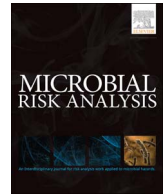




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Estimates of the burden of illnesses related to foodborne pathogens as from the syndromic surveillance data of 2013 in Rwanda

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ABSTRACT

Food related illnesses contribute significantly to the global burden of disease and the estimates of these illnesses are important to develop evidence based food safety policies. However estimating the burden of these illnesses is complex. There is paucity of input data, and developing and sustaining disease surveillance systems that provide the input data is resource-intensive. In most developing countries with relative peace, the initial, faster and cheaper kind of health data is generated through syndromic surveillance. In this study, we estimated the burden of food related clinical features and illnesses (watery diarrhea, bloody diarrhea, suspected cases of cholera and typhoid fever) by making use of various syndromic surveillance data sources in Rwanda. Data sources were the reported cases as by the notifiable surveillance system, an opinion survey with health care providers about the prevalence of clinical features related to foodborne pathogens and over the counter prescription of drugs associated with foodborne illnesses. Study findings indicate that for the year 2013, watery diarrhea occurred all year round as by the surveillance system data, resulting to an estimated 672 (95% credible interval [CrI] 424–932) DALY per million inhabitants, bloody diarrhea was seasonal coinciding with the rainy months and caused an estimated 213 (95% CrI 50–475) DALY per million, typhoid and cholera cases were sporadic with an estimated 73 (95% CrI 57–91) and 1 (95% CrI 0–2) DALY per million respectively. Our DALY estimates from the different data sources were in the same range for combined cases of watery diarrhea, bloody diarrhea and cholera, but significantly different for typhoid fever. The methodology applied in this study can be adopted in resource-scarce settings where most data is from syndromic surveillance (a common phenomenon in most developing countries) other than the desired integrated food chain and laboratory-based surveillance systems, to pave way for future improved estimates of the burden of foodborne illnesses.

1. Introduction

Worldwide, foodborne illnesses are a threat to public health and social-economic development. Causes of food borne illnesses include bacteria, parasites, viruses, toxins, metals, and prions (Thomas et al., 2013; Havelaar et al., 2015) but the risk due to microbiological agents is higher due to their ability to emerge, re-emerge and adapt to various niches (Lasky, 2002). Foodborne illnesses are usually characterised by acute conditions like gastroenteritis and in some cases by long term sequelae such as hemolytic uremic syndrome (due to shiga toxin-

producing *Escherichia coli*), Guillain-Barré syndrome (*Campylobacter* spp.), or central nervous system (CNS) abnormalities (*Listeria monocytogenes*) (Havelaar et al., 2015). Other associated long-term sequelae also include chronic arthritis (*Campylobacter* spp., *Shigella* spp. and *Salmonella* spp. can be involved); mental retardation, seizures, paralysis, blindness, or deafness (*L. monocytogenes*); the incurable irritable bowel syndrome (IBS) (bacterial pathogens) and mental retardation and crossed eyes in newborns (*Toxoplasma gondii*) (US FDA, 2012). Recently colon cancer has been associated with severe *Salmonella* spp. infections (Mughini-Gras et al., 2018). In addition, foodborne illness may also

Abbreviations: OTC, Over the counter drug sales; HCPs, Health care providers; RBC, Rwanda Biomedical Centre; RSSB, Rwanda Social Security Board; NISR, National Institute of Statistics Rwanda; ORS, Oral Rehydration Salts; MoH, Ministry of Health; DW, Disability Weight

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exacerbate other underlying medical conditions (Barton Behravesh et al., 2011).

While infectious diseases like malaria, HIV/AIDS and tuberculosis (“the big three”) continue to dominate the agenda of health programmes in most African countries (Sidibé et al., 2012), it has been estimated that foodborne illnesses comparably and significantly contribute to the overall burden of disease (Havelaar et al., 2015). Estimates from the World Health Organisation (WHO) in 2010 indicate that 31% of the 33 million Disability Adjusted Life Years (DALYs) lost globally due to 31 foodborne hazards was from sub-Saharan Africa with diarrheal disease agents causing nearly 70% of this burden (Havelaar et al., 2015). Studies on costs of foodborne illnesses from the USA (Hoffmann et al., 2015; Minor et al., 2015; Montgomery, 2015) reported economic losses estimated at 0.1 to 0.2% the national gross domestic product (GDP) in 2015 due to productivity and medical care costs (Scharff, 2012). Estimated costs due to diarrhea in Rwanda in the year 2000 were in the range of 2.5 to 5% of the GDP (von Witzke et al., 2005).

