IMPORTANCE OF MEDICAL TEXTILES AND DATA VISUALIZATION IN REDUCING MATERNAL AND CHILD MORTALITY

Shaghayegh R. Arangdad[1], **A. Blanton Godfrey**[2]
[1] *North Carolina State university, Wilson College of Textile*
[2] *North Carolina State university, Wilson College of Textile*
srezaei@ncsu.edu

ABSTRACT

The United Nations Sustainable Development Goal 3 includes reducing maternal and child mortality by 50% by 2030. Leading global public health experts have begun to realize the importance of data visualization for understanding the causes of death and best practices in reducing mortality.

Modern textiles are receiving increasing attention in healthcare improvement. The use of textiles for preventing injury including infections, diseases spread by insects, water-borne parasites, and in treating many medical conditions is constantly expanding in healthcare. Innovation in medical textiles and many other forms of textiles is playing a major role in reducing mortality in the world.

Key Words: MEDICAL TEXTILES, DATA VISUALIZATION, MATERNAL AND CHILD MORTALITY, IMPROVEMENT SCIENCE, IMPLEMENTATION SCIENCE

1. INTRODUCTION

In 2015, there were 216 maternal deaths per 100,000 live births in the world, 4200 children out of every 100,000 died before age 5, and 3100 infants per 100,000 live births died before their first year (2015).

Even though the number of deaths has been declining since 1990, clearly much remains to be done to reach the United Nation's Sustainable Development Goal 3, which is reducing maternal and child mortality by 50% by 2030.

In recent years, leading healthcare providers and global public health experts have begun to realize the importance of implementation science and have come together globally to focus on implementing best practices to reduce maternal and child mortality. Improvement Science and Implementation Science must be closely linked. There can be no true improvement without implementation and no implementation without improvement. Quality improvement and implementation are inseparably related and mutually reinforcing.

The purpose of this research is developing a dynamic and interactive data visualization and utilization tool to support the World Health Organization, UNICEF, the United Nations Family Planning Agency and the World Bank who are working together with the University of North Carolina – Chapel Hill WHO Coordinating Center. In this study, we have identified the most trusted and accurate databases for maternal and child mortality as well as the reasons for these deaths. We are now identifying the proven best practices used throughout the world in reducing maternal and child mortality and the roles textiles and medical textiles play in achieving these results. These best practices will be shared with 193 countries through the dynamic interactive data visualization and utilization lab.

As we continue to build our data base, we are identifying many different causes of deaths. These causes include disease, nutrition, contaminated water, education, transportation, communication, access to healthcare, and even poor care itself. Infections are one of major causes of maternal and child mortality and can be significantly reduced by medical textiles such as antimicrobial linens, gowns, and scrubs. The findings of this research will become a major part of structured improvement and implementation practices that support the United Nation's Sustainable Development Goals for health.

This article is structured as follows. The next section presents a literature review on medical textiles, use of textiles in healthcare, and data visualization in healthcare. Then the research method is described. Next, analysis and results are presented. Finally, conclusions and directions for future research are discussed.

2. LITERARURE REVIEW

2.1 Medical Textiles and Use of Textile in healthcare

According to a literature, each year about 700 million people are infected by mosquito spread disease worldwide resulting about one million deaths [1]. According to UNICEF, everyday over 1200 children died with malaria transmitted due to the mosquito bite [2].

As per the world Health Organization (WHO), current methods of preventing malaria are pesticides spraying, long-lasting insecticidal nets and insecticide-treated clothing or repellents for the time people are away from houses or not under nets at the places where malaria vectors prefer to bite [3]. Although repellents such as lotions reduce the chance of getting affected by malaria, there are limitation in their efficiency. This has required the development of mosquito repellent fabrics. A textile fabric with the mosquito protection is one of the radical ways of getting away from mosquitoes.

From all of the mosquito bite protection methods, textile protection method acts importance because textile materials are considered as third most important fundamental element of life after food and shelter for living. Mosquito protective textiles are categorized as insecticide including nets, curtains, home textile materials, military uniforms, and etc. It protects the humans from the mosquitoes' bite and thus assuring safety from the mosquito borne diseases [4].

