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Protocol of the dual burden of animal and human zoonoses: a systematic review

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Abstract

Background:

When we talk about zoonoses, it is undeniable that we have a human and animal population that has been isolated in studies over time. Besides human and animal health, zoonoses also impact the economy and society. Therefore, the integration of the analysis in this area is essential to optimize resources in public health decisions.

We have new challenges in public health that we need to overcome in a more comprehensive method such as One Health. For better measures in public health, the dual burden of zoonoses seems a logical way to determine the integral impact of such diseases in society and thus take better measures to prevent and reduce the impact of these diseases.

Methods:

We follow the guidelines for “Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA). We search human and animal zoonoses on Embase, Ovid Medline, Scopus, Web of Science, and Google Scholar, from an unrestricted period until November 2021. For the search, we consider the Disability Adjusted Life Years (DALYs) for the human zoonotic burden and the animal zoonotic burden in monetary terms. A librarian collaborates to optimize the search string for the databases, and two reviewers screen eligible articles (first by title, then by abstracts, and finally, by full-text assessment.) For the analysis, we aim to convert the burden of zoonoses of all selected studies into the zoonotic Disability Adjusted Life Years (zDALYs) – including the human and animal components.

Discussion:

The study results will provide information on published studies that have accounted for the dual burden of zoonoses (both human and animal health aspects.) In addition, the synthesis of the available literature will address the knowledge gap in this area in order to know to what extent it is possible to convert the burden of human zoonoses to the animal burden of zoonoses and integrate them into a more comprehensive approach (dual burden of zoonoses.)

Keywords

review; zoonosis; zoonotic diseases; infectious diseases; burden of diseases; DALY, zDALY, monetary burden; animal losses

Background

Zoonotic diseases cause morbidity, mortality, and production losses in both human and animal populations. According to recent research, these diseases can have significant socioeconomic consequences in endemic places (1).

In this study, we refer to the dual burden of zoonoses as the morbidity and mortality that zoonotic diseases cause in the human and animal populations. However, the “dual burden of zoonoses” is used with different meanings such as the impact that zoonoses can cause in two areas namely health and economy (2). Even though, we are aware that zoonoses have a broader impact, or “multiple burden,” we need to integrate gradually different disciplines to study this complex topic in zoonoses. A zoonotic disease implies both animal and human components for their occurrence, and we need to logically study them in an integrative way for better decision-making in public health. However, studies including human and animal zoonoses are not common.

For human disease burden, the Disability-Adjusted Life Years (DALY) is a well-known metric which was developed in 1990 (3,4) The Disability Adjusted Life Years (DALYs) are the primary population health metric used by WHO to estimate disease burden. DALYs are comprised of *Years of life lost due to premature mortality*, and the *Years Lost due to Morbidity*. The DALYs or the loss of health in years for a population have been changing over the years, since it represents a picture that we take in a determined place and moment to identify the disease priorities in a population. However, the DALYs do not cover the health impact of animal diseases – being important when we study zoonoses – another modified metric has been suggested, called zDALYs (5). In animals, the burden of zoonoses usually is measured in monetary losses due to diseases. However, the zDALYs represents the time-trade off that a population needs to recover the animal loss due to diseases. Researchers have suggested using this metric integrated into DALYs and estimating the impact of zoonoses both in humans and animals (zDALY). Therefore, the zDALYs allow us to include the animal loss equivalent (ALE) to the DALYs, and thus to determine the losses in human and animal health due to zoonoses.

In this study, we will conduct a systematic review to identify papers that have estimated the burden of zoonoses in humans (in terms of DALYs) and in animals (cost of losses). The findings will demonstrate how often the burden of zoonoses in humans and animals are considered together. The extracted data will allow us to calculate zDALYs – when this latter metric has not been estimated yet.

The One Health concept is not new, but there is still a challenge to apply concrete ideas under this concept (6,7). The dual burden of zoonoses will help to identify studies that bind the human and animal component regarding zoonoses. This is helpful to optimize resources and coordinate efforts among different sectors in health.

Hypothesis

The zDALYs will add an additional value to the human zoonotic burden of the selected studies.

Research question

- How many papers have estimated the burden of zoonoses in humans in terms of DALY combined with the burden of animals in terms of their economic loss?
- Would the conclusions change when incorporating zDALYs? What economic analyses are described in the selected studies?

