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Annotated Bibliography

1. **Models for estimating projections for disease prevalence and burden: a systematic review focusing on chronic obstructive pulmonary disease.**

This journal article focuses on a series of epidemiological models that estimate the prevalence and burden of obstructive pulmonary disease from studies conducted all over the world. Data was collected from the World Health Organization, CAB Abstracts, Medline, and Embase databases that had models produced over a span of 33 years (1980-2013). Across all 22 models that were reviewed, many modes of calculation were employed, including "mortality, demographics, and risk factors or Markov-type modelling and microsimulation modelling" (McLean 246).

The impact of this study is far reaching as it was crucial to governmental policy-making. Health - the overarching concern and focal point of this study - is crucial to human development and one that Amartya Sen regards as a fundamental freedom that is strongly connected to social and economic arrangements. At the time this study was conducted, governments were taking substantial steps to understand the burden of this disease and the actions needed to move forward with planned improvements to healthcare.

As with any study, there were challenges facing researchers when looking at models. Seven different criteria had to be met in order to properly evaluate each epidemiological model; the disease had to be explicitly defined, every source of data needed to be correctly recorded to ensure legitimacy, the methods of data collection for each model needed to be documented for subsequent researchers, and a strong understanding of the techniques employed by each study such as the Markov model. Furthermore, the time frame is important to consider when interpreting the data. Researchers had to decide whether they were going to make estimates based on past data or project trends in the future based on data from the present. Another important factor was sensitivity analysis which is "where the inputs of the model are altered by a threshold amount, e.g. 10% and the model re-run to see the effect on the output" (247). Lastly, it is critical that models are compared to extensive prevalence survey results.

The main question this study aimed to answer and investigate was not the success of these models, but to estimate "incidence, prevalence, disease burden and mortality" (247) of COPD. At the end of the study, 6 models were found to have scored the highest in terms of reporting conditions. One particular model of focus was the Atsou smoking burden model which was a type of Markov model that focused on the stages of COPD: mild, moderate, severe, and very severe, and was designed to determine what affect the discontinuance of smoking would have on the life expectancy of a COPD patient. In this model, the development of one stage of severity to the next was changed, and the transition from "the mortality and exacerbation rates" to "the costs of COPD management" (249). Analyses revealed sensitivity to the progression rates from one severity stage to another and an overall mortality rate increase. One of the most integral findings that came from this study results from the Atsou model which decisively displays the potential increase of life expectancy in COPD patients who cease smoking.

The epidemiological models focused on COPD are pivotal to advancement in each of the individual populations studied by these models and health on a global scale. Policy-makers are able to use the data collected to pursue a greater development of freedom within societies.

This study presented a narrow focus on just one health issue but the problem with this is the lack of services that governments are able to provide. Policy-makers are largely left in the dark about the disease burden estimation and there aren't adequate measures in place to help decrease mortality rates and increase life expectancy.

2. **Estimating the Burden of Acute Gastroenteritis, Foodborne Disease, and Pathogens Commonly Transmitted by Food: An International Review.**

There is an alarming increase in foodborne diseases that can be seen across the world, however estimates of these burdens are scarce. More specifically, acute gastroenteritis has presented an enormous problem that has greatly contributed to the problem of food safety and public health. The purpose of this study is to estimate, at the global level, the degree to which this is a problem. Already, there are certain challenges as it is nearly impossible to link every illness to food definitively. The World Health Organization has made many efforts to establish what they call, sentinel sites, in locations with few estimates. Four subsets of surveillance systems were outlined, with each system being ranked depending on the efficiency of it to come up with data on foodborne disease. Sentinel sites were determined based on categories , with category 3 and 4 surveillance systems being chosen for the studies. Jordan was chosen first to have a population study in which in-person interviews were conducted to count the number of

persons with continuous diarrhea, fever, those needing medical assistance, and those who sent in stool and blood samples.