Access to unimproved water and sanitation among children under 5 years old is a serious public health problem in many developing countries [5]. Globally, almost a billion people still do not have access to improved sources of drinking water, and about 2.5 billion lack improved sanitation [6].

Unimproved water and sanitation have been identified as a major cause of diarrhea for children in the public health literature, which globally accounts for approximately 1.4 million child deaths each year. The majority of these deaths occur in sub-Saharan Africa where nearly half the population do not have access to clean water [7]. Drinking clean water is more important for vulnerable groups like pregnant women and children under age of 5[8], especially those play in the contaminant's areas [9]. Previous studies have shown that access to clean water and sanitation can reduce child diarrhea and consequently reduce child mortality [10-11]. Although

most of the water filtrations are from ceramic, textiles can play a major role in water filtration. Filtering water of cotton cloth could reduce disease in cholera-plagued countries [13].

Medical textiles are a major growth subject in technical textiles and can be defined as products that can be used outside of body. Medical textiles can be used in a healthcare provider's practice including product like bandages, feminine hygiene products, diapers, or a cast. They can also be used in an operating room, such as surgical drapes, gowns, gloves, hairnets, and bedsheets. The main aims for medical textiles are to improve health and wellness, maintain comfort and hygiene, prevent or treat injury, avoid infection, or assist in rehabilitation [14]. Infections are one of major causes of maternal and child mortality and can be significantly reduced by medical textiles such as antimicrobial linens, gowns, and scrubs.

2.2 Data Visualization in Healthcare

Although solving the problems and statistical analysis are principal, data visualization will certainly play an important role in data analytics. Many years ago, back to the foundations of health science, in 1855, Dr. John Snow mapped the cases of a London cholera epidemic, he was exploring and discovering what is the cause of cholera [15] (Figure 1). In 1858, Florence Nightingale plotted deaths in the Crimean War. Florence was using graphics to present data to convince people of the need for sanitary reforms [16] (Figure 2).

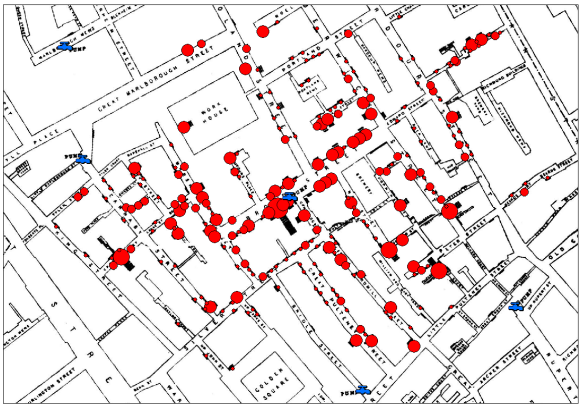

Figure 1. John Snow's 1855 cholera map [15]

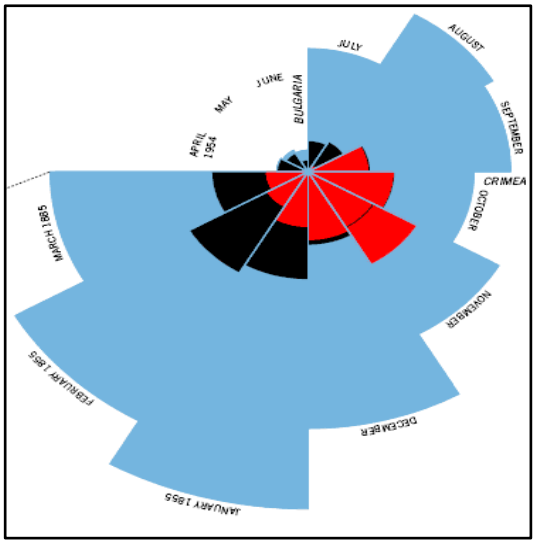

Figure 2. Nightingale's 1858 plot of war deaths [16]

Visualization has found increasing use over the last several years, most visualizations have been tools for creating meaning from data to help people to see and understand the data. Analytics should be fast to create and recently there are many visualization tools specially in data science.

