CHIA
Chronicles of Health Impact Assessment
Improving community health through health impact assessments

June 2018 VOLUME 3 ISSUE 1

LETTER FROM THE EDITOR

We are glad we continue to have a mixture of U.S. and internationally based HIA articles being submitted to the Chronicles of Health Impact Assessment journal. We would like to encourage others to provide "tips from the field" or practical suggestions that you have found to be helpful in your HIA work.

We will be trying a new process this year of having two issues. Our second issue will have guest editors who will be recruiting active transportation related HIA studies and information. Quite a few people responded to our request for guest editors, so we will be using those volunteers in future issues. If you do HIA work in active transportation, please consider submitting your work by July 30, 2018. If you would like to assist by providing peer review of these articles please let us know that as well.

I also want to report that the Chronicles of Health Impact Assessment has been accepted into the Directory of Open Access Journals (DOAJ). This is great news as they have stringent criteria for indexing and most libraries/ researchers use the DOAJ to identify high-quality open access journals. This is one step closer to CHIA being indexed in PubMed, when enough content has been published.

I want to thank all of our editorial board members for their support and assistance and all who provided peer reviews for this issue. We also had an Undergraduate Service Learning Assistant Danielle Boberschmidt, who assisted us with this issue and I want to recognize her contributions as well.

Enjoy your summer.

Cynthia Stone, DrPH, RN
CHIA Editor-in-Chief

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LETTER FROM THE SOCIETY OF PRACTITIONERS OF HEALTH IMPACT ASSESSMENT

The articles contained in this issue highlight diverse aspects of HIA practice, including how HIAs can be used to demonstrate the interconnected nature of social, environmental, and economic effects from decisions; the role of legislators in exploring policies to support the use of HIA; and how the field can equip students to do community-engaged HIA practice. A key principle underlying the work highlighted in these articles is equity. It is well documented that health inequities are the result of social, economic and environmental disadvantages. Therefore, advancing equity involves identifying and improving those conditions that create avoidable, unfair, and unjust differences in health.

HIA has been promoted as a tool to address health equity by selecting policies, programs or projects that affect the health of the most vulnerable or disadvantaged populations; engaging community members in decisions that affect their health and well-being; increasing the transparency of evidence generation and the decision-making process; and by creating recommendations that improve health equity and reduce disparities.

HIA practitioners work to integrate equity into the HIA process by ensuring broad community participation in the HIA's planning, organizing and implementation; promoting representation of the communities most affected by the decision; making decisions through a collaborative processes; and respecting the beliefs, culture, perspectives, and histories of disadvantaged communities.

In addition to these great practices, the field has more to learn about how it can advance health equity through HIA work across the globe. The Chronicles of Health Impact Assessment provides a critical vehicle for documenting and sharing best practices. We hope the ideas and recommendations provided through this issue inspire your continuing efforts to advance health equity through your work.

Sincerely,

Susan Sutherland
Vice President of Development, Society of Practitioners of Health Impact Assessment (SOPHIA)

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ABOUT THE JOURNAL

A Health Impact Assessment (HIA) is a systematic process that uses a variety of data sources and analytic methods and input from community stakeholders to determine the potential health effects of a proposed policy, program, or plan. HIAs provide recommendations to decision makers on how to adjust the policy or program to minimize negative health effects and increase potential positive health benefits.

The editorial board and staff of CHIA strive to give expression to health impact assessment research and scholarship while serving the public health profession.

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TRACKING STATE-LEVEL HEALTH IMPACT ASSESSMENT LEGISLATION FROM 2012-2016

Joshua Waimberg, JD; Lindsay K. Cloud, JD; Andrew T. Campbell, JD; Ruth Lindberg, MPH, MUP; Keshia Pollack Porter, PhD, MPH

Abstract:

Background: Scientifically constructed, open source legal datasets that capture key features of state legislative activity can be used for evaluation, and to identify trends in law across jurisdictions and over time.

Methods: Using policy surveillance methods, a team of legal researchers collected and analyzed state-level Health Impact Assessment (HIA) legislation across 50 U.S. states and Washington, D.C. between January 1, 2012 and December 31, 2016. One dataset captures the characteristics of all HIA bills that were introduced but not enacted during the period of the study. The second dataset captures the characteristics of all HIA laws, including statutes and regulations that were enacted or amended during the period of the study.

Results: Between January 1, 2012 and December 31, 2016, 40 HIA bills were introduced but not enacted, and three HIA laws were enacted or amended. Notable trends include: greater legislative activity was observed in the Northeastern United States as compared to the rest of the country; a majority of HIA legislation was proposed by Democratic members of state government; HIA mandates were promulgated through state agency rulemaking process more frequently than the legislative process; and most of the proposed legislation provided no explicit source of funding to implement HIAs within the legislative text.

Conclusion: Evaluation research is necessary to understand the factors that drive the success and failure of HIA legislation, and its impact when applied to decision-making, health determinants and outcomes, and health equity.

Introduction

State policymakers recognize that decisions made in housing, criminal justice, and education also affect public health and state health care spending — spending that amounts to hundreds of billions of dollars each year across the United States (Marmot, M. & Allen, J., 2014; The Pew Charitable Trusts and John D. and Catherine T. MacArthur Foundation, 2016). As legislators aim to reduce costs and improve population health, some are exploring how Health Impact Assessments (HIAs), which assess the potential public health effects of a proposed decision, could be used to better inform state-level decision-making. One straightforward way that legislators can promote HIAs is to require or encourage the practice through legislation.

The impact of HIA legislation on government practice, policy making, and social outcomes has not been evaluated. In order to gain a deeper understanding of HIA legislation, and to support evaluation of its implementation and effects, this research captures and analyzes trends in requiring, encouraging, or incentivizing the use of an HIA, including legislation requiring the use of HIA as a tool and HIAs addressing state-level policy, between January 1, 2012 and December 31, 2016.

To examine the full legal landscape of HIA legislation, the bills research included collecting bills that were introduced and failed, and those that were introduced but still under consideration on December 31, 2016. The laws research included collecting legislation that was enacted or amended during the period of the study. Bills were identified independently from laws because identification and analysis of failed or stalled efforts to implement HIA legislation, in conjunction with the analysis of the successful laws, allows for a comprehensive understanding of state-level HIA policy activity, or lack thereof. This article summarizes HIA legislative activity, notes key patterns and trends, and highlights the need for additional research to evaluate the impact of laws on population health.

Background

HIA is a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population (Quigley, et al., 2006). HIAs provide recommendations on monitoring and managing those effects (Quigley, et al., 2006). The formal elements of an HIA include screening of the need for and value of conducting an HIA, scoping and creation of objectives, assessment of the baseline health status of affected populations, inclusion of recommendations, reporting on the findings, and the monitoring and evaluation of its results. (National Research Council, 2011). HIAs provide pragmatic, evidence-informed recommendations about how to modify the proposed action to reduce risks and promote benefits, as well as provide recommendations on monitoring health effects after implementation (National Research Council, 2011). HIAs also examine whether and to what extent decisions could reduce health disparities and improve health equity.

A total of 419 HIAs have been conducted in the United States as of June 2017 (The Pew Charitable Trusts, 2015). They have aimed to inform decision-making at the federal, state, and local levels in a range of sectors, including agriculture, criminal justice, labor and employment, education, transportation, and housing (The Pew Charitable Trusts, 2015). Approximately 18% of these 419 HIAs (n=76) focused on state-level policy decisions (The Pew Charitable Trusts, 2015). These HIAs examined state legislation, such as paid sick leave and food tax policies; state programs or regulations and their implementation, such as housing inspection and tax credit grant programs; and projects by state-level decision-makers, such as highway design and redevelopment (The Pew Charitable Trusts, 2015).

Prior research by the National Conference of State Legislatures (NCSL) identified 56 bills that were introduced in 17 states between January 2009 and May 2014 that would require some consideration of health effects in decision-making (National Conference of State Legislatures, 2014). Most of these bills, however, did not meet the formal definition of an HIA (Health Impact Project, 2015; National Conference of State Legislatures, 2014). NCSL's analysis found eight states that considered legislation that required or encouraged assessments that met most, but not all, requirements of a formal HIA. Policymakers in three of these eight states ¬— Massachusetts, Vermont, and Washington — enacted legislation that ranged in scope from requiring an HIA for a specific bridge replacement project, to establishing the use of HIAs to determine the health effects of state transportation projects.

In 2016, through a grant from the Health Impact Project — a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts — the Policy Surveillance Program of the Center for Public Health Law Research at Temple University developed two longitudinal datasets in order to create a comprehensive and systematic study of recent HIA legislative activity.

This study, which builds on the research conducted by NCSL from 2009-2014 (National Conference of State Legislatures, 2014), illuminates the variation that exists in successful, unsuccessful, and pending HIA legislation across the 50 U.S. states and Washington, D.C., from 2012 to 2016 as it pertains to HIA requirements, techniques, and various sectors and industries.

Methods

The research team used the methods outlined in Anderson et al., (2013) as a foundation to develop a policy surveillance mapping study on HIA legislation. Policy surveillance, one form of scientific legal mapping, is the ongoing, systematic collection, analysis, and dissemination of policies across jurisdictions, and over time (Burris, 2014). The HIA study focused on state-level HIA legislation from January 1, 2012 to December 31, 2016 across the United States. The research team created two distinct datasets. One dataset, HIA Bills, captures characteristics of all HIA bills that were introduced but not enacted during the time period of the study. The second dataset, HIA Laws, captures the characteristics of all HIA laws that were enacted or amended during the period of the study. For the purposes of the study, both statutes and regulations were included as laws. The research team consisted of two legal researchers and one legal supervisor from the Policy Surveillance Program of the Center for Public Health Law Research at Temple University who collaborated with two subject matter experts from the Health Impact Project.

The researchers included policies that explicitly use the term "health impact assessment(s)" within the legal text, and/or include the six formal elements of an HIA. Policies that did not meet the inclusion criteria were excluded, including legislation requiring only health risk assessments, community health assessments, or proposals where vague references to assessing public health impacts were discussed.

The researchers identified and recorded citations of relevant bills and laws (including statutes and regulations) from Westlaw, a legal research database. The researchers developed search strings and conducted keyword searches for each dataset: "TE(health /5 (assessment or impact or review))"; "health and impact and assessment"; and "health and impact and review." When these searches yielded a relevant bill or law, the researchers examined the table of contents to determine if any of the surrounding statutes or regulations were also relevant. The researchers supplemented keyword searches by consulting secondary sources. For quality control, the team conducted redundant research, in which each researcher independently identified and recorded relevant citations for each jurisdiction. The supervisor then compared the research to identify and resolve all divergences (or differences in research results) between the original and redundant research. Once the citation

list was finalized, the researchers collected the legal text from each state legislature's website. This research process was repeated in batches of ten states at a time until all relevant bills and laws were collected. HIA bills that were separately proposed in each chamber of the state legislature were individually collected. However, if there were multiple versions of the same bill, the researchers collected the most recent version of the bill that included the HIA requirement.

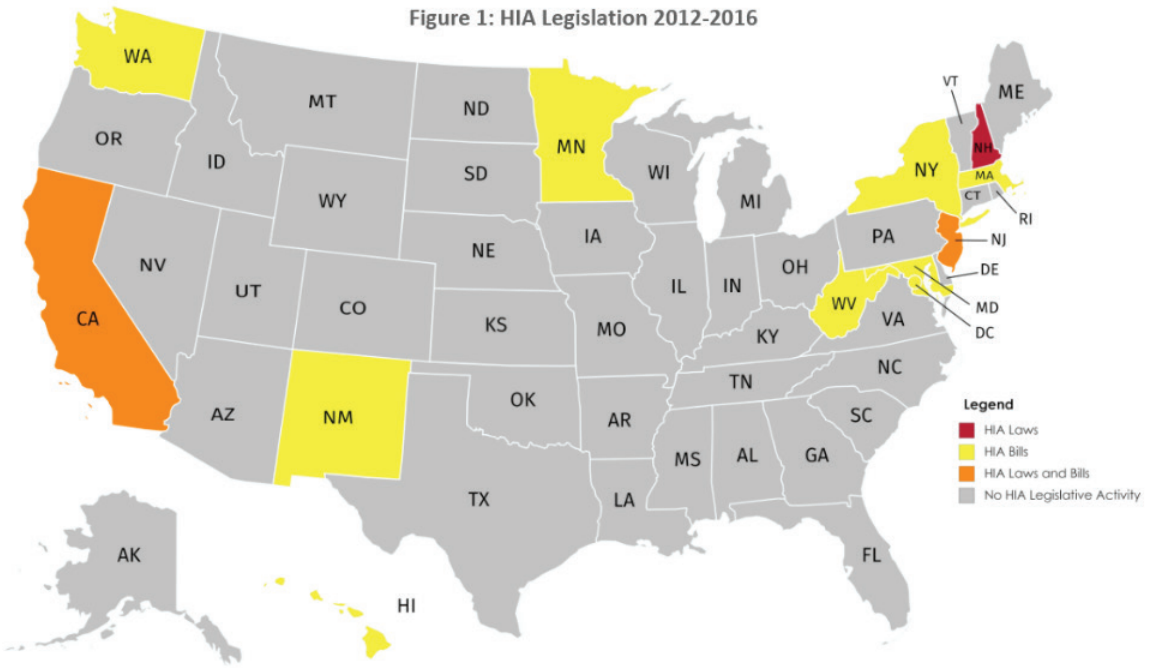
The team developed a list of constructs, or important features of the policies, based on the policies collected for the first ten states. Coding questions were drafted from the list of constructs in order to observe the policies' characteristics. HIA experts reviewed and refined the coding questions to ensure that the key elements of the policies were captured within the coding scheme. Once the questions were finalized, the team entered them into MonQcleSM, a coding-software platform.

