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Evaluating one health: Are we demonstrating effectiveness?

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ABSTRACT

The perceived benefits of a One Health approach are largely hinged on increasing public health efficiency and cost effectiveness through a better understanding of disease risk–through shared control and detection efforts, and results that benefit human, animal and ecosystem health. However, there have been few efforts to identify and systematize One Health metrics to assess these perceived efficiencies. Though emphasis on the evaluation of One Health has increased, widely cited benefits of One Health approaches have mainly been based on modeled projections, rather than outcomes of implemented interventions. We conducted a review of One Health literature to determine the current status of One Health frameworks and case studies reporting One Health metrics. Of 1839 unique papers, only 7 reported quantitative outcomes; these assessments did not follow shared methodology and several reviewed only intermediate outcomes. For others, the effectiveness of One Health approaches was often assumed without supporting evidence or determined subjectively. The absence of a standardized framework to capture metrics across disciplines, even in a generic format, may hinder the more widespread adoption of One Health among stakeholders. We review possible outcome metrics suitable for the future evaluation of One Health, noting the relevance of cost outcomes to the three main disciplines associated with One Health.

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1. Introduction

One Health refers to the health connections among people, animals and our shared ecosystems [1]. Over time this definition has expanded to incorporate food security, poverty, gender equity, and health systems strengthening [1–3]. Incorporating a One Health approach into public health policy is widely expected to increase efficiency and cost-effectiveness by reducing overlap among public health, animal health and ecosystem health sectors. Based on these anticipated benefits, One Health initiatives have been established among intergovernmental organizations [4–7], national agencies in the USA [8], and internationally (e.g. the World Bank's Global Program for Avian Influenza) [9]. This has been supported by new societies [10–12], journals [13,14], and other private sector initiatives [15,16].

These initiatives promote integrated research, surveillance, and control programs and policy frameworks. Given the transboundary nature of people, pathogens, and ecosystems, One Health collaborative partnerships have been set up internationally, e.g. the East African Infectious

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Disease Surveillance network [17], One Health Alliance of South Asia (OHASA) [18], the South East Asian One Health Universities Network [19] and Mekong Basin Disease Surveillance consortium [20]. One Health curricula have been incorporated into public health and veterinary degree programs [21] (e.g. the One Health post-graduate program through the Royal Veterinary College) and One Health research centers and institutes have been formed, such as the One Health Institute at the University of California Davis and the Center for One Health Research at the University of Washington.

Despite these initiatives, there has been little focus on measuring the efficacy, cost-savings, or reduced duplication of effort within One Health programs, and it has been proposed that this hinders more widespread political interest in the approach [22]. Evaluative metrics of interventions in the One Health realm (e.g. rabies, brucellosis, pandemic prevention) such as cost-benefit analysis, cost-effectiveness analysis, or Disability-Adjusted Life Years (DALYs) averted are often derived from models rather than One Health interventions in practice. For example, models from the World Bank project rates of return upwards of 71%—an expected benefit of US$30 billion per year from the prevention of a pandemic—if the international community were to invest up to US$3.4 billion per year in veterinary and human health service capacities [23]. Analysis of rabies in Africa and Asia project that the cost-effectiveness of mass dog rabies vaccination would be US$837 per averted human exposure [24]. A similar analysis of brucellosis in a scenario of 52% reduction through livestock vaccination demonstrated that a total of 49,027 DALYs would be averted with a net present value of US$18.3 million. Whereas contribution between sectors would give a cost-effectiveness of US$19.1 per DALY averted [25]. Another study showed that mitigation is a more cost-effective policy than adaptation programs, saving between US$344.07 and $360.3 billion over the next 100 years if implemented today [26]. While informative, global figures may be too abstract to motivate stakeholder investment on a regional or national scale, and without demonstrated outcomes, it is unclear whether approaches perform to modeled expectations.

Furthermore, a lack of standardized One Health metrics means that there is limited objective evidence on the potential benefits of these programs [27]. In the current paper, we assess a wide scope of One Health literature to capture metrics reported across all outcomes and to identify and analyze new programs that may not have been reviewed by previous authors. We then consider policy recommendations for a more systematic evaluation of One Health across disciplines in an effort to strengthen its integration into the decision-making process.

2. Materials and methods

We conducted a literature review using Scopus, PubMed, and ISI Web of Science searching the term 'One Health', restricting publication date from the formal introduction of the term in the literature (2003) [28] until May 26, 2015, when the literature review was first initiated. References were extracted, their abstracts and articles separated into 'Topical' (One Health referred to as a concept—i.e. the linkages between animals, humans and ecosystems) or 'Non-Topical' (One Health not referred to as a concept). Non-English articles were not reviewed. Articles without an abstract were categorized by title.