3. METHOD

We are looking at different causes and solutions by countries and regions, trying to understand the solutions and find the best solution, and implement them. The data used was provided by the Institute for Health Metrics and Evaluation which is partnered with the University of Washington and the Gates Foundation. After the data was requested and delivered, several different data analysis tools were used to analyze it including Excel, JMP Pro 13, and Tableau. The data given to us can be analyzed either as the total number of deaths or as a rate per 100,000 live births. We used our data analysis tools to do this by taking advantage of of JMP Pro along with the geographic map feature of Tableau.
Using JMP Pro and a pareto plot, it can easily be seen which causes account for the most deaths both as a rate per capita and total number. It is then important to research which countries have the highest and lowest death rates among the most fatal causes of death. By discovering which countries and regions are susceptible to different types of disease and fatalities, we will be able to look into methodologies and determine which practices are proven to be effective.

4. RESULTS AND DISCUSSION

Globally, diarrhea and malaria are in top 5 causes of deaths for children under age of 5 since 1990. Based on our database Figure 3 shows the screen shots of our interactive global map and chart visualizing the number of children under age 5 deaths per 100,000 live birth globally aside with cause of deaths.

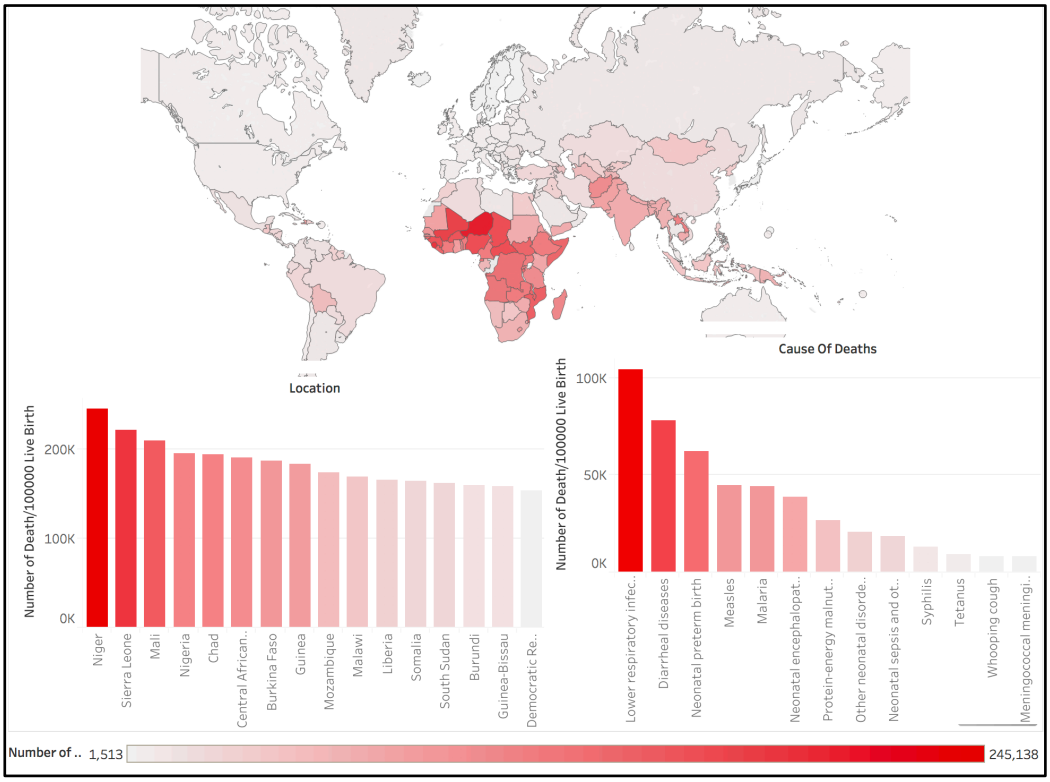

Figure 3. Interactive global map and chart visualization for children under age 5 mortality

Malaria is the main cause of deaths for children under age 5 in Sierra Leone, Mali, and Nigeria, but the number of deaths caused by malaria dropped over 50 percent from 1990 to 2017 (Figure 4). Diarrhea is the second top cause of the deaths globally, which had a great improved over the time, it declined from 77,858 deaths to 19,623 from 1990 to 2016.