Each jurisdiction was independently coded by two legal researchers. The supervisor compared the results and the team resolved discrepancies through discussion and consultation with HIA experts. The team developed a research protocol to record the divergence rates and outline the coding scheme, definitions, and scoping parameters, including inclusion and exclusion criteria. Each dataset contains downloadable text of the policies, an interactive map and table, summary report, research protocol, codebook, and empirical legal data (Policy Surveillance Program, 2017a; Policy Surveillance Program, 2017b).

Results

Between January 1, 2012 and December 31, 2016, 40 bills were introduced but not passed in the 51 jurisdictions (50 states and the District of Columbia) surveyed across the United States. These 40 HIA bills were introduced in 11 jurisdictions (Fig. 1; Policy Surveillance Program, 2017a). Of the 40 bills, seven were introduced in 2012, ten in 2013, four in 2014, 14 in 2015, and five in 2016. During this period, one law was enacted in California in 2015, one regulation was readopted in New Jersey in 2014, and one regulation was amended in New Hampshire in 2016 (Fig. 1; Policy Surveillance Program, 2017b).

Figure 1: HIA Legislation 2012-2016



The collected bills and laws varied in focus and scope. Some legislation proposed that an HIA be conducted for a specific project, such as 2016 MD H.B. 363, which required that an HIA be conducted by a specific date on the deployment of smart meters across Maryland. Some proposed legislation would have mandated the use of an HIA for specific activities conducted within the state. For example, 2015 NY S.B. 902 proposed that an HIA be conducted for all horizontal gas drilling and high-volume hydraulic fracturing activities in New York, while 2015 MN H.F. 3261 proposed that an HIA be conducted for projects involving clear-cutting in Minnesota. Other legislation had a broader focus, such as 2014 NM S.B. 48, which proposed that an HIA be conducted whenever a construction or development project in New Mexico would require an environmental assessment pursuant to state or federal law.

The study shows how state legislatures' approaches compare to each other, and thereby lays the groundwork for studies evaluating the implementation of state-mandated HIAs and the potential impact of such legislation on public health. The following sub-sections describe the key trends and features of HIA legislation from 2012-2016 captured by the study.

HIA Required

Some legislation mandates an HIA in order to assess a program or activity's public health impacts, while others only encourage their use (Health Impact Project, 2015). Of the 40 HIA bills analyzed, 37 (92.5%) required that an HIA be conducted, as opposed to simply encouraging the use of an HIA.

All three (100%) of the enacted HIA laws required, as opposed to encouraged, that an HIA be conducted.

Political Affiliation

Political affiliation of the sponsor may correlate with HIA legislative activity (Wismar, et al, 2007). Democratic members of state legislatures introduced more HIA legislation than representatives from other political parties. Democrats introduced 30 (75%) of the 40 HIA bills, while four (10%) bills were introduced by Republicans, and one (2.5%) was introduced by an Independent legislator. Three (7.5%) bills were sponsored by a combination of Republican and Democratic legislators. HIA provisions were included in two budget bills (5%) with no named sponsor.

A Democratic state senator initially introduced California's enacted law. New Jersey's administrative regulation was readopted under a Republican governor, and New Hampshire's regulation was amended under a Democratic governor.

Geographic Location

Although non-legislative HIAs have been conducted in nearly all states (The Pew Charitable Trusts, 2015), legislative activity to mandate or encourage HIAs was concentrated in specific geographic regions in the study's period. Twenty-four (60%) bills were introduced in the Northeastern United States, with the majority originating in New York and Massachusetts. States in the Midwest followed with seven (17.5%) bills and the Southern states introduced five (12.5%) bills. States in the West proposed three (7.5%) bills, while only one (2.5%) bill came from the Southwest.

Two (66.7%) of the three states that enacted an HIA law are located in the Northeastern United States, in New Jersey and New Hampshire. The third HIA law was passed in the West, in California.

Sectors Specified

The research team classified HIA legislation based on the various sectors and industries that are generally targeted in HIA legislation in order to determine whether HIAs are more commonly used to address decisions within specific sectors (National Conference of State Legislatures, 2014). The sectors were selected based

on the North American Industry Classification System (U.S. Census Bureau, 2017). The 40 HIA bills required their proposed HIAs to apply in seven distinct sectors. Environment – not including agriculture or oil and gas – was included most frequently, with 17 (42.5%) bills focused on issues in that sector, such as air and water, waste facilities, or forestry. Oil and gas was the focus in 10 (25%) of the HIA bills, the transportation sector accounted for six (15%) of the 40 bills, and the remaining bills were targeting other sectors including two in health care (5%), two in construction (5%), two in education (5%), and one in agriculture (2.5%). Three (7.5%) bills did not apply to a specific sector.

Each of the three enacted HIA laws targeted specific sectors. California's law requires HIAs in the health care sector; New Jersey's regulation applies to the environmental sector; and New Hampshire's regulation applies to oil and gas.

Organizations Required to Conduct HIA

HIA legislation generally specifies the organization that is required to conduct the required or encouraged HIA (National Conference of State Legislatures, 2014). In this study, twenty (50%) of the HIA bills tasked their state's department of health to conduct the HIA. A public health program within a local university was explicitly mentioned in eight (20%) of the bills. Local governments were required to conduct the mandated HIA in five (12.5%) bills. Three (7.5%) of the bills required a private, non-government contractor to conduct the HIA. The remaining organizations included private entities (2 bills, 5%), a specific committee or task force (2 bills, 5%), the department of transportation (2 bills, 5%) and the department of environment (1 bill, 2.5%).

California's HIA law requires that the California Health Benefit Review Program, a program established by the University of California (local university public health program), conduct the HIA. New Jersey's regulation requires the HIA be conducted by a private entity seeking permit approval, while New Hampshire's regulation requires that an independent health and safety expert, (private, non-government contractor) conduct the HIA.

Methods Used in Conducting the HIA

The HIA process can be accomplished using a variety of methods, including risk assessments, population analysis, and expert opinion (National Research Council, 2011). Twenty (50%) of the collected HIA bills required that the entity managing the HIA conduct their own original research, data collection, and analysis. Other methods that are required within the HIA bills include risk assessments in 10 (25%) bills, population analysis in nine (22.5%), literature review in nine (22.5%), and stakeholder engagement in eight (20%). Expert opinion was required in six (15%) bills, while secondary data analysis was only specified in two (5%) bills. Notably, 14 (35%) bills did not require any specific methods be followed while implementing the HIAs.

California's HIA law requires original research and data collection, expert opinion, and policy analysis. New Jersey's HIA law requires original research and data collection, risk assessment, and secondary data analysis, and New Hampshire requires just risk assessment and expert opinion.

Funding Mechanism

The provision of funding is an important practical consideration in HIA legislation (National Conference of State Legislatures, 2014). Of the HIA bills, 10 (25%) included a funding mechanism within the language of the bill, while 28 (70%) of the bills did not mandate any funding for the required HIAs within the legislative text. Two of the bills (5%) did not require governmental funding, but did mandate that a private entity that is required to conduct an HIA fund such an HIA on its own.

Of the three states that passed or amended HIA laws, only California creates a funding mechanism for HIAs, requiring that the Health Care Benefits Fund in the State Treasury fund the assessments. The regulations in New Jersey and New Hampshire do not create an explicit funding source within the legal text.

Discussion

Only three HIA laws were enacted or amended at the state-level across the country between January 1, 2012 and December 31, 2016. The failure to pass or amend HIA legislation was a common thread throughout the United States regardless of the variation among the legislation's applicable sector, the HIA methods required by the legislation, the geographic location of the state, or the legislation's inclusion of an HIA funding mechanism.

Although HIAs do not require legislative authorization, policy support, including HIA legislation, has been identified as an enabling factor for HIA use (Dannenberg, 2016). Most bills introduced in state legislatures fail to pass, and this study was not designed to identify the reasons the proposed bills did not become law. It is possible that some or all of these bills failed simply because lawmakers were opposed, or were unfamiliar with HIAs and their potential utility. Other political and contextual factors, such as funding constraints, or controversy over the sector or subject area that would be the focus of the HIA (such as fracking), may also be responsible (National Research Council, 2011). Further research on HIA policymaking may illuminate how HIA proponents can use policy advocacy, policymaker education, or translational research to improve the adoption rate in the future. It would also be valuable to examine if and how the success and failure rates of state HIA legislation compare with other types of legislation, which may generate knowledge that can help with policy formulation and adoption.

Research gaps remain in understanding how HIA laws are implemented, the impact of those laws on decision-making in various sectors, and ultimately how HIA laws affect health determinants and health outcomes. Future research could track the implementation of the three successful HIA laws from this time period, as well as others that may arise in future state legislative sessions, to understand the facilitators and barriers of these laws and to monitor their impacts. Monitoring these laws' effects on health determinants and outcomes, a formal step of HIAs that includes process, impact, and outcome evaluation, could also help advance HIA practice, since the monitoring step of the HIA process is often omitted in practice. (Dannenberg, 2016). Studying the implementation of these laws could also help to identify and establish the critical components that any HIA bill should contain in the future. It is likely that HIA laws need to provide sufficient clarity in terms of how the HIA will be carried out and provide enough guidance and support, such as funding or staffing mechanisms, for the HIA process to be successful.

The findings presented in this paper also highlight the disproportionate distribution of HIA bills and laws in terms of geography, sector, and political affiliation of the primary sponsor. Approximately two-thirds (66%) of the HIA bills and laws in the datasets were introduced in the Northeastern United States, and most of the bills sought to use HIAs to inform decisions related to environmental issues, oil and gas, and transportation. Future research should explore these trends in more depth and seek to understand why policymakers may be more likely to pursue HIA bills and laws in specific sectors or topic areas. The findings also demonstrate that Democrats introduced 75% of the HIA bills. Again, future research may benefit from exploring these differences by political ideology.

As of June 2017, HIAs have been conducted in 42 of 50 states and the District of Columbia (regardless of legal mandate), and have informed decisions across a range of sectors including transportation, natural resources and energy, housing, criminal justice, education, and labor and employment (The Pew Charitable Trusts, 2015).

These HIAs are being conducted across the country, but recent legislative activity has only occurred in 11 states within the period of this study. Clearly, HIA practice is expanding in the absence of legislation, with 419 HIAs being conducted as of June 2017 (The Pew Charitable Trusts, 2015). The lack of state-level HIA legislation in recent years raises the question of whether state-level HIA laws are necessary, and whether they should be promoted to support HIA activity over more voluntary practices. Future research may test the hypothesis that HIA growth and practice differs by whether or not a state has HIA legislation, and to examine differences among the impacts of HIAs conducted because of legislation compared to those undertaken without legislation. This information can help practitioners identify whether HIA legislation as policy support is a critical enabler for HIA use, and may provide empirical data to support policy diffusion from one state to another (Nicholson-Crotty, 2015). If research finds that legislation is unnecessary, identifying which non-legislative approaches best support state-level HIA activity will be crucial in order to meet the goal of positively affecting population health and health equity.

Limitations

The research team designed the study to exclude bills and laws requiring forms of public health analysis that did not meet the narrow definition, or include the specific criteria, of a formal HIA, such as the exclusion of health risk assessments and community health needs assessments. Also excluded were bills and laws that included vague provisions ordering the examination of the potential impact of a specific issue or project on health, but did not provide details to suggest that an HIA would be the mechanism. Moreover, the study's state-level mapping does not capture HIA provisions enacted at the federal or local levels. This focus on formal, state-legislated HIAs may underestimate the true volume of HIA legislative activity.

Additionally, this project observed the policies as written in the bills, statutes, and regulations, and thus it does not provide insight on how well an HIA was carried out in practice. Further, if a law was passed prior to January 1, 2012 and was still effective during the period of the study it was excluded as out of scope. Lastly, while we captured introduced bills that were not enacted, we did not capture proposed rules and regulations that had failed or were still pending, as only successfully amended or promulgated HIA regulations were included in the scope of the study.

Conclusion

Legislative action can encourage the use of HIAs across the United States to examine the public health implications of decisions in a range of sectors. The findings presented in this study highlight the need for additional research to understand the factors that may drive success or failure of HIA bills, such as political will and resources, in addition to the question of whether state-level HIA legislation is the best approach to drive HIA implementation. Further research is needed to understand how HIA legislation is being implemented and the impacts of HIA legislation on decision-making, health determinants and outcomes, and health equity.

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HEALTH IMPACT ASSESSMENT OF THE CONSTRUCTION OF HYDROELECTRIC DAMS IN BRAZIL

Diego Velloso Veronez, MD; Karina Camasmie Abe. PhD; Simone Georges El Khouri Miraglia, PhD

Abstract:

Background: Brazil´s dam-building plans in Amazonia imply substantial environmental and social impacts. This study evaluates the relationship between social, environmental, economic aspects, and impacts on the health status of the population of Rondônia, Brazil, due to the implementation of the Jirau and Santo Antônio hydroelectric dams.

Methods: A qualitative and retrospective Health Impact Assessment (HIA) is used to focus the study objectives. The information is arranged in a structured diagram that enables an outside reviewer to assess the aspects/impacts relationship derived from the construction of the dams. This comes with outline recommendations for health risk management that can orient national health authorities. We selected a narrative review synthesis as the most appropriate approach for the study.

Results: The diagram network was built making it possible to analyze the impact changes caused by this enterprise in the health sector. Additionally, the model will serve in the implementation of a complete HIA approach in an attempt to quantitatively map the impacts and to propose recommendations.

Conclusion: The diagram pathway has been useful as an important tool for assessing a broader view of direct and indirect impact categories, serving as a basis for further evaluations and studies. This effort is very important for highlighting the priorities in the public policy decision-making process, serving as a basis for the Brazilian Health System.

Introduction

Brazil is undergoing a rapid demographic expansion and intensive development process, supported by the implementation of major infrastructure projects in the country to facilitate the development of the national territory (Brasil 2013; 2014).

To ensure the country's infrastructure and economic growth in the face of worldwide economic uncertainties, the Brazilian government created the Growth Acceleration Program (Programa de Aceleração do Crescimento - PAC) in its first phase in 2007, which has since promoted the planning and execution of major social, urban, logistical, and energy infrastructure in the country (Brasil, 2013).

Currently, the PAC is in its second phase, which started in 2010, in which investments are directed towards the energy sector with the construction of large dams, such as the Jirau (9° 15' S 64° 38' W) and Santo Antônio (08° 48' S 63° 56' W) dams, both located on the Rio Madeira in the municipality of Porto Velho in the state of Rondônia (Brasil 2013).

In the construction of hydropower plants, financial resources are mobilized from the public and private sectors through consortia; furthermore, many inputs, such as labor, machinery, equipment, and the construction materials needed for the work, are required. This mobilization often disfigures the region where the project will be installed, leading to impacts[1] with cross-border dimensions (Bortoleto, 2001; Brasil, 2013; Cruz and Silva, 2010; Fearnside, 2014; Rocha, 2014).

In large enterprises, the human and ecological impacts must be considered. According to World Health Organization, health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (WHO, 1946).

To demonstrate the relationships arising from works of large enterprises and the health of the affected population, the need to compile evidence of health impacts and to represent them in an interconnected manner has been identified.

An understanding of the impacts of major projects requires socioeconomic and environmental studies, which should be presented according to the relevant legislation (CONAMA No 001/86) to minimize any possible negative impacts in the periods prior to the project, during the construction of the project, and after its completion. Thus, it is possible to perform a proper management of the impacts of the project (CONAMA, 1986; Cruz and Silva, 2010).

To minimize the negative impacts and maximize the positive impacts, any project in Brazil that will potentially cause an environmental impact must undergo the licensing process, according to CONAMA Resolution No. 01/86 and CONAMA Resolution No. 237/97. Resolution 01/86 defines the concept of an environmental impact assessment, its criteria, its guidelines, and establishes the mandatory Environmental Impact Assessment (EIA) and Environmental Impact Report (EIR) to exemplify the activities subject to the EIA/EIR. These reports have less formal language and represent key aspects of the EIA, and they are presented at public hearings to all stakeholders (Cunha, 2008).

However, the EIA/EIR does not adequately address the possible impacts on the health of the population and the health system (increased demand for medical care) based on the type of project because all constructions of large enterprises result in positive or negative impacts that directly reflect the population's wellbeing (Brasil, 2014).

Faced with this problem in the conceptual approach of the EIA/EIR, the World Health Organization (WHO) and the National Health Service of the United Kingdom (UK-NHS) consider that numerous activities of the public and private sectors produce health consequences (WHO, 2002).

Due to the fact that the health system can be overloaded by diseases provoked by environmental impacts, in an attempt to improve the health care approach in environmental impact studies, a new method of impact assessment for health has been proposed, the Health Impact Assessment (HIA). This methodology, which officially appeared in 1999 in a document called

[1] Environmental aspects are a result of activities, products, or services that can interact with the environment, causing or possibly causing environmental impacts, whether positive or negative. Environmental impacts are any change in the physical, chemical, and biological properties of the environment resulting from human activities(4).

the Gothenburg Consensus, is defined by the WHO as a set of tools and procedures to judge policies, plans, or programs by systematically evaluating the potential effects on public health (WHO, 1999).

The HIA is an established method in countries such as Canada, the USA, Australia, and the member states of the European Union. This tool allows one to evaluate a project and its potential health impacts and propose mitigation actions for health promotion (Brasil, 2014; Winkler et al., 2013). In Brazil, the concept was disseminated in 2014 by the Ministry of Health of Brazil with the publication of a national guide aimed at transferring the HIA methodology in the country. Its application has been encouraged in environmental licensing, aiming at large enterprises that could cause health impacts. The challenge faced by the Ministry of Health is the integration of the HIA and EIA/EIR (Brasil, 2014).

Considering this scenario, this study aims to identify and organize the direct and indirect health impacts and their determinants due to the environmental alteration caused by the construction of the hydroelectric dams on the Madeira River in the state of Rondônia, Brazil, considering national and international available data and references. We provide a review of various health effects associated with environmental, social, and economic aspects to provide a systematic, integrated, and clear overview of both the aspects and impacts with regard to the scope of the problem detailed in a network schematic diagram. Recommendations are proposed for the health authorities to pursue the constructors to seek means to protect the public health associated with the construction's impacts in the region and to obtain bases for health policy makers.

Methods

A qualitative and retrospective HIA was used to focus the study objectives. Rapid assessment was performed because of shortages of time and money as well as due to the difficulties of accessing data on projects and their construction. The HIA steps conducted in this study were Screening, Scoping and Appraisal (partial). The HIA relied on secondary data and expert informants and interviews to obtain essential qualitative data. The information was arranged in a structured diagram that enables an outside reviewer to assess the aspects/impacts relationship derived from the construction of the dams and to identify gaps that require further study and intervention. The product is a diagram network that enables one to easily visualize the relationships among the aspects and impacts associated with the environmental, social, and economic consequences of the dams' construction resulting in public health effects. This comes with outline recommendations for health risk management that can orient national health authorities towards indicating the steps required to formulate specific management plans through negotiation with local stakeholders.

We selected a narrative review synthesis as the most appropriate approach for the study because studies regarding health impacts derived from hydroelectric dams have been conducted in diverse types of traditional research, with widely different methodologies and often varied but nevertheless related research questions. This heterogeneity makes it difficult to apply a more traditional systematic review approach.

The main search engines used to source the literature were PubMed, Scientific Electronic Library Online, Latin American and Caribbean Health Sciences (Lilacs), and Google. The search was conducted using the terms "hydroelectric" or "power plants" and "Brazil" in combination with the terms "impact" or "effect", in English, Portuguese, or Spanish, without time limits. Moreover, the date of the last search was August 2016. The references of all of the retrieved original articles and reviews were assessed for additional relevant articles. International guidelines, government sites, grey literature, and expert opinions were also consulted for data and additional references. The articles' languages considered in this search were English, Portuguese, and Spanish.

The reading of the documents and articles was performed to refine the selection, leaving only those that addressed the issue related to the research objectives. The main articles and retrieved documents were reviewed with the focus on the diagram network impacts of the construction.

After collecting the information, a diagram network linking the environmental, social, and economic aspects and impacts was built using the CMAP software (developed by the Florida Institute for Human & Machine Cognition).

Study Area

The state of Rondônia (RO) is located in the northwest of Brazil and covers an area of 237,590.543 km2 with 52 municipalities, and it is bordered by the states of Amazonas to the north, Mato Grosso to the east, Acre to the west, and the Republic of Bolivia to the west and south (Figure 1) (IBGE, 2015).

Fig 1 Location of the state Rondônia in Brazil. Source: Prepared by the authors with the ArcGIS Online software

Both hydropower plants are located in the state of Rondônia on the Madeira River, in the municipality of Porto Velho. The first is the Santo Antônio hydroelectric dam, which has a reservoir with a flooded area of 421.5 km2 at its maximum level and an installed capacity of 3,568 MW, located at a distance of 8 to 10 km from the urban area of the municipality of Porto Velho (IBGE 2015; SANTO ANTONIO ENERGIA, 2016).

The second hydroelectric dam is the Jirau dam, which has a reservoir with a flooded area at its maximum level of 361.6 km2 and an installed capacity of 3,750 MW. This plant is on the Madeira River 120 km from the urban area of Porto Velho. The work of the Santo Antônio plant began in the second half of 2008, whereas the construction of the Jirau plant began in mid-2009. Both began partial power generation from 2012 (IBGE, 2015; ESB, 2016).

Results

Baseline Assessment

The state of Rondônia, whose capital is Porto Velho, is located in the north of Brazil, bordering Bolivia. This state represents 2.8% of the country, with an area of 237,765 km2, and contains approximately 0.8% of the Brazilian population, with 1,562,409 inhabitants in 2010 (Hacon and others 2014). Porto Velho is a municipality that has an area of 34,090 km2 and a population of 428,527 inhabitants (Cruz 2010).

The state of Rondônia has a predominantly young population and has also recently seen an increase in its population over the past 60 years. Between years 2000 to 2010, Rondônia saw an increase in the number of people who self-identified as colored or black, brown, and Asian; maintained its indigenous population; and saw a decrease in the share of people who self-declared as white in 2010 compared to the data from 2000. In 2010, the black or brown population in Rondônia represented 62.5% of the total population, whereas in Brazil, this ratio was 50.7%. A relevant piece of information is a 717% increase in the number of Asian people in Rondônia between 2000 and 2010, increasing from 0.2% to 1.4% in the population distribution and suggesting an intense migratory movement of this portion of the population.

The per capita household income of Rondônia increased by slightly more than 31% from 2000 to 2010, going from 78.8% of the national income to 84.3%, supported by an approximately 50% drop in the unemployment rate (from 9.88% in 2000 to 5.31% in 2010). In both census years, the unemployment rate in the state of Rondônia has remained below the national rate in Brazil, whereas the literary rate has remained very close. The Rondônia vehicle fleet grew by 330%, from 0.6% of the Brazilian fleet by 0.8%.

Life expectancy at birth for both men and women and for the total population in Rondônia remained below the Brazilian average and showed a small increase in the period, rising from 69.1 years in 2000 to 72.1 years in 2010 (IBGE census C).

With regard to the existing health establishments in the state and in the capital of Porto Velho, there was an increase in the number of health facilities, particularly after 2010. However, the number of establishments has not grown in proportion to population growth, and greater attention is required when taking into consideration access to health services and the conditions of service and assistance.

The Madeira River, which passes through the state of Rondônia, belongs to the Madeira River basin, which is the most important basin in the state and extends far beyond its limits within the lands of Brazil and the Republic of Bolivia, occupying an area of 1,244,500 km2.

The hydroelectric dams of Santo Antônio and Jirau on the Madeira river, both in the municipality of Porto Velho, have a total installed capacity of 7,318 MW. The two projects cost an estimated R$ 18.4 billion. The Madeira River, due to its importance has tributaries in Bolivia, Peru, Acre and Rondônia. This river is the main tributary of the Amazon (downstream), both in volume of water and sediments (de Souza Moret and Guerra, 2009). Several irregularities were verified during the dams' construction, such as the change of dam axis of the Jirau unit without the preparation of specific studies required by the Environmental Legislation, no study was presented on the impacts in the communities downstream of the plant. Moreover, there was no mitigation measures regarding the restructuring of the fish spawning area, compromising local and traditional feeding based on fishing, due to decrease of fishing areas (FURNAS et al., 2005).

In addition, the EIA/EIR states that there would be no impact on indigenous lands (FURNAS et al., 2005), which is false, since the Kaxarari indigenous communities in the extreme region of Katawixi, on the upper Candeias River, on the Karipuninha River, in Alto Jaci and Jacareuba on the Mucuinnão river (who live less than 20km from the hydroelectric construction) were not reported in the EIA/EIR and consequently does not present any assessment data or monitoring of the effects affected by the construction (Moret and Guerra, 2009).

Besides that, during the construction only 1,500 workers would stay as permanent workers. Between the first and third year would be around 15,000 contracted workers and, at the peak of the work, there will be the hiring of up to 20 thousand workers for only 3 months (Moret and Guerra, 2009). Unemployment itself is detrimental to health and has an impact on health outcomes, for example, increasing mortality rates, causing physical and mental ill-health, and greater use of health services (Mathers and Schofield, 1998). This shows the importance of exposing and gathering the health determinants, sometimes even unanticipated during the construction of the plants, in order to make it possible to mitigate negative impacts on future infrastructure works.

Network of aspects and impacts

To begin a systemic analysis of the aspects and impacts caused by the Jirau and Santo Antonio hydroelectric dams in Rondônia, this paper notes some of the positive and negative impacts related to all phases of the design and construction, showing the relationship between an aspect and an impact through a macro-systemic view. Table 1 shows the main potential aspects and impacts observed during the construction of hydroelectric plants.

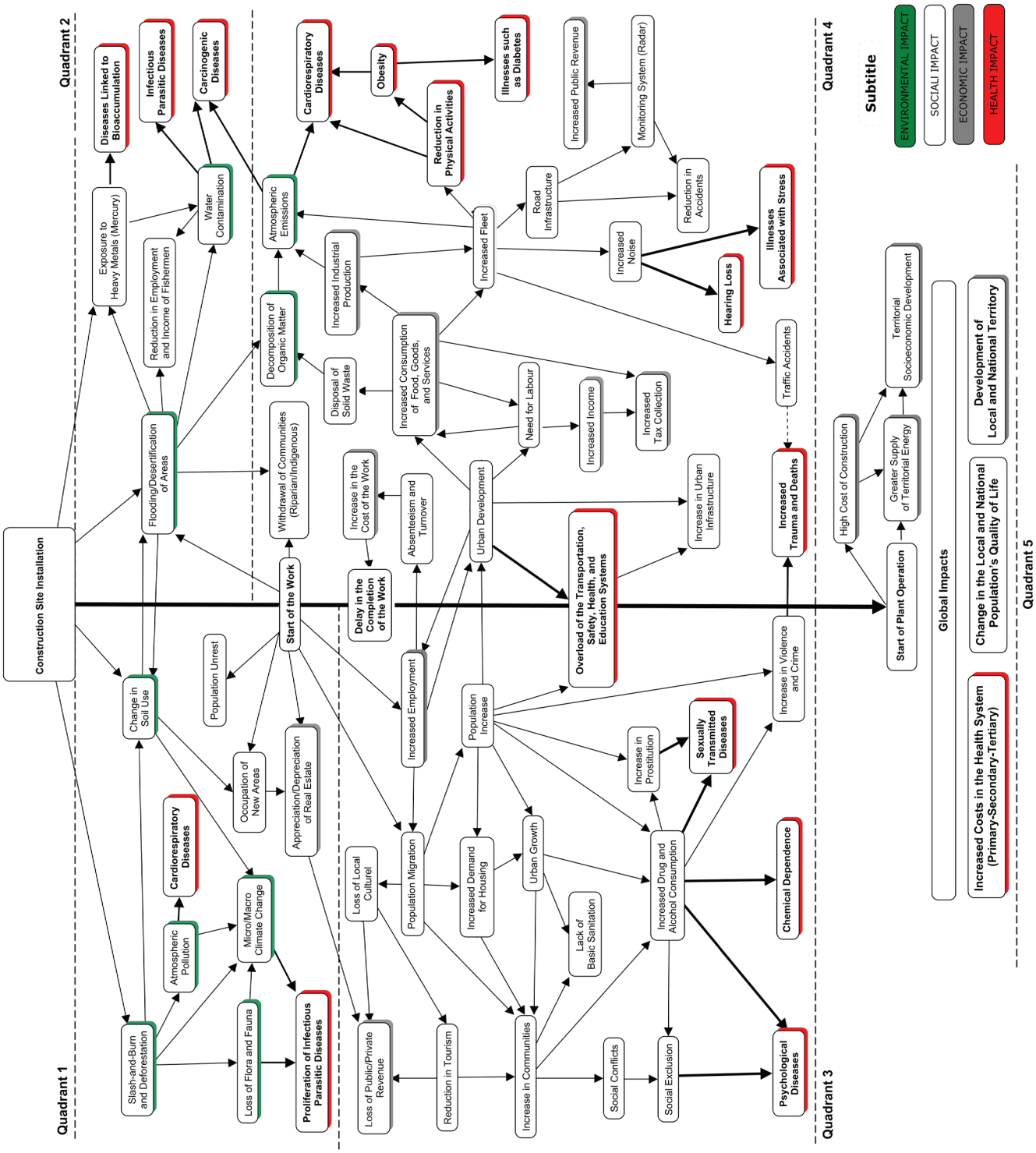
Table 1. Processes that induce impacts and actions and impacts/aspects resulting from the construction of hydroelectric dams in Brazil

Processes that induce impacts	Resulting actions	Impacts/aspects	Reference
Construction site installation	Occupation of land and changes in land use, deforestation, slash-and-burn, and floods	Elimination of flora and fauna; micro- and macro-climate change; proliferation of human infectious parasitic diseases.	Guerra and Carvalho 1995. Cunha 2008. Sanches and Fisch 2005. Alves and Justo 2011.
		Mobilizing communities (riparian, indigenous, and others) and changes in fishing activity	Guerra and Carvalho 1995. Alves and Justo 2011. Rocha 2014.
		Human exposure to mercury and heavy metals	Lacerda and Malm 2008. Almeida et al. 2005. Luca, 2012.
		Cross-border impacts	Marengo 2008.
Recruitment of labor	Rapid population growth and urban development	Unplanned territorial occupation, volatility of real estate values, loss of cultural heritage, restructuring of pre-existing economic activities, disorderly population growth, unemployment, slums, social marginalization.	Cruz and Silva 2010. Rocha 2014.
		Need for expansion of health, transportation, and education infrastructure	Cruz and Silva 2010. Franco and Feitosa 2013
		Increased vehicle fleet and air pollution, increased incidence of cardiorespiratory diseases on urban population, increased stress and greenhouse gases.	Queiroz and Motta-Veiga 2012. Fearnside, 2005a
		Increased noise and number of traffic accidents on urban population	Expert analysis

Increase of Population (local and migrant)	Increased income	Greater access to the consumption of alcohol, drugs, and prostitution, leading to violence and social exclusion	Queiroz and Motta-Veiga 2012.
		Increased tax collection	Expert analysis
		Population lifestyle change due to the purchase power increase	Queiroz and Motta-Veiga 2012.
		Change in eating habits, increase in unhealthy food outlets, increasing obesity	Queiroz and Motta-Veiga, 2012
	Increase in prostitution	Increase in sexually transmitted diseases	Expert analysis
	Increase in communities and social conflicts	Inequalities and social conflicts, increased drug use	Expert analysis
		Increase in neuropsychiatric disorders	Expert analysis
Delay in work completion	Elevated cost of the work	Worker turnover, fluctuation in workers' incomes	Expert analysis
Start of plant operation	Reduced supply of unskilled jobs and increase in skilled labor	Decrease in income and unemployment; increased social conflicts, Health impacts of unemployment	Expert analysis
	Increase in national electricity supply	Socioeconomic development, increased affordability of energy	Expert analysis
Global Impacts	Population increase	Increased costs in the health system	Expert analysis
	Change in the population's quality of life	Improved regional and national infrastructure	Expert analysis
		Territorial development	Expert analysis

In Figure 2, one can observe the link between environmental areas (highlighted in green), health areas (red), social areas (white), and economic areas (gray). This figure is divided into quadrants to facilitate viewing and understanding during the explanation.

Fig 2. Network of Aspects and Impacts.



The first stage in the construction of a hydroelectric dam is the installation of the construction site, which, in our study, started in the second half of 2008 and provided changes in the installed location. These changes can be observed in quadrants 1 and 2 in Figure 2. In quadrant 1, it appears that the occupation of the land can lead to a change in land use due to deforestation and slash-and-burn practices. This can cause the elimination of the diversity of flora and fauna. Due to slash-and-burn practices, an increase in the incidence of respiratory diseases may occur in the population caused by the emissions of the generated pollutants (Dominici et al., 2006).

By analyzing quadrant 2 in Figure 2, the flooding of areas for water storage purposes by the plant as well as other potential regional flooding due to the change in land use (observed in quadrant 1) and the installation of the construction site can be observed. This impact can cause the expropriation of areas by relocating the local riparian population, which is mainly composed of fishermen, indigenous people, and other population groups, to other locations. This way of displacement deprives people of their means of production and shifts them from their traditional ways of life.

Flooding in the riverbed can significantly change fishing activity and the life of the riparian community, which is often completely dependent on fishing for its subsistence. Other likely impacts are the proliferation of infectious parasitic diseases and community exposure to heavy metals. For example, mercury, released by erosion and ingested through water use and fish consumption, can trigger diseases linked to bioaccumulation, including neurotoxicity and loss of motor control and other health problems (Passos and Mergler, 2008).

In quadrant 3 of Figure 2, a probable population increase is observed due to the need for labor to start the project, which can generate an exacerbated migration of human resources to the construction site installation. The vast majority of this migrant population consists of direct and indirect workers (contractors) of projects that contribute to unplanned land occupation, with an urban growth beyond that tolerated by the city (Moret and Guerra, 2009)

Thus, there may be the expansion of poor communities with inadequate housing conditions due to the housing demand generated by migration. In many cases, these are areas that lack basic sanitation and with social conflicts, including indigenous lands, leading to the social exclusion of the population or the individuals who live in the community. Another fact is that this change in the place brings a loss of cultural identity, leading to a decrease in tourism in the region and, consequently, lost revenue. This scenario causes a change in the price of real estate or the appreciation of some areas over others (FURNAS et al., 2005).

Another change in the population's life is the increase in income provided by the supply of employment. This increase in income boosts the purchasing power of the local population, allowing access to goods and services that improve the quality of life. However, possible negative aspects consist of a higher consumption of alcohol and drugs, which also leads to increased prostitution and violence, producing direct effects on the population's health and wellbeing, such as psychological diseases, sexually transmitted diseases, fractures, and trauma caused by violence.

Traumas are also accentuated due to traffic accidents, as noted in quadrant 4. The increase in population attracted to the region affects the morbidity and mortality rates of non-communicable diseases, especially those of external causes, such as accidents and violence (Silveira, 2016). This effect can have several reasons, among them comes from the change in behavior in the population because the increased income begins to consume a greater number of goods and services, notably the acquisition of cars and motorcycles, in addition to the expansion of industrial production to meet the need for transportation.

This increased demand can cause environmental consequences, such as a greater generation of solid waste and atmospheric emissions. Atmospheric emissions are the result of the increased vehicle fleet and the increase in industrial production because the burning of fossil fuels releases gases into the atmosphere that are harmful to health. Consequently, there may be an increase in the incidence of respiratory diseases in the population, such as pneumonia, bronchitis, emphysema, asthma, cardiovascular ischaemic diseases, and cancer, which are diseases commonly associated with air pollution (Kampa and Castanas, 2008; Abe and Miraglia, 2016). In addition to these diseases, it is also possible to trigger stress and obesity due to decreased physical activity, and pollution exposure (Madrigano et al., 2010).

Additionally, in Quadrant 4 in Figure 2, one can observe the need for infrastructure in the state of Rondônia, such as roads, avenues, streets, bus terminals, basic sanitation, and others to bring an improvement in people's quality of life.

Another impact in the increase in the fleet, according to expert analysis, is the generation of noise for residents who live in the vicinity of roads, increasing the morbidity associated with stress.

A transversal fact that typically occurs is the delay in the completion of the work (quadrants 3 and 4 in Figure 2), which occurs due to factors such as the lack of raw materials, strikes and absenteeism by employees, financial resources, and environmental conditions. All of these factors increase the cost of the work and may lead to dismissal.

By analyzing quadrant 5 of the network of aspects and impacts, one can verify the global results of the operation of the hydroelectric plant, which can be positive or negative. The positive results are the increase in quality of life in the country due to higher energy availability and increased purchasing power. The negative results include an accelerated migration, increased health demand in both the public and private network, and increased demand for education, which served a certain number of people prior to the project installation and must meet an increased demand from people but with the same infrastructure after the installation.

Discussion

The socio-environmental impacts from the installation of hydroelectric power plants have received increasing attention from researchers and the media in both the national and international conjunctures. The problems arising from the implementation of these works, both social and environmental, are broader than imagined. In this sense, this is the first time, through an extensive bibliographical survey, that the direct and indirect health impacts of the population, derived from hydroelectric projects, have been gathered in Brazil. These effects were addressed in a systemic and networked way, showing the interconnections between environmental effects and people's health.

The diagram network impacts elaboration is an efficient and structured method to begin an HIA and facilitates the reading of the various impacts and their correlations, allowing the implementation of mitigation actions (policies and actions) at the source, preventing a collapse in the health system. In this case, the effects were analyzed retrospectively, and the experience gained from these analyses will serve as a substrate for future projects on the same topic (Harris, 2007; Harris et al. 2007).

To build the diagram network impacts (Figure 2), from the starting point, there were premises that facilitated the understanding of the correlation of the wide range of existing variables, their causes, and the ultimate effects on public health (Bortoleto, 2001; Guerra and Carvalho, 1995; Queiroz and Motta-Veiga, 2012).

The objective of this study was to demonstrate the possible consequences of the hydropower project

by creating a matrix of interconnected aspects and impacts, called the network of aspects and impacts. The target study population was the riparian, urban and indigenous population. Nothing in the literature, in which there is a broad view and the dynamics of changes caused by the implementation of a project of this size, similar to this network, has been found. This view is pioneering and allows both a global and a specific analysis of existing problems or potential damage due to the changes stemming from an intervention.

The importance of creating a holistic view is noted by Wehnham (2011), who describes the importance of a multi-sectorial vision, including sectors such as transportation, energy, and the environment, aiming to understand the health consequences (Wernham 2011).

The network of aspects and impacts presents a multi-sectorial vision. This is noted from the installation of the construction site, which causes initial impacts such as the occupation of land and changes in land use through deforestation and slash-and-burn, thereby eliminating the flora and fauna (Lerer and Scudder, 1999). Studies in Australia, which has more than 446 hydroelectric dams, show that dams and weirs affect the fluvial fauna and flora (Teodoro, 1995, Kingsford, 2000, Thoms and Walker, 1993) and that the ecological impacts on lowland flooded areas are still poorly understood because habitat loss may have widespread impacts on native fish and waterfowl. Associated with road construction and the urbanization of the area, one can observe that there is the loss of native habitats, causing deleterious effects on the population of bees, birds, animals, and riparian populations as well as a significant change in eating habits, with most food being purchased in nearby cities rather than produced locally or collected (Schmidt 2011). It results in the loss of access to traditional means of life, including agriculture, fishing, livestock, and plant extraction (Cruz and Silva, 2010).

This leads to micro- and macro-climate change, which, combined with previous environmental changes, exacerbates the proliferation of infectious parasitic diseases for humans (Alves and Souza 2011; Cunha 2008; Guerra and Carvalho 1995; Sanches and Fisch 2005). In addition, silting and sedimentation in the soil due to the construction of the dams have affected the water quality of the region of the enterprise, increasing the eutrophication phenomenon, damaging the fauna and the aquatic flora of the reservoir and, with this, the quality of the water of this region, which may constitute not only an environmental and economic problem but also a public health one (Carneiro and Rubin, 2007).

The increase in vector-borne diseases due to the construction of hydroelectric dams is a recurring problem and was also reported during the construction of the dam in Turkwel Gorge, a semi-arid region in Kenya, which was completed in 1994 (Renshaw et al. 1998). Since then, concerns about the environmental and health impacts have been reported, and authors have noted the proliferation of the main vector of malaria, Plasmodium falciparum, near the reservoir of the hydroelectric plant (Pantoja and de Andrade, 2012). Schistosomiasis was also an endemic disease in Kenya, but authors suggest that there may be a high risk of an increase in cases of schistosomiasis due to the population migration to the construction site. This risk has also been identified for leishmaniasis. Nomadic herdsmen, fishermen, and farmers have been identified as high-risk groups for these diseases (Renshaw et al, 1998). In our study, the threat of the proliferation of vector-borne diseases during the construction of large hydroelectric projects in tropical regions is also a reality and impacts the local riparian population, including the indigenous population of Rondônia. During the construction of the Rosal Dam, in south eastern Brazil, authors have revealed the potential in the area for the transmission of malaria, schistosomiasis, and cutaneous leishmaniasis (Rezende et al, 2009). Among the infectious parasitic diseases, the researchers involved in data collection in the

hydroelectric dam in Kenya also identified a risk of an outbreak of the disease known as "Rift Valley Fever", a viral disease transmitted by mosquitoes, because the construction site of the hydroelectric dam has a combination of people, water, animals, and mosquitoes that facilitate a virus outbreak (Renshaw et al, 1998). In Brazil, there is also the risk of outbreaks of mosquito-borne diseases, specifically dengue, yellow fever, and malaria, which are endemic in the Amazon region, where hydroelectric plants on the Madeira River are installed (Britto, 2007).

The change in land use is also a by-product of floods that occur due to the plant, which has resulted in the mobilization of riparian communities, changing people's way of life (Guerra and Carvalho, 1995; Rocha, 2014). The population flows that are configured from the construction of the hydroelectric plants usually occur through two processes in the Amazon: the search for territories of contingents looking for work that come to occupy this area and that of lands' desocuppation, marked by the expropriation of the population of the areas of influence of the reservoir. This results in a behavior of migratory flows and refluxes, with no sustainable convergence of public policies and investments (Cavalcante et al. 2011). In Canada, the construction of the La Grande Hydroelectric Complex, known as the James Bay Project, in Quebec spurred rapid population growth and the need for housing and infrastructure, which contributed to the expansion of the construction industry in nearby villages and the growth of public services, driving business activity (Senécal and Égré 1999). However, as with other projects involving the displacement of people, there are always positive and negative aspects because, despite a marked improvement in the quality of life in the new location, several dozen people refuse to leave the premises and move, especially senior citizens who are forced to move due to the construction of the dam where they live. These people seem to experience a sense of loss, which may result in health problems or depression (Senécal and Égré 1999).

Another affected community in the Amazon region is the indigenous population, which, in addition to removal, undergoes the process of loss of indigenous culture. During the construction of the Lajeado hydroelectric plant in the state of Tocantins in northern Brazil from 1996 to 2001, there was an indigenous environmental compensation program to mitigate the social and environmental impacts of construction on the 3,000 indigenous people from the Xerente tribe, who were located a few kilometres downstream of the dam. Although there was a mitigation program, the history of indigenous people with so-called "non-indigenous" people has repeatedly been marked by violence and the struggle for land since the time of missionaries, prospectors, and settlers, causing great concern among the heads of tribes who were led to believe in the government programs which announced the advantage of the hydroelectric for getting progress and they had to accept it. In this sense, it caused a great migration of indigenous peoples (Hanna et al. 2016; de Paula 2000). This clearly shows the importance of analyzing cultural and social aspects when addressing any project. Moreover, it is reported in a recent study, that the indigenous chief knew the undesirable side effects that the proximity of the dam construction would bring to his people, for example, the increase in prostitution, alcoholism, the arrival of new diseases, the invasion of Xerente land due to the proximity to the construction site, and urban expansion, bringing associated impacts such as roads and noise (Hanna et al. 2016).

Other impacts can be noted in the urban population due to the rapid progress of the city and the increase in the population over a short period of time. According to Rocha (2014) and Cruz (2010), rapid population growth causes unplanned land occupation, which results in the volatility of real estate values and the loss of cultural heritage, with the degradation of local history in contrast to development (Cruz and Silva, 2010; Rocha, 2014).

Urban development creates a need for the State and municipalities to expand infrastructure to meet the burden on health, transportation, education, and sanitation systems generated by the population growth (Cruz and Silva 2010; Franco and Feitosa 2013). Due to the large inflow of workers to the construction site, it is common for the basic sanitation infrastructure to be absent or poor, particularly in developing countries, hindering personal hygiene actions and contributing to outbreaks of diseases that are transmitted by poor sanitation, such as diarrhea and cholera (Renshaw et al. 1998). The inflow of workers is one of the factors that is felt the most by the local population and was also found in a study on the hydroelectric plant of Lajeado in the state of Tocantins in northern Brazil. The city of Lajeado was full of "people from the outside"; according to anecdotal reports at the time, the city had doubled in population (Araújo 2003). Next to this plant, the city of Porto Nacional was also affected by the construction of the dam, starting with the flooding of an old and famous beach and sections of a traditional avenue that had mansions owned by old families in the city. Due to submersion by the dam, more than 50 of these mansions had to be demolished. The natural beach was often visited by tourists from various regions of the country and generated a significant income for the city (Araújo 2003). The year after the construction of the dam, there was the inauguration of a tourist complex on the banks of the dam, including a new avenue, sports courts, a go-kart racetrack, and an artificial beach, to reduce the impact generated by the loss of tourism and to boost new tourism (Araújo 2003). Unfortunately, it was reported that, a few months after the opening of the tourist complex, the water from the dam was of poor quality and the beach needed to be interdicted to take appropriate action (Araújo 2003); thus, there was a decrease in tourism, which was an important source of income, in the region due to poor infrastructure and sanitation.

During the construction of the Jirau and Santo Antônio hydroelectric dams, there was also an STD increase among the regional population, which is very worrying due to the proximity of the plants to the urban area of the state capital. Prevention and awareness campaigns about STDs are an alternative suggested by several authors (Renshaw et al. 1998) because these cases overwhelm the local health service and reduce the population's quality of life.

The change in the population's lifestyle caused by urbanization and the increase in population is also a reflection of increased income. On one hand, increased income may allow access to better health services, however, on the other hand, it may have permitted greater access to the consumption of alcohol, drugs, and prostitution, leading to violence and social exclusion and resulting in direct health effects among the population (Queiroz and Motta-Veiga 2012). Construction workers are a vulnerable community because they often live apart from their sexual partners, but they have a sufficient income to pay for sex workers. In this study, there was an increased rate of STDs in areas where construction sites are installed, and this event was also observed in the study by Renshaw et al (1998), who identified a gonorrhea outbreak during the construction of the Turkwel Gorge hydroelectric plant in Kenya.

The construction of a dam has the effect of submerging both wetlands and dry areas and may include rivers, lakes, and nearby towns. In a study after the construction of the Rosal plant in Brazil, it was reported that the most significant impact during the construction phase was the increase in temporary residents due to the influx of workers. The increased population involved the risk of introducing infectious agents, in addition to resulting in increased disturbances in the environment, waste production, and wastewater. In the operational phase of the plant, the authors suggest that the greatest impact was the formation of the lake and the departure of residents and workers from the area (Rezende 2009). The migration of large numbers of workers into the region, the displacement of local residents, and the change in flora and fauna are the main factors for the loss of local culture and

identity, which may result in a wide range of social and environmental impacts on communities, such as intra-group conflicts and changes in agricultural practices and diets (Hanna et al 2016).

According to Alves and Justo (2011), the change in the water flow rate and riverbed flooding significantly alter fishing activity and the life of the riparian community, who are often completely dependent on this activity (Alves and Justo 2011). Changes in the physical environment trigger a higher exposure to heavy metals, especially mercury. This element has high natural concentrations in the soil, which are absorbed by the population when using the water and fishing resources for their needs (Lacerda and Malm 2008, Almeida et al. 2005). According to the WHO, the maximum allowed concentration of mercury is 50 parts per million (ppm) in water, and in the Amazon region, the riparian population has a concentration of 70 ppm in their urine, creating a health risk of mercury poisoning (Luca, 2012).

The fear of intoxication can cause changes in the diet, passing to the consumption of industrialized products, related to the indices of diabetes and obesity. This change in eating habits has had an economic and cultural impact, as well as not providing a connection with culture and a connection with the land. In addition, the indigenous population presents less life expectancy and face risks of obesity and chronic diseases (Queiroz and Motta-Veiga, 2012).

With urban development, there is also an increase in the vehicle fleet to meet the population's needs. However, this increase contributes to air pollution, with an increase in cardiorespiratory diseases in the population, which are commonly associated with air pollution (Abe and Miraglia 2016; Saldiva et al. 1995; Veronez et al. 2012). Dwellings near roads or highways may also cause health problems related to air pollution. A recent study in Beijing suggests that long-term exposure to air pollution related to vehicle traffic on major roads in Beijing is associated with lower lung function, airway acidification, and a higher prevalence of chronic cough (Hu et al., 2016).

Other illnesses are also identified, such as the increase in obesity caused by the change in eating habits due to the increased consumption of processed foods and the reduction of physical activity, which alters the previous nutritional behaviour. Another factor that causes correlated diseases is the stress caused by vehicular traffic (Ferreira et al., 2013).

The changes not only impact the riparian population but also reach the entire population of the city of Porto Velho in the state of Rondônia and in other states in the Amazon region; that is, they have cross-boundary impacts (Marengo, 2008)

For example, in the case of air pollution, the contamination plume can be carried by the wind to other areas beyond the site where it was generated, damaging health with diseases associated with air pollution or causing acid rain that deteriorates property. Another negative impact caused by air pollution is the emission of greenhouse gases, which result in the destruction of the earth's ozone layer, raising the planet's temperature and contributing to drought in places such as the Amazon basin, the melting of the polar ice caps, and even the destruction of the planet's biodiversity (Ehrmann and Stinson, 1994; IPCC, 2014).

The diagram network impacts elaboration at the national or international level will be of great value to enable preventive or mitigating actions to be taken before a change in public health resulting from an environmental impact. The actors engaged in the environmental licensing process in Brazil have the perception that health is simply the absence of disease, and the treatment of health in the EIA/RIMA is sometimes limited to an inventory of the health services infrastructure in the enterprise's area of influence (Brasil, 2014). In spite of the institutionalization and obligatory nature of the EIA-EIR to have meant a milestone in the evolution of Brazilian

environmentalism (Silveira and Neto, 2014), it is a fact that the inclusion of the evaluation of health effects in the environmental licensing process is lacking. There is no regulation of any specific health impact assessment tool for the environmental licensing process in Brazil (Silveira and Neto, 2014).Negligence with the health effects of the population occurs relatively frequently, since the only legalized mechanisms of health participation in the environmental licensing process is the assessment of malarious potential in malaria endemic regions (mainly the Amazon region) (Barbosa et al., 2012, CONAMA, 2001, Katsuragawaet al., 2009, Silveiraet al., 2012, SVS/MS, 2006). For other health determinants, there are no specific legislation or directives articulated with Brazilian environmental licensing, as opposed to evaluations in developed countries that consider various social and health aspects in large enterprises.

Stinson (1994) expresses concern over the potential impacts of environmental degradation on human health, indicating the need to increase environmental awareness and unify various parts and sectors of society that analyze environmental risks differently and therefore observe differences regarding the effects on human health (Ehrmann and Stinson 1994). Thus, it is considered that the applicability of this model will be a key point for Brazilian public health, which lacks information or studies that show the influence of actions, projects, or programs in the area of health. This model will serve as a basis for the Unified Health System (Sistema Único de Saúde - SUS) in its actions and improve the decision-making process of the managers of regional health systems.

Motta-Veiga (2012) states that the effects of the implementation of hydroelectric plants in Brazil have been the focus of many discussions due to the size of their impacts. The large scale of the Jirau and Santo Antônio hydroelectric projects provokes the displacement of workers from other localities. However, because this intensive use of labor is temporary, it does not provide permanent employability, that is, as soon as the work get concluded, there will be a vertiginous growth of unemployment and definitive interference in the local social, environmental and economic dynamics (de Souza Moret and Guerra, 2009). However, the approaches found in the literature show an isolated view, such as only environmental or social impacts, without appropriately including the health issue. Therefore, we can appreciate and understand the importance of creating the network of aspects and impacts to analyze the interaction of sectors and stakeholders (Queiroz and Motta-Veiga 2012).

The proposed model supports the creation of mitigation actions and even remediation actions in health so that an increase in morbidity and mortality resulting from the development of the state of Rondônia can be avoided. This promotes the movement of a state's economy with positive impacts regarding sustainable development and negative impacts with regard to health, which has been estimated to date.

The impacts of the installation of the hydroelectric dam can be positive with regard to local and national development in terms of energy availability and a consequent change in the quality of life of this population. However, the development can introduce increased costs in the health system (primary, secondary, and tertiary, included social and mental costs). Thus, one can observe the impact on health, which, despite being a sector that is highly affected, is often overlooked in projects of large enterprises. The construction of the hydroelectric dams on the Madeira River will add new social and economic plots in the Rondônia territory. The implementation of transport and electric energy infrastructures in the Brazilian Amazon has been marked by major impacts due to the environment and have assigned new functions and forms of organization in the territory. In this way, hydroelectric plants constitute a structural element, generating new arrangements, revealing the political character and the power use in the territory, considering that its construction is to meet a demand external to the Amazon region (Cavalcanteet al., 2011).

The balancing of ecological needs with demands of industries and urban centers can be helped with certain technical expertise, but it is largely a contest between powerful political forces and the mute but fundamental needs for sustaining life on our planet (Jobin, 1999). It is necessary to consider the health opportunities, managing and mitigating the social conflicts. The cost of a dam is usually stated in terms of the money spent to build the infrastructure and carry out necessary preparatory tasks such as viability studies and resettlement. However, the opportunity cost of sacrificing the land use that would have occupied the site had it not been used for a reservoir should also be part of the decision when a dam-building project is initiated (Fearnside, 2005). This study demonstrates the importance of a qualitative diagram that serves as a basis for more efficient quantitative analysis to assist the start of conducting a prospective and quantitative HIA. The evidence generated from studies such as this can support the analysis of likely impacts and can predict and mitigate future impacts. The diagram begins to articulate some of the non-environmental outcomes and impacts of dam-building that are important to consider. The Brazilian government needs to develop and adopt a credible institutional framework (Fearnside, 2006).

We are aware of the limitations of our methodological approach in terms of the coverage of impacts and a complete analysis of each different situation and location. The lack of national high quality studies to cover a detailed range of determinants of health on affected population lead us to offer an extensive bibliographic search to summarize the hydroelectric dams impacts and to highlight its relevance. Nevertheless, we are confident that we provide an adequate basis for enlarging the overview aspects/ impacts influencing a case study that can be replicated in other situations. We adopt this methodological approach to the evaluation of an environmental policy and its associated health effects and we are finding interesting and significant results. Moreover, this tool is promising with regard to both retrospective and prospective HIA studies.

Recommendations

Some recommendations derived from this qualitative HIA retrospective study should be addressed to stakeholders and decision-makers.. We summarize them as follows:

1. Dams have to be weighed against alternative energy projects in terms of environmental, social and health costs, sustainability and climate effects;
2. Perform a prospective and quantitative HIA study to predict and minimize the health impacts;
3. Obtain evidence from previous studies to serve as the basis for the probable impacts analysis;
4. Develop a monitoring program to be performed along with the construction, enabling interventions with focus on minimizing health impacts;
5. Consult stakeholders frequently, searching for changes in habits and in the health status that appear before the increase in demand for the health service;
6. Create a communication system with health authorities, the construction company and policy makers to emphasize all of the occurrences of alterations in the project and construction process.

Conclusion

The diagram network impacts elaboration has been useful as an important tool for assessing a broader view of direct and indirect impacts categories, serving as a basis for further evaluations and studies. International data are limited to adapt in a national scenario, however, bring together national and international data and evidences can possibility cover a range of effects, collaborating for the network construction of evidences and country´s environmental licensing system.

Brazil´s dam-building plans in Amazonia imply substantial environmental and social impacts and pose a challenge to the country´s environmental licensing

system (Fearnside, 2006). We recommend a strategic planning in health impacts to avoid externalities, to prevent and reduce costs in the health system, and to obtain continuous improvement with investments lower than that planned.

Therefore, one can conclude that the implementation of hydroelectric dams has significant regional effects in social, environmental, and economic aspects and especially in the health sector. We suggest a more comprehensive analysis in all of these sectors in order to improve the national knowledge and the adoption of HIA model to mitigate the negative impacts and maximize the positive aspects on the environment and the population.

Ethical approval: This article does not contain any studies with human participants performed by any of the authors.

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EXPANDING THE INDIANAPOLIS CULTURAL TRAIL: A HEALTH IMPACT ASSESSMENT

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Abstract:

Background: Health Impact Assessments (HIA) are used to measure the effect of policies and/or projects that influence the health of populations. As a way to increase HIA practitioners, university courses in HIA can benefit both students and community organizations by presenting real-world opportunities for students to conduct HIA while partnering with community organizations or policy makers.

Methods: As a course assessment, students in a graduate-level public health course conducted a rapid six step HIA of three potential expansion routes of the Indiana Cultural Trail (ICT). The six steps were 1) screening, 2) scoping, 3) assessment, 4) recommendations, 5) reporting, and 6) monitoring and evaluation. To complete the HIA, students examined local health data, conducted walkability assessments, and conducted seven key stakeholder interviews.

Results: The analysis results show that the Riley Hospital Drive/Gateway Bridge (route 3) was the best potential route for expansion due to traffic safety considerations and the impact on residential parking in the adjacent Ransom Place neighborhood. In general, the key informants were in favor of the expansion, with the two most cited reasons being additional space for exercise and recreation and the potential economic impact and connection to local businesses in the area.

Conclusion: Through the course assessment, students determined the expansion across the proposed Gateway Bridge would combat parking issues associated with expanding the trail through Ransom Place as well as be the safest way for pedestrians and vehicle traffic to approach large intersections. The ICT trail expansion could lead to improved health outcomes by offering additional space for exercise, recreation, and active transportation.

Introduction

Many populations in the United States face health disparities attributable to factors such as the environment, social inequality, socioeconomic status, and neighborhood attributes. For instance, lack of access to public services and healthy food options, as well as limited public transportation, can contribute to poor health outcomes (Ross, 2014). It is increasingly evident that the health of individuals and communities is largely shaped by the settings in which they live and work (Meyer, 2014; Robinette, 2017). In order to identify ways to alleviate and overcome health disparities in communities across the United States, communities need resources that will allow identification of the upstream root problems causing the disparities. One tool developed to guide this decision-making process is the Health Impact Assessment (HIA) (Pollack, 2014).

The National Research Council's Committee on Health Impact Assessment states, "HIA is an approach to assessing the risk factors, disease, and equity issues that create poor health outcomes" (Committee on Health Impact Assessment, 2011). Fundamentally, HIA is a mechanism that organizations and legislative bodies can employ to examine current and future policy proposals, programs, and projects to ensure that they will produce the intended health benefits. It should be noted that HIAs are used more to study projects and proposals that were not intended to have a public health benefit, but that nonetheless impact health (Ross, 2014).

As HIAs have become more common in the United States, university programs have developed courses that teach students about the reasoning and methodology behind HIAs. Oftentimes, students have the opportunity to apply the course content to analyze real-world programs in order to identify their potential health impacts. Frequently graduate programs are contacted by organizations to conduct HIAs for one of their projects or proposals before the organization begins work (Pollack, 2014). Students learning about HIAs can provide a cost-effective service to community organizations that are interested in learning more about the impact of a problem. However, there are limitations associated with students conducting HIA. This paper demonstrates one example of a graduate-level course utilizing a real-world problem to learn about HIA, while offering results to a community partner.

Project Description

The Indianapolis Cultural Trail (ICT) consists of eight miles of urban bicycle and pedestrian trails in downtown Indianapolis, Indiana (Marion County). The trail connects neighborhoods and cultural districts within the downtown area to the larger greenway system of the greater Indianapolis area (Indianapolis Cultural Trail, Inc., 2017). Though the intent of the trail was to be a transit connector and act as a promoter for economic growth, previous assessments of the Cultural Trail show that exercise and recreation is a main reason why people use the trail (Indiana University Public Policy Institute, 2015). In order to continue serving residents and visitors of Indianapolis, ICT leaders plan to extend the trail northwest of downtown Indianapolis connecting it to Ransom Place, a residential neighborhood, and 16 Tech, a developing industrial park. During initial expansion planning, ICT wanted to examine three potential expansion routes that would connect Ransom Place and 16 Tech (Figure 1) (Table 1). All three proposed routes are within the same zip code.

Figure 1.

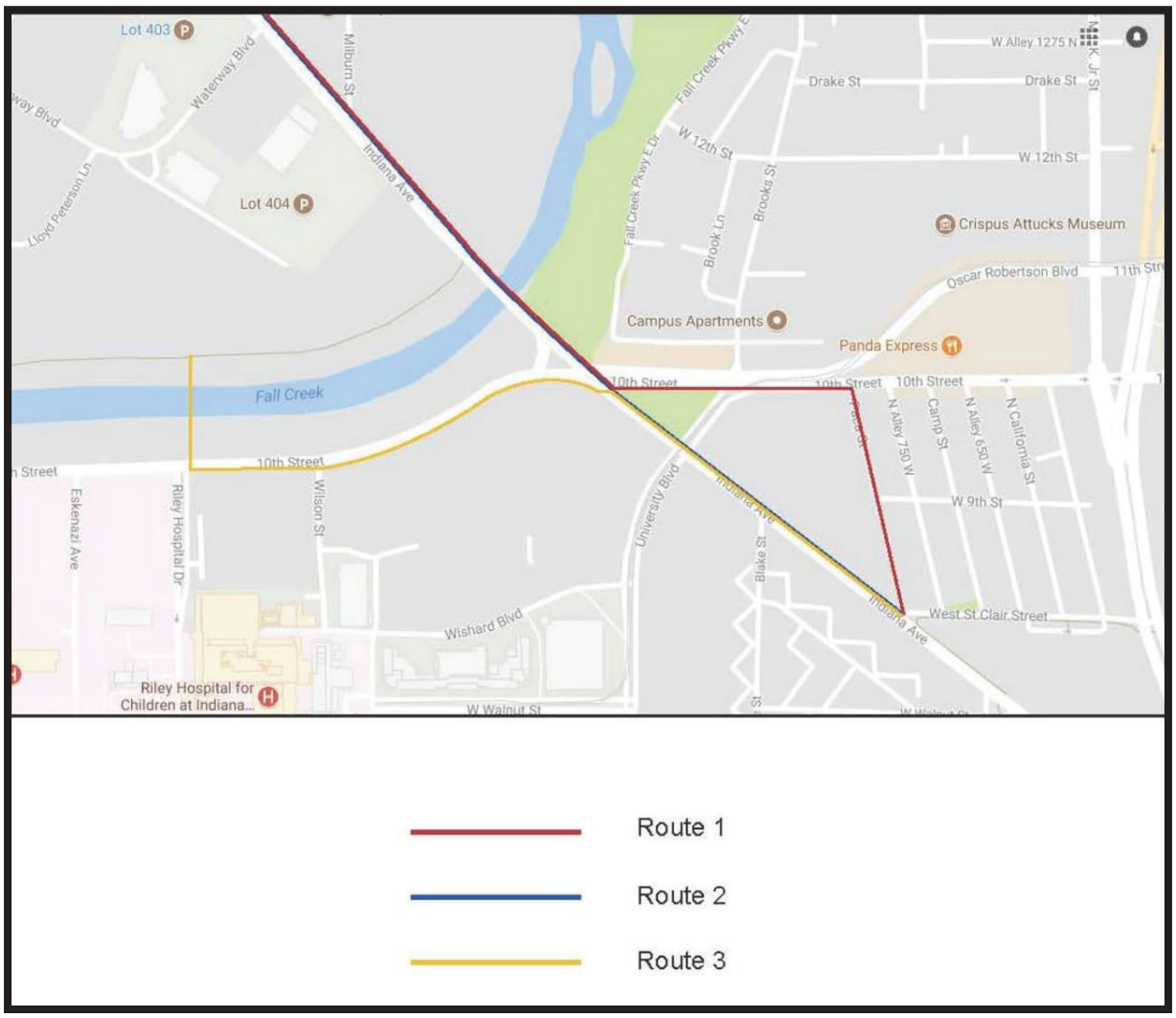

Table 1: Three Potential Expansion Routes

1.	From the end of the trail at Indiana Avenue and St. Clair Street: Utilize neighborhood streets in the Ransom Place residential neighborhood to connect with 10th Street and cross the Indiana Avenue bridge in the direction of 16 Tech.
2.	From the end of the trail at Indiana Avenue and St. Clair Street: Follow Indiana Avenue west to 10th Street and cross the Indiana Avenue bridge in the direction of 16 Tech.
3.	From the intersection of Indiana Avenue and 10th Street: Follow 10th Street west to Riley Hospital Drive, cross 10th Street and head north into the developing river-front in the direction of 16 Tech (future Gateway Bridge).

The three route options are in close proximity to each other and all involve the Ransom Place neighborhood, which is directly adjacent to the Indiana University-Purdue University Indianapolis campus, a large medical center, and several area businesses. The area is compact with a great deal of traffic, including emergency vehicles, which exit and enter the neighborhood streets and nearby interstate system. Pedestrian and bicycle traffic is common in the area with students, staff, and employees commuting to work or class.

To examine the route options, ICT approached the Richard M. Fairbanks School of Public Health graduate-level Health Impact Assessment course to conduct a rapid health impact assessment of three potential routes. ICT sought to identify the safest, most usable, and least restrictive path for their extension route choice.

The HIA focused on the following questions:

1. What is the current health status of the resident population in the neighborhood?
2. Do neighborhood residents, employees, and visitors believe there is a better route among the three proposed routes?
3. Would an extension of the trail be utilized by the residents, employees, and visitors to the area?
4. Is one of the three options a better route when considering the health and safety impact of the residents, employees, and visitors of the area?

Methods

During the first week of the course, the ICT staff presented an overview of the ICT, the potential expansion routes, and the information they were interested in learning with the project. At that time, the class began examining the options for conducting a comprehensive HIA, including a standard HIA, which requires a substantial time commitment and primary data collection, and a rapid HIA, which uses already-existing and available data and resources (Mindell, 2003). Due to the short turnaround time (approximately five weeks to conduct and complete the HIA) and nature of the project, the class decided that the rapid HIA would be appropriate to assess the suitability of the three proposed routes. Students divided into three groups, with each group examining one proposed route option. Students followed a six-step rapid HIA process of screening, scoping, assessment, recommendations & reporting, and monitoring and evaluation (Ross, 2014) (Table 2).

In order to answer the key questions and complete the HIA, data were collected by three methods: 1) secondary data provided by the local health department and the CDC that detailed the basic demographic, chronic diseases, cause of death, and cause of hospitalization of the zip code, 2) students in the course conducted a walkability assessment of each potential route, and 3) conducting brief, iterative key stakeholder interviews that were guided by a standardized question list but not bound by those questions (Table 3).

Table 2: Health Impact Assessment Steps

Screening	Minimal screening was needed for this project as it was part of an assigned course. The ICT staff made an informative presentation to the class that outlined the need for the HIA. Students began to identify data sources and other resources to assist with the screening process.
Scoping	With the limited time available to perform an HIA, students chose to focus on two issues affecting the health of residents and potential trail users, namely physical activity and safety. These were chosen due to the nature of the ICT being a center for physical activity. Additionally, safety is a concern for the area due to a large amount of traffic and pedestrians. 1. Indianapolis continually ranks low in physical activity health-related outcomes on the American Fitness Index. Therefore, increasing access to physical activity options may lead to improve chronic disease health indicators of the affected population. 2. Vehicle and pedestrian safety is a concern for many of those living in the area and should be considered when attracting bike and pedestrian traffic to an area.
Assessment	The assessment had three components: 1. The current health status of the area was assessed using existing quantitative data from the local health department and CDC. Cause of death and hospitalization data were pulled for the zip code. This secondary data was prepared by an epidemiologist at the local public health department. 2. Each student group conducted a walkability survey to help evaluate the existing walkways of the area. These assessments were done in order for students to understand the walkability of the existing walkways and a first-hand look at the potential routes. This helped students to better understand the routes. 3. Non-formal, face-to-face interviews were conducted with seven key stakeholders in order to gather information, thoughts, and feelings about the ICT expansion from those who may be greatly impacted by the expansion. The interviews were conducted with a sample of residents, students, and employees of the area. The interviews were brief, lasting approximately 15 minutes each, and major ideas were documented in notes by the student(s). Students were prepared with a list of interview questions, however they interviews were iterative, allowing for the stakeholder to detail the important aspects of the ICT trail expansion in his or her own words.
Recommendations & Reporting	The HIA team developed an initial set of four main recommendations and four secondary recommendations for ICT. A final report was submitted to ICT.
Monitoring & Evaluation	Due to time constraints of the course, only recommendations for monitoring and evaluation could be made to ICT.

Table 3: Question Guide for Key Informant Interview Questions

Stakeholder Interview Questions	Summary of Stakeholder Responses
1. Do you currently use the sidewalks along Indiana Avenue between St. Claire Street and the bridge that crosses over Fall Creek into 16 Tech?	For each section of the trail, most respondents stated that they were familiar with the sidewalks of the proposed routes.
2. If yes, how frequently do you use the sidewalks?	The responses for frequency of use differed, but most use was due to small commutes several times a week.
3. If yes, in what capacity do you use sidewalks? For pleasure? For transit to work? For exercise?	Respondents currently use the sidewalks in the area during their work day to get to and from different locations, such as eating establishments.
4. Do you use the Indianapolis Cultural Trail?	Respondents stated that they had used the Cultural Trail.
5. If yes, how frequently do you use the trail?	The responses for frequency varied from a few times a week to a few times a year depending on proximity to the existing trail.
6. If yes, in what capacity do you use the trail? For pleasure? For transit to work? For exercise?	Respondents typically only used the existing portions of the trail on special occasions for pleasure, especially if the respondents did not live in the vicinity.
7. How do you feel about extending the Indianapolis Cultural Trail along the proposed route (students explained route options)?	Respondents were positive about the proposed expansion and saw it as a means to increase foot traffic to area businesses as well as for feasibility in healthy transportation. Those living along route 1 only opposed the routes extension through the Ransom Place neighborhood. Many respondents felt that extending the trail along route 3 would help to divert pedestrian traffic away from vehicular traffic at the intersection of Indiana Ave. and 10th St. Riley Hospital Drive was most the most popular choice.
8. Would you use the trail more if more sections were added?	Respondents unanimously expressed their interest in more frequent use if the trail were extended.
9. If yes, for pleasure? For transit? For exercise?	Respondents would mostly use of the trail for pleasure and transit.
10. What do you see as the advantages to extending the Indianapolis Cultural Trail along route specified earlier?	Most respondents commented on the increased economic advantages that the trail would provide, such as the potential for more restaurants, shops, and jobs.

11. What do you see as disadvantages to extending the Indianapolis Cultural Trail along the routes?	Respondents commented on the potential cost the trail could incur for the build and other costs for related structural changes, such as road repairs for connected streets.

Results

Resident Demographics and Characteristics

The three potential routes fall within the 46202 zip code in Indianapolis, inside Marion County (Table 4).

Table 4: Demographics of the Population in the 46202 Zip Code (2010)

Variable	n (%)
Total Population	16335
Median Age (years)	30.4
Sex	
Female	7397 (45)
Male	8938 (55)
Race/Ethnicity	
White	9043 (55)
Black	5802 (36)
Other/Don't know/Refused	1490 (9)
Hispanic/Latino	605 (4)
Median Household Income (dollars)	$32,186

Note: (Marion County Public Health Department, 2017)

Public health data show that residents living in the 46202 zip code fare better than the rest of the county with regard to hospitalizations and deaths from heart disease and stroke. However, there is a higher rate of death from diabetes reported (26 per 100,000 vs 20 per 100,000) (Marion County Public Health Department, 2017). In 2017, the overall prevalence of diagnosed diabetes for Marion county, which houses the Indiana Cultural Trail expansion, was 10.2%, which is higher than the 9.2% prevalence rate of diabetes for Indiana (Center for Disease Control, 2017). Likewise, deaths due to hypertension were 239.6 per 100,000 people, which is significantly higher than the national average for 219.8 deaths per 100,000 (CDC, 2017). Additional local data shows that life expectancy of those residents in the geographic area is 69.4 years, which is 14 years lower than those living 28 miles north of the area (Weathers, 2015).

Walkability Assessment

Each group conducted a walkability survey (Health by Design, 2009) that consisted of five sections to assess quality of walkways, intersections and crosswalks, safety, and accessible amenities in the area. The main findings from the walkability surveys were: 1) portions of existing sidewalks were not in good repair due to cracks, uneven pavement, and disconnection to other pathways, 2) all three route options included existing major intersections that are challenging for pedestrians to use due to fast moving traffic from multiple directions, and 3) the proposed routes will all lead pedestrians to local amenities, such as residential areas, restaurants, and hospitals. The main finding resulting from the walkability assessments was the examination of the large intersections that feed vehicle and pedestrian traffic through the area.

Key Stakeholder Interviews

Seven face-to-face key stakeholder interviews were conducted including two employees of local businesses who drive, walk, and work in the area; the president of the local Ransom Place neighborhood association who represents Ransom Place residents; a state senator who represents the local area; a local church leader located in the neighborhood; a patient who utilizes a local hospital and drives, parks, and walks in the hospital area; and a college student who lives in the neighborhood and attends the adjacent university. Stakeholders were chosen because they live, work, and/or are a community member of the local area that could be affected by the expansion. Additionally, they were chosen because of their quick accessibility, which was required due to the limited project timing.

Interviews were brief, lasting approximately 15 minutes each.

A summary of the main findings of the key stakeholder interviews were as follows (see Table 3 for summary of interview responses):

1. All but one of the seven key stakeholders stated they were in favor of the ICT expansion project. The one who opposed the ICT expansion suggested that gentrification would be possible and that already existing parking issues in the area would be heightened.
2. After an overview of the three potential routes during the interview, those in favor of the ICT expansion all agreed that the Riley Hospital Drive expansion route (future Gateway Bridge) would be the best route as long as it was safe to use.
3. The economic benefits of connecting the area with 16 Tech could be beneficial to residents, employees, and businesses by driving more pedestrian traffic to local businesses.
4. The new expansion would allow for additional walking/biking paths that can be used for transportation, exercise, and recreation.

Recommendations

After conducting the HIA steps, four key recommendations were proposed and four secondary recommendations proposed (detailed in discussion section) to the ICT.

1. After discussing the current options with the

engaged stakeholders, students determined that expanding the trail to use west 10th Street and the proposed Gateway Bridge (option 3) would provide the easiest connection and safest route for trail users. Likewise, the new proposed path would link other existing pedestrian and bicycle trails from the west, south, and north of the general area. This would avoid disrupting the Ransom Place neighborhood and any potential parking issue in the area that a new trail might cause.

2. In order to monitor the expansion and use of the trail, ICT trail should conduct pedestrian and bicycle counts to track types of use, times of high and low usage, and whether or not the extension of the trail sees increased pedestrian use after the linkage with 16 Tech. Additionally, ICT should track trends in property development both along the Indiana Avenue corridor and in 16 Tech for use in future trail development. Increased employment opportunities, healthier eating establishments, grocery store, and other resource development should be documented should those entities be implemented.

3. Indianapolis Cultural Trail Inc, should work in tandem with the Marion County Public Health Department to identify and compare health-related data and automobile collision data within the 46202 zip code and immediate geographic area during and after the trail expansion. The Indianapolis Transit Authority should be consulted for data pertaining to changes in mass transit use along the corridor as well as changes in frequency and timeliness of mass transit options.

4. Finally, future HIA or evaluation courses should conduct an evaluation of the trail expansion during a future semester in order to monitor changes in health and the economy along the path as they look at implementing new long-term HIAs for other trail expansions.

Discussion

Conditions that promote health in places where we live, work, and play can have an important impact on the health status of Americans. HIAs can assist decision makers with determining the best options that allow for the promotion of health of those impacted by the planned policy or project. HIAs help to connect scientific data, public input, and health expertise to guide decisions (Pew Charitable Trusts, 2017). This rapid HIA was conducted in order to 1) provide students taking the graduate-level HIA course experience with conducting a real-world assessment, and 2) produce recommendations for the ICT.

The key stakeholder interviews allowed for in-person one-on-one conversations to happen with those most-likely impacted by the proposed trail expansion. Although the majority of those interviewed were in favor of the expansion, stakeholders stated that the trail could negatively impact the Ransom Place residential neighborhood. One interview participant suggested that the development may lead to gentrification. With the potential to increase economic activity in this area of the city, it is critical to emphasize the importance of policies to promote mixed income housing to discourage immediate gentrification (Read, 2017). Other parts of the city with a current trailway saw vast gentrification, and the housing prices rose quickly leaving many low income residents without the ability to afford their homes. Because income and housing can be significant drivers of overall public health, researchers recommend that planners work with city officials to draft policies protecting current residents. To help overcome concerns of disconnectedness that the ICT expansion may have on local residents, one stakeholder suggested that the newly expanded trail include local artwork or historical markers by saying, “It would be great; I would want to walk it if it’s close to work; I would like having that area developed to look useable and pretty—it would make me happy to use it. It would benefit my quality of life; it is safe and pleasant to use.” In order to educate local residents

about the historical significance of the area, planners should include local art, specifically art relative to the African American community who first settled the area and continue to inhabit it. In order to inform trail users of the area, additional signage should be added along the trail to indicate the historic neighborhood of Ransom Place and informational signs would be useful in maintaining the deep history of the area.

The ICT plays an important role in exercise and recreation for users. Marketing and promotion of the cultural trail expansion should be used to promote use in order to increase physical activity. In cities similar to Indianapolis, having a well developed network of biking and walking trails increases walkability and bikeability, thereby increasing physical activity for all residents (Brownson, 2000). Recent studies have found that walkability is a highly significant predictor of physical activity independent of individual behavior and even socioeconomic status (Sallis, 2009). Many studies have shown the importance of infrastructure in increasing walking and cycling mode shares. Cross-sectional studies consistently show a positive correlation between bike facilities and cycling (Pucher, 2010). Dill (2003) found each additional bikeway mile per square mile is associated with a roughly one percent increase in bicycle mode share.

Safety was also a main concern for the ICT and the key stakeholders who live and/or work in the area. As each of the three potential routes include large intersections and city streets that carry a large volume of fast moving traffic, it is important for the expansion planners to consider safety as a main priority. Safety education is an important aspect of both public safety and encouraging physical activity in potential trail users. Safety training programs improve pedestrian skills such as timing and choosing safe crossings (Killoran, 2006). Marketing programs have been successful in promoting individual behavior change. Such programs can increase the use of alternative modes by 10-25 percent (Victoria Transportation Policy Institute, 2010). These evidence-based recommendations are potentially useful in Indianapolis and are easily applicable to the expansion of the cultural trail.

This project had several limitations. First, because the course was a six-week intensive course, there was a limited amount of time in which students could conduct this rapid HIA. Although the course was six weeks, students had approximately five weeks to design, implement, and report the findings of the HIA. If time would have allowed for a full HIA, more in-depth primary data could have been collected that might show a more direct health impact of the expansion. Second, as students implemented the HIA plan, students determined there were gaps in the data collection plan, such as the interview guide did not match the need for the stakeholder interviews and limited data for the specific area of interest. In order to accommodate for these items, students made adjustments as they went along with the guidance of the course instructor. The health impact-related outcomes could not be thoroughly examined in the allotted time frame and with the existing student resources. The recommendations were a product of the planned data collection, but there were unforeseen gaps in the planning and data collection processes which led to less rigorous findings as could have been expected in a full HIA. This was due to the lack of student experience conducting HIA. Third, characterization impact assessment was not made for each of the factors affecting the three routes. Impact characterization is an important step to allow for an overview of the full project. This step should be completed if time allows in any future HIA of the ICT. Finally, the potential ICT expansion routes were already identified prior to the HIA taking place. There could be additional routes that may have a different impact on the area.

Implications for Practice

This project allowed graduate students to have hands-on experience conducting a rapid HIA in the real world with potential impact on the project. The outcomes

of the HIA were meaningful, and contribute to the ICT organization's planning process for future expansion of the route. Likewise, this HIA demonstrates the importance of engaging communities most affected by proposed projects, as they provide valuable insight to unintended consequences of community based projects. The HIA project serves as an example for other academic courses that focus on HIA. Students can use this as a reference or case study for future studies.

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Figure Legend

Figure 1: Map of Three Proposed Expansion Routes

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HEALTH EQUITY GUIDE REVIEW

Cynthia Stone, DrPH, RN; Danielle Boberschmidt

Human Impact Partners (HIP) has led the development of a partnership that produced the Health Equity Guide (HIPP-a 2017). The guide includes five key organizing concepts that include the following:

- Mobilize data, research, and evaluation
- Building internal infrastructure to advance health equity
- Work across government to advance health equity
- Foster community partnerships to advance health equity
- Champion transformative change to advance health equity

Under the five main concepts there are 15 strategic practices and key actions that local health departments can use to advance health equity within their organizations and with their community partners (HIP, 2017). The fifteen strategies include:

Under Mobilize data research, and evaluation:

1. Mobilize data, research, and evaluation to make the case for, assess, and inform interventions for health equity.

Under Build Organizational Capacity

2. Strategic practice change of internal practices and processes to align internal processes to advance equity.
3. Prioritize upstream policy change to improve the social determinants of health.
4. Build awareness of the connection between the social determinants and health with different audiences, including health department staff, healthcare institutions, government agencies, elected officials and community stakeholders.
5. Allocate resources to advance equity for health equity staff positions and to track and align resources.

Under Work Across Government to Advance Health Equity

6. Build government alliances with other government agencies to advance equity through training.
7. Develop a shared analysis with other agencies about government's role in creating health equity.
8. Broaden the administrative and regulatory scope of public health and other agency practices to advance health equity.

Under Foster Community Partnerships to Advance Health Equity

9. Share power with communities by building strategic community relationships, sharing power and decision making, and sparking meaningful participation.
10. Build community alliances with community partners to protect against risk and build community power.
11. Engage in movements such as social justice campaigns and movements to advance equity by providing data and conducting research, as well as advocating in support of community partners' interests.

Under Champion Transformative Change to Advance Health Equity

12. Confront the root causes of power imbalances and the racial and other forms of oppression used to maintain those imbalances.
13. Develop leadership and support innovation and reward strategic risk taking to advance equity.
14. Change the conversation about what creates health equity within public health, across government, and in communities.
15. Build a health equity movement by joining with others in public health to build a health equity movement to advance justice and equity (Human Impact Partners-a, 2017).

The Health Equity Guide cautions that the guide is not advocating to be a step by step guide, but for organizations to use the provided suggestions to model their own organizational path to improving health equity.

The "Ways to Get Started Guide" provides additional details. For example, in the Actions to Build Internal Infrastructure to Advance Health Equity the suggestions include: Creating a team; developing a plan; documenting inequities; leveraging existing staffing; leverage existing funding; using equity tools, surveying your staff, organizing a training and changing your forms (HealthEquityGuide, 2017). One resource recommended to use for this step is the Bay Area Regional Health Inequities Initiative (BARHII) Organizational Self- Assessment Toolkit (2010).

The HealthEquityGuide.org website provides information on the strategic practices, and provides over 25 case studies from local health departments (HIPP-b, 2017). The website also has over 150 interactive resources you can search by key concepts (HIPP-c). The website also provides a link to recordings from a four part webinar series that reviewed the strategic practices and presented related case study examples. The partners on the webinar series included the Government Alliance on Race and Equity, the National Collaborative for Health Equity, and the National Association of County and City Health Officers' Health Equity and Social Justice Committee (HIP, 2017)

The HealthEquityGuide is a useful tool for health impact assessment (HIA) practitioners so they can implement and advocate with local health department partners. Health equity is a key value of HIAs and the Human Impact Partners Project states that "used collectively, these strategic practices can help local health departments systematically address power imbalances, racism, and other forms of oppression which are at the root of health inequities" (HealthEquityGuide.org: A Human Impact Partners Project-a, 2017, p.# 4).

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