The next part of the study focused on national-level initiatives of six different countries: England, The Netherlands, United States, Australia, Canada, and Ireland/Northern Ireland. Two types of studies – cross-sectional surveys and prospective cohort studies - were conducted in order to display pathogen-specific incidence rates for each community and self-reported cases of acute gastroenteritis on the individual level. Prospective cohort studies are expensive and complex, whereas cross-sectional surveys are less expensive and more simple. England was of particular interest as the study conducted there was one of population based. The two goals of this study were to estimate the number of acute gastroenteritis cases and the number of persons consistently sending stool samples to be analyzed as well as comparing the total etiology and number of cases with the data from their national laboratory. Each year, 20% of England's population had acute gastroenteritis. In 1992, there were 2.9 million foodborne illness cases and in 2000, there were 1.3 million cases. Presently, models have been made to assess different food types and estimate the burden and risk of disease coming from them. The pathogen-specific burdens were calculated based on the sources of outbreaks and the percentages associated with each food type. Very similar studies were conducted across all six countries. In the United States, over 450 laboratories were studied using active surveillance. This active surveillance collected data on practices of these laboratories and physicians. Just as in England, cross-sectional surveys were conducted to look at communities more closely and what proportion of people were seeking medical care and those who were sending in stool samples to be analyzed. It was found that of the 76 million cases of foodborne illness seen each year in the US, only 18% have known etiology.

As can be seen from the models in each of these countries, there is a global foodborne disease issue. The number of acute gastroenteritis cases is estimated to be significantly lower than is indicative of the true burden of foodborne illnesses. This is because many people are undiagnosed as they never seek medical and they never submit stool samples to be tested. Because of this underestimation, prospective cohort studies are the most consistent way to estimate pathogen-specific disease burden. This study conducted shed light on the elements that future studies should have in order to accurately estimate the burdens and risks. Immunity is an important variable when considering burden estimates. It is also important to note that without adequate surveillance, estimates can be hard to develop, so in countries with limited understanding of foodborne disease data, causes of acute gastroenteritis cases will be hard to determine. This problem poses a barrier to Amarya Sen's definition of development which is having the freedom to In conclusion, the socioeconomic burden of these foodborne diseases could be greatly reduced with the growing collection and analysis of data from these studies.

3. The Effect of Arsenic Mitigation Interventions on Disease Burden in Bangladesh.

Across Bangladesh, little is known about the burden of arsenic contamination. This study aimed to estimate the mitigation measures and whether those interventions would be more beneficial than harmful. Of great importance in this study was the comparison of arsenic-related disease and infectious water-borne disease as the impact of the interventions is largely unknown. These burdens hit Bangladesh severely because health-care is not as accessible there as it is in more developed countries, fatalities from arsenic exposure are extremely high there, and they do not have the capacity to record the data on cases.

Two endpoints (also risk factors) - arsenic-related diseases and infectious water-borne diseases - were compared using "mortality rates and DALYs lost for endpoints related to these two risk factors" (Lokuge 1172). DALYs (Disability-adjusted life years) is a measure that takes into account risk factors and decisive endpoints to determine disease burden. The use of DALYs allows for overall arsenic-related infections to be compared with other causes of disease across Bangladesh. "The calculated exposure and disease-specific attributable fractions were then applied to relevant background estimates to obtain the total disease burden due to the factors under study" (1172).

The burden of nine categories were specifically studied; Arsenic exposure, arsenic-related endpoints, non-included end points, calculation of "arsenic related attributable fraction of disease (1173), arsenic-associated cancers, arsenic-related noncancer effects, infectious-water diseases, risks associated with a shift in water supply, mortalities caused by diarrheal disease. Extremely significant among these specific focuses was arsenic exposure disease burden. To calculate this burden, researchers assumed that (1) the age structure of the group who was exposed to arsenic was comparable to the surveyed BDHS population from 1999-2000, (2) the respective population numbers of every *thana* subunit was analogous to the national census conducted in 1991, and (3) that the water in the tube wells was the cause of the exposure. The total number of various arsenic-level exposures was calculated "by using the distribution of arsenic exposure" (1173). A series of tables associated with each category was presented. Table 1 displays the different levels of arsenic exposures and their respective mean and median concentrations of arsenic. The most important results of this study include the estimates of arsenic exposure alone and the actual disease burden from it. However, without looking at these in the context of other endpoints and risk factors, the results are largely

meaningless. Estimates also need to be made for diarrheal risk, burden of arsenic-related diarrhea as well as the potential diarrheal risks that come from these interventions.