We found that the countries with the highest rates of mortality were typically located in the African region including: Niger, Sierra Leone, Mali, Nigeria, and Chad. A lot of this can likely be attributed to the fact that this has been a war-stricken region for a while now. Other common causes of children death in this region aside from diarrhea and malaria include: infections and measles disease.

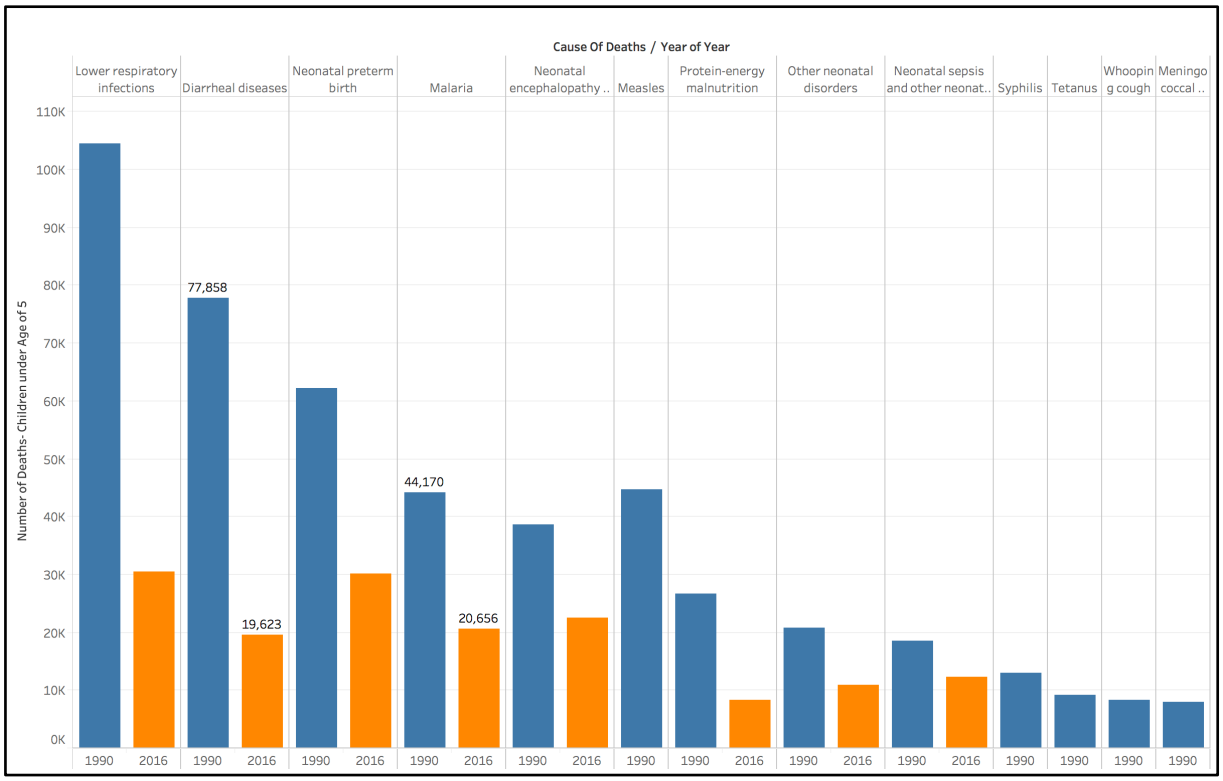

Figure 4. Comparison of main causes of deaths for children under age of 5

Infections were recognized as one of the main causes of maternal and child mortality. From the different cause of deaths, infection was selected and was found that India has a highest number of maternal mortality caused by infection, however, based on our database there is a huge decline (15,819 to 4,291) in number of maternal deaths caused by infection in India from 1990 to 2017.