To implement effective control measures, risk managers need information on the magnitude of the burden of foodborne illnesses in order to prioritise, develop and implement risk based food safety policies (Wallace et al., 2010). However, assessing the burden of foodborne illness is complex. First, disease surveillance systems that provide the data used in these assessments are resource-intensive and to date all countries are still developing their systems (Janati et al., 2015). Second, a number of acute foodborne illnesses are self-limiting, implying that some patients do not seek medical care and as a consequence, the real burden is underreported (Gibbons et al., 2014; MacDougall et al., 2008; Majowicz et al., 2005). Third, many pathogens that are usually associated with food can also be transmitted from the environment or from direct contact with animals or infected persons (Gkogka et al., 2011; Havelaar et al., 2012). Cognizant of this complexity, the WHO through the Foodborne Disease Burden Epidemiology Reference Group (FERG) has encouraged national and international studies to assess the burden of foodborne illness. The FERG and volunteer researchers have since adopted the DALY (disability adjusted life year) concept to summarise and rank diseases. The DALY is a measure that combines the Years of Life Lost due to premature death (YLL) and the Years Lost due to Disability (YLD) from a disease or condition, for varying degrees of severity, making time itself the common metric for death and disability (Torgerson et al., 2015). Studies on food borne illnesses at a global level

(Havelaar et al., 2015; Murray and Lopez, 1997), provide world estimates but with many assumptions due to paucity of data. At country level, most studies come from the developed countries with elaborate disease surveillance systems *i.e.* England (Adak et al., 2002), USA (Scallan et al., 2011), Netherlands (Havelaar et al., 2012), Greece (Gkogka et al., 2011) and Canada (Thomas et al., 2013). More studies on the burden foodborne illnesses from developing countries are required, however, availability of disease surveillance data to use in these studies is still among the major challenges. Syndromic surveillance data that are collected by using standard case definitions of clinical features like watery diarrhea and suspected cases of illnesses (typhoid fever) without laboratory diagnosis or from surrogate data sources (*viz.* over-the-counter prescription sales, opinion of health care providers) can provide a cheaper and fast data option (WHO, 2012; Nsubuga et al., 2006).

In this study, we provided insight into- and estimated DALYs for foodborne illnesses in Rwanda using syndromic surveillance data of 2013 as a reference year, presented a methodology and also identified data gaps to contribute to future improved estimates in Rwanda and other developing countries. Because of the kind of data used in this study *i.e.* non-laboratory confirmed cases and surrogate health data, the term “foodborne illnesses” should be used with caution and hereafter replaced with “food related illnesses”. (Further definitions are provided as supplementary material in the glossary, Appendix A).

2. Methods

2.1. Study approach

Fig. 1 shows the approach used to investigate the burden of food related illnesses in Rwanda. Our study was based on the syndromic surveillance data aspects explained by the WHO manual for integrated foodborne disease surveillance in the WHO Africa Region (WHO, 2012). Data from the opinion survey with health care providers (HCPs), the national notifiable surveillance system, and over the counter (OTC) drug prescriptions were used to show trends and estimates of YLL, YLD and DALY for food related- clinical features and illnesses. Clinical features (watery diarrhea and bloody diarrhea), and illnesses (cholera and typhoid fever) related to foodborne pathogens were investigated. For cholera and typhoid fever illnesses, this study was based on suspected cases. Standard case definitions of watery diarrhea, bloody diarrhea

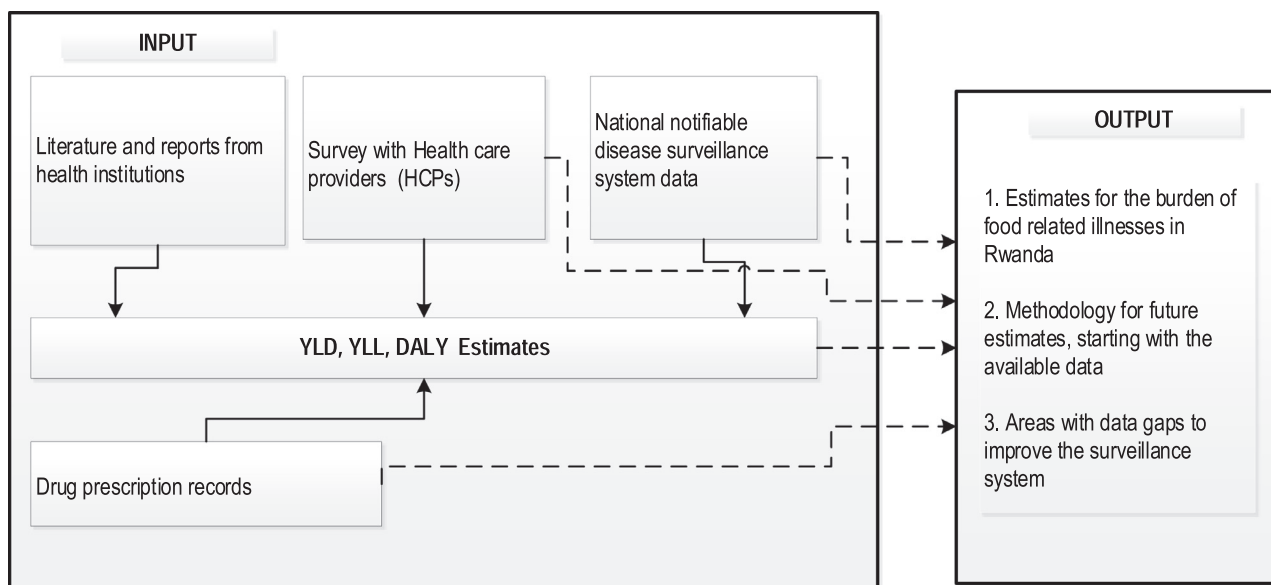


Fig. 1. Study approach and data sources (inputs) used in this study. YLD, years lived with disability for prevalent cases of illness; YLL, years of life lost due to premature death caused by illness in the population; DALY = (YLD + YLL), disability-adjusted life years.

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