Methods/Design

Aim, design and setting of the study

We aim to identify papers that include the burden of zoonoses in both humans (in terms of DALYs) and in animals (in terms of economic value of the animals). The studies that provide data on animal losses will be used to calculate zDALYs.

We follow the guidelines for “Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) (8)

The objectives therefore are:

- I. Assess the burden of diseases in human population
 - II. Assess losses in animal population
- } Both in the same paper

Assess the risk of bias, and report bias through ROBIS tool (9) and meta-analysis (if feasible)

Study eligibility

We will consider all peer-reviewed-studies that evaluate the burden of zoonoses in humans and animals. All peer-reviewed studies, from an unrestricted period until November 2021, based on the following criteria:

i. Inclusion criteria

Observational epidemiological studies on, at least, a zoonotic disease that includes human disease burden in DALYs and animal disease burden of diseases in monetary terms.

Selected countries: the literature review will cover all countries globally.

ii. Exclusion criteria:

- Outcomes of experimental studies (e.g., only molecular biology studies)
- Clinical case studies
- Mathematical models without data on the burden of zoonosis.
- Scientific correspondence

Search strategy

A systematic search for epidemiological studies will be conducted in the following sources:

[Electronic academic databases](#)

- a. Embase
- b. Ovid Medline
- c. Scopus

d. Web of Science

Internet search engines

Google Scholar

A librarian will collaborate to optimize the search string for the databases. Two reviewers are involved in the initial screening of the titles and abstracts, the uncertainty during this step will be resolved during full-text screening.

Data extraction

The relevant papers will be selected by screening the titles in the first step. The abstracts are screened on the second step and entire articles at last. On each step, the reviewers ensure that articles meet inclusion criteria. In case of disagreement, the third reviewer is asked to allocate eligibility.

The following data from eligible papers will be recorded by the reviewers in an excel file.

1. General information	Authors and title, country/region and year, journal, language, pathogens
2. Population characteristics	Region, age / species
3. Disease characteristics (outcomes) / community based	DALYs, and economic burden on animals for zoonoses
4. Methodological information	Study and analysis design

A flow diagram of the literature search will be provided according to the PRISMA guidelines.

Qualitative analysis

Description and interpretation of the chosen studies.

Statistical analysis

We will conduct meta-analysis if there is enough quantitative data.

zDALY (YLL + YLD + ALE)

ALE = monetary value of animal health losses/GNI per person at the period of the study

Meta-analysis: if we count on enough data quality and comparable studies for such analysis

Stochastic / uncertainty analysis / sensitivity analysis

Discussion

We believe that the results of this literature review will provide information on the availability of the studies that have tried to account for the dual burden of zoonoses. The recently developed zDALY methodology provides the possibility to estimate the total societal burden of the zoonotic disease, considering the combined costs of the disease in humans and animals. Estimation of the zDALYs will

provide a good basis for underestimating the dual burden of zoonoses and address the knowledge gap in this area. We presume that only a few studies have calculated zDALYs for zoonotic diseases (10,11).

The zDALYs might represent a breakthrough in the One Health approach. What and how we can improve this integrative approach of zoonoses are still pending, and only with enough evidence we will be able to answer these questions.

We will discuss in detail our findings after conducting the systematic review.

Illustrate the utility of zDALY

List of abbreviations

ALE	Animal Loss Equivalent
DALY	Disability Adjusted Life Years
GNI	Gross National Income
WHO	World Health Organization
YLD	Years Lost due to Disability
YLL	Years of Life Lost
zDALYs	Zoonosis Disability Adjusted Life Years

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

- Conceptualization: LPNZ, DC, SR, SH, PT
- Funding acquisition: LPNZ
- Investigation: LPNZ, DC

- Methodology: LPNZ, DC, SR, SH, PT
- Project administration: LPNZ, DC, PT
- Resources: PT
- Supervision: SR, SH, PT
- Writing – original draft: LPNZ, DC
- Writing – review & editing: LPNZ, DC, SR, SH, PT

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Please, visit the Section of Veterinary Epidemiology website

<https://www.vetepi.uzh.ch/en/aboutus.html>

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