The problem this study addresses is different from that of the other studies relating to precision epidemiology and disease burden estimation. This study conducted was focused much more specifically on assessing the interventions themselves. No other studies placed as strong of an emphasis on the capacity for these interventions to have adverse effects on arsenic exposure cases. All other studies concentrated mainly on what improvements would come out of these models.

At the conclusion of this study, it was clear that the data on the disease burden was biased towards the theory that arsenic mitigation is more beneficial rather than harmful. However, there may be negative implications that come with arsenic-related interventions and that is the potential increase in infectious water-related diseases. If the interventions made are not sufficient, then they may have a more negative effect than no interventions at all. This study only scratched the surface on the need for more evaluative studies of arsenic mitigation. In developing countries such as Bangladesh, such interventions are crucial to the social and economic freedoms, such as sufficient access to healthcare, Amartya Sen deems every individual in the population should have.

4. **Estimating the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level**

Just as in the previous study of arsenic exposures, this study also employed the disability-adjusted life year to compare the burden of water, sanitation, and hygiene to the burden of non-related diseases/risk factors. A study like this is crucial to the development of public

health all across the world. The burden of disease from these 3 risk factors is one of the greatest challenges that is still faced in the modern world. Amartya Sen, in his *Development as Freedom*, discusses how one of the biggest unfreedoms that inhibits development is limited healthcare. Many people around the world do not have sufficient access to clean water or basic sanitation and hygiene necessities.

The defined risk factor – water, sanitation, and hygiene – has several transmission pathways that include the transmission through consumption of water, limited water supply for hygiene, "poor personal, domestic, or agricultural hygiene" (Prüss 537), contact with water, airborne from contaminated water systems, and transmission through stagnant bodies of water. The problem of disease from this risk factor is evident in the fact that 11.7% of deaths came from a deficient supply of water which directly led to malnutrition. In this study, several different contributors to the burden of disease from water, sanitation and hygiene were presented. Infectious diarrhea is the biggest of these contributors, however it can also be attributed to food and airborne disease. This leads into the point about researcher's decision to attribute "the population to typical exposure or situation scenarios" (538). Six scenarios were presented with tables associated with the amount of fecal-oral pathogen loads in the environment. The most optimal scenario is designated a relative risk (RR). The RRs between each of the scenarios were calculated and through the subtraction of the number of gastrointestinal illnesses in the US that are foodborne from the total number of person-to-person transmissions of illness through viruses in the air, it was found that the risk factor accounted for 60% of diseases. In scenario II, the majority of disease transmission was from land to water where the sewage system did not adequately prevent contamination of the drinking water.

To adequately estimate the burden of this disease in scenarios, two approaches were taken. A more conservative estimate accounts for only personal hygiene and the improvement it attains, rather than all factors combined. The more practical and likely estimate accounts for the impact clean drinking water has on total improvements. When looking at other water, sanitation, and hygiene related diseases, all data on the distribution of exposures within the population were added to the diarrheal disease figures, to determine total burden of illness. An overall incidence rate was calculated for each region which led to a baseline incidence rate. This is significant because the baseline incidence rate is what you would expect to see in the optimal or ideal scenario.

A series of results were obtained from this study, one of the most important being that in developing regions, "the disease burden can be up to 240 times higher" (541) than it would be in a developed region. Another important result with a strong correlation to Amartya's Sen is the disproportionate effects, "diseases related to water sanitation, and hygiene have on poorer members of society" (541). This is an immense unfreedom that Amartya Sen would define as an inhibitor to human development. This revised approach of combining the disease burden from diarrhea with the disease burden from water, sanitation, and hygiene, helps policy-makers to target more specifically, the reduction of fecal-oral diseases.

Works cited

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