, quantification of small health effects and its significant impacton the policy-making process call for a pressing need for epidemiologic and public health studies to meet a minimum standard.

A study to the context of epidemiology is reproducible when a minimum standard is maintained. A minimum standardfor the epidemiologic and public health studies to be reproducible can be set with the following criteria adapted from Schwab et al.,[3] and others.[2]

Data

The first and foremost criterion for reproducible research in epidemiology and public health is that analytical data set is available.

Methods

Computer codes that are used to generate figures, tables, and other principal results should be made available in a human-readable form. It is also important that the software environment necessary to execute that code is available.

Documentation

Due to the complex nature of data generation and analysis, documentation is another critical step. Adequate documentation of the computer code, software environment, and analytical data set should be available to enable independent investigators to repeat the analyses and to address other similar research questions.

Distribution

Standard methods of distribution such as websites through World Wide Web should be used for others to access the software, data and documentation.

Conclusion

Reproducible research is critical for epidemiologic and public health studies since these fields deal with quantification of health effects due to important, but subtle, risk factors. The findings of epidemiologic and public health studies shape the implementation of important health policies for mass public. The major stakeholders

of the public health policy implementation are the general public including vulnerable subpopulation of children, senior citizens, pregnant women and people with compromised health. Among all scientific research areas, public health and epidemiologic studies warrants reproducible research the most due to the huge stake that might result from findings of these studies.

Acknowledgement

None.

Conflict of Interest

None.

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