'Topical' references were included in a full text review if their abstracts referenced specific One Health research, action (e.g. collaboration, surveillance, zoonotic disease control program integrated across animal-human-ecosystem interface) or case studies. Articles for which full text could not be extracted were excluded. All articles that passed screening were examined by topic, sectors involved, metrics used, policy and regulations implemented, challenges posed, and best practices suggested. Articles that discussed a specific One Health intervention were then categorized based on whether an assessment of their intervention was or was not conducted. Evaluations that were conducted were then identified to be either quantitative or qualitative, and whether demonstrated metrics were intermediate or distinct outcome-based (Fig. 1).

3. Results

A total of 3858 articles were identified: 1333 in Pub Med, 1172 from Web of Science, and 1353 in Scopus. After removing 2019 duplicate papers, 1839 unique papers were included for a primary screening of title and abstract. Of these, 1025 were determined to be 'Non-Topical', seven were printed in a language other than English, and 807 were identified as 'Topical'. Of the 73 'Topical' articles included for full text review, 39 detailed a specific One Health action or intervention. The approach used was evaluated in 15 of these articles, with seven using quantitative metrics to report on a One Health program. Examples demonstrating quantitative cases are given in Table 1.

Programs reporting intermediate inputs were separated from those reporting targeted outcome metrics. Quantitative outcome metrics included data from economic, epidemiological and social assessments. Cost was defined both as direct monetary expenditures for the implementation of control activities (i.e. surveillance, window installation) [29], education programs, treatment costs, epidemiological investigations (i.e. disease outbreak investigations) and indirect losses (i.e. loss of income due to absence from work) [30]. Intermediate epidemiological parameters included number of wildlife sampled, number of water sources sampled monthly [31], and number of disease outbreak and surveillance investigations conducted by residents [32]. Outcome

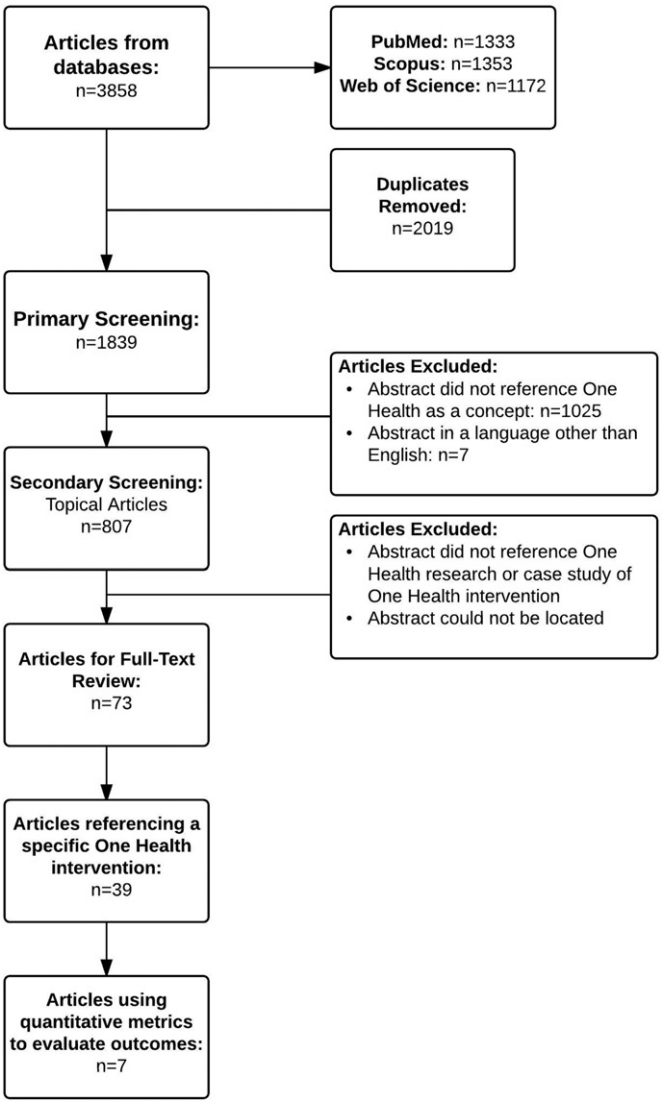

Fig. 1. Flow chart of review of One Health literature.