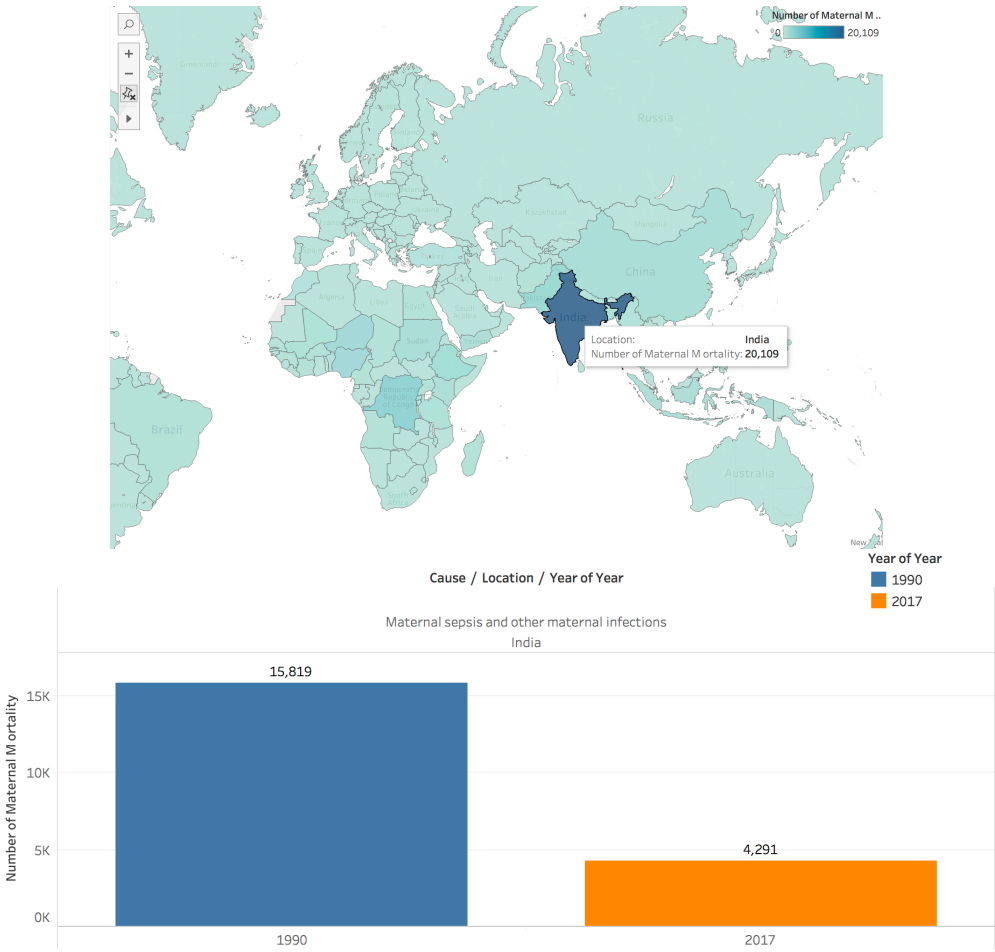

Figure 5. Maternal mortality caused by infection

5. CONCLUSION

This research identified different usage of textiles and medical textiles in healthcare in order to reduce the maternal and child mortality. An interactive data visualization dashboard by using Tableau to show child mortality as well as the reasons for these deaths. The roles textiles and medical textiles were identified in reducing mortality in the world.

Malaria was found as one the main cause of deaths for children under age 5 in many countries specially African region, but by implementing the different best solutions including using fabric protector as insecticide-treated nets the number of deaths caused by malaria dropped over 50 percent from 1990 to 2017. Diarrhea was another cause of death and based on the data that visualized in the map, it was a huge decline since 1990. Using water filtration and providing clean and sanitation water mainly in the children playing area was a big implementation solution in preventing diarrhea and reducing the number of child deaths. Also using the cotