Consortium on Law and Values in Health, Environment & the Life Sciences

2017-18 Student Proposal Cover Page

Applicant Information

Applicant name(s):	BRITTANY KRZYZANOWSKI	Email:	krzyz016@umn.edu
Project title:	**Bridging the gap between health geography and evidence-based public health policy by facilitating knowledge of spatial methods with dynamic geovisualization.**		
Department:	Geography, Environment & Society	College:	College of Liberal Arts
Degree program:	Ph.D.	Faculty advisor name email:eshook@umn.edu	ERIC SHOOK ☐ NA
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How did you hear about this funding opportunity?
☒ Consortium e-mail ☐ Graduate & Professional Student Update ☐ The Brief ☐ Advisor ☐ Dept. email/newsletter
☐ Consortium website ☐ Other

Funding

Total amount of funding requested: **$7,000**

Executive summary (maximum 200 words)

Increased availability of spatially-referenced health data and advances in geographical information systems (GIS) has provided epidemiologists with powerful analytical tools enabling them to explore health across space. Spatial epidemiological studies ensure that decision makers have complete knowledge to guide evidence-informed public health policy. Alarmingly, there is a clear lack of detailed examples of how GIS has influenced health policy. This is especially concerning given the serious impact of regional context on community health intervention strategies. The absence of spatially-informed health policy is partly due to a lack of confidence in GIS methods which are generally not well-understood. This lack of understanding is a result of a gap in epidemiological literature which can be easily filled by geographical perspectives. Epidemiologists are generally not aware of one of the most pervasive problems in spatial epidemiology, the Modifiable Areal Unit Problem (MAUP), which is widely-explored in geographical literatures. Our project highlights the importance of MAUP by using real epidemiological data to build a dynamic geovisualization to serve as a research instrument and instructional tool for facilitating understanding of MAUP. The geovisualization will be hosted on an informational web resource, and this outreach will help bridge the gap between spatial epidemiology and health policy.

Approvals

Check all appropriate approvals required for your proposal. It is not necessary to have all approvals at the time of proposal submission; however, approvals must be obtained prior to receipt of funding. If you have applied for approval but have not yet received it, indicate that below.

IRB ☒ Yes ☐ No ☐ NA ☐ Application pending

Other ☐ Yes ☐ No ☐ NA ☐ Application pending Specify:

Checklist—for reviewer use

☒ The proposal is 1000 words or less excluding budget, biographies, references and citations.

☒ The proposal includes a work plan with a specific timeline using months or quarters to identify work to be done and completion dates.

☒ The proposal includes a 1-2 paragraph biography of the applicant and all co-investigators.

☒ The budget form is complete including the funds sought for this project, other pending applications for this project, and the amount/source of matching or other funds.

☒ The applicant's faculty advisor is copied on the application email. Professional students w/o advisors check NA.

☒ All necessary approvals are pending or received.

SIGNIFICANCE

The United States invests approximately $30 billion annually on health research, promoting population wellness by the means of the clinical trials and epidemiological studies that inform health policy (Brownson et al., 2009; NIH, 2016). In epidemiology, the "setting" or "context" of a region under study has dramatic implications for the overall success of public health policy and, for this reason, decision-makers routinely consider how regional characteristics impact the effectiveness of an intervention (Boulos, 2004; Nykiforuk and Flaman, 2011). Prior research suggests that geographically-constrained social, economic, and environmental determinants of health can influence population responsiveness to policy and community interventions (Altman et al., 1999; Smith et al., 2012).

The role of regional context is well-recognized in epidemiology and perhaps has fueled the increased interest in spatial epidemiology (Arsenault, 2013). At the same time, advances in geographical information systems (GIS) technology, cyberinfrastructure, and an increased availability of spatially-referenced health data has provided epidemiologists with analytical tools that enable them to explore health across space (Elliott and Wartenberg, 2004**;** Jelinski et al., 1994). By considering regional context, spatial epidemiological studies provide decision makers with a complete knowledge to guide evidence-informed public health policy, and yet there is a clear lack of detailed examples of how GIS has influenced health policy (Nykiforuk & Flaman, 2011).

The literature often alludes to the potential for GIS to inform health policy and decision making, but this potential has not yet been realized. Perhaps the absence of GIS-informed public health policy is due to a general lack of confidence in geospatial methods (Cockings et al., 2004). Most epidemiologists are not trained to engage in "spatial thinking" and geographic studies of health can oftentimes be characterized as having nontransparent methods (Fielding and Briss, 2006; Lavis et al., 2008). For this reason, policy makers are presented with results from traditional epidemiologic approaches which are well-understood in contrast to the methods of spatial epidemiologic reports (Cockings et al., 2004; Jacquez, 2000).

The lack of confidence in GIS methods hinders innovation in population health science and further degrades the quality of communal care by denying policy makers a complete knowledge of the problem (Cockings et al., 2004; Fielding and Briss, 2006). To prompt confidence in geospatial approaches in epidemiology, the proposed project aims to secure the credibility of GIS techniques by demonstrating transparency of the spatial analytics used to investigate geographic variation. The primary goal of the project is to promote knowledge of one of the most pervasive problems in spatial epidemiology, the Modifiable Areal Unit Problem (MAUP), using a study of pneumonia incidence in the Minneapolis metro area as an example. The MAUP denotes how study results change per the scale of the analysis (Openshaw, 1984). This project will promote spatial thinking by creating an informational web resource tailored for broader public health research audiences with the aim of legitimizing GIS methods while making transparent its limitations. The overarching goal is to make results from spatial epidemiological studies visible to decision makers so that geospatial methods can help guide evidence-informed public health policy.

METHODS

The proposed interdisciplinary project relies on innovative methods to leverage cutting-edge technologies within the domain of cyberGIS—a coalescence of GIS and cyberinfrastructure (Wang, 2010)—to build a dynamic geovisualization demonstrating the pervasiveness of a concept well-recognized in geography to a community of public health researchers. This interdisciplinary project brings together the knowledges of multiple domains including Geography and GIS, Computer Science, and Epidemiology to advance population health science and promote better-informed public health policy.

Epidemiological investigation of health and disease across space relies heavily on using predetermined regions (e.g., school district boundaries, census tracts) as their unit of analysis, but--because these delineations are arbitrary and not built with a research question in mind-- the outputted coefficients are vulnerable to the effects of the MAUP. This is especially concerning knowing that the MAUP effects are more prevalent in complex, multivariate, cross-correlated data which characterizes most public health data. The effects of the MAUP are potentially dramatic for studies relying on geographic units for analyses, and this contributes to the hesitancy of health scientists to utilize spatial methods. The MAUP remains largely ignored in literatures relying on spatial methods thereby exacerbating the lack of confidence in GIS methods.

To shed light on the pervasiveness of MAUP in spatial epidemiologic research and promote general transparency of geospatial methods, I will demonstrate MAUP effects on the relative risks outputted from Poisson regression in 25 redistricted zones in both simulated data and in a real dataset of pneumonia cases across the Minneapolis metro area. I will use Jupyter Notebooks to document and execute the redistricting function as well as create and host the geovisualization. We will host this geovisualization on an informational web resource for research community outreach to encourage GIS-informed public health policy.

CONCLUSION

Epidemiology is the study of population health, and--because populations are inextricably bound to place--geospatial health studies should be considered by policy makers. Despite advances in GIS technology, epidemiologist have failed to fully recognize the capabilities of GIS methods because most lack spatial training. Our project will bridge the gap between spatial epidemiology and health policy by demonstrating transparent geospatial methods and promoting knowledge of MAUP.

TIMELINE

	2017-2018											
Month	1	2	3	4	5	6	7	8	9	10	11	12
Data Collection Creating the simulated dataset. We already possess the metro area dataset of pneumonia cases under IRB protocol 1508M77083 and will submit to renew before expiration in June 2017.	X											
Methods Building Writing python script in Jupyter Notebooks for redistricting.		X	X									
Analysis Executing 25 iterations of the python script in our simulated data and 25 iterations in the pneumonia dataset. Debugging and recoding.			X	X	X							
Building Dynamic Geovisualization Using iterative output from analysis to build an animation within Jupyter Notebook.					X	X	X	X				
Community Outreach Designing an informational webpage using Github to host the informational animation.									X	X	X	X
Writing Manuscript									X	X	X	X

BIOGRAPHY

Brittany Krzyzanowski is a doctoral student exploring human/environment interactions, population health, and spatial research methods within the University of Minnesota's Department of Geography, Environment, and Society. As an interdisciplinary scholar Brittany uses spatial analytical techniques to engage with population health topics, and she has further familiarized herself with traditional epidemiologic approaches by completing coursework within the University of Minnesota's top-ranked public health program. Her undergraduate background in Psychology and Geoscience sparked her passion for interdisciplinary health studies, and she went on to receive her master's in Experimental Psychology from Central Michigan University studying an environmental model of Parkinson's disease. Brittany's unique background in human health and environmental science has fueled her drive to improve societal health by advancing public health research methods and promoting transparency of geospatial techniques. Brittany has collaborated with health professionals on a number of projects, promoting GIS within the School of Public Health, the School of Nursing, and the Medical School at the University of Minnesota. Her research interests include regionalization, geovisualization, dynamic representation, public health policy, health disparities, social epidemiology, behavioral health, cognitive usability studies, psychology, and chronic disease epidemiology. This study is a part of her PhD dissertation.

BUDGET

Project Title: Bridging the gap between health geography and evidence-based public health policy by facilitating knowledge of spatial methods with dynamic geovisualization

	Provide justification along with costs.		**Requested funding**	**Other funding**	
	Category& instructions	**Justification**	**Amount**	**Amount**	
1	Your stipend *Maximum of $5,000*	**Project Research (at $20/hr.)** Coding (100 hrs.) Web Development (50 hrs.) Literature Review (50 hrs.) Writing (50 hrs.) Previous coursework and research experience in spatial analysis, biostatistics, and cyberGIS has sufficiently prepared me to successfully complete the project outlined in this proposal. Furthermore, I have obtained IRB approval and completed required HIPAA privacy training.	$5,000		
2	Speaker	___ speakers x $ _____ honorarium	$0		
3	Supplies & Services *Identify and explain use here or in the body of your proposal.*	**Web Developer/Visual Designer (at $20/hr.)** Undergraduate student worker (40 hrs.) The primary goal of our project is to facilitate understanding of MAUP and promote knowledge through public health research community outreach. To ensure that this goal is met, it's vital that our geovisualization and informational web resource are well-received by public health audiences in addition to being functional. This will require a legitimate, professional-looking webpage with a user-friendly interactive design. We will employ a student from the school of Graphic Design, Marketing, or Psychology (preferably multidomain-affiliated) to help with some of the more advanced aspects of web design.	$500		
4	Equipment	**STATA/IC Software** Poisson regression would be performed in STATA. I have received prior training in STATA.	$200		
5	Travel *Indicate the purpose of the travel, estimated dates of travel, transportation, housing and allowable per diem costs (see travel.umn.edu).*	**GEOMED Conference** **APHA Conference** It would be in our best interest to present our research and demo our geovisualization at the *GEOMED International Conference on Spatial Statistics, Spatial Epidemiology, & Spatial Aspects of Public Health.* This conference draws attendance from public health researchers interested in spatial analysis, which is the audience we are targeting for our research community outreach. Because this conference is held every other year—and the next meeting is scheduled for September 2017—we would need to complete the first stage of our analysis (within simulated data) over the coming summer. I am optimistic that we will have enough data by then to present preliminary results, however, if we are unable to produce a working geovizualization in time for GEOMED, we plan to submit our abstract to the *American Public Health Association Annual Meeting* in 2018.	$1,300		
		Subtotal research expenses (2-5)	**$0**	**$0**	
	TOTAL BUDGET		$7,000	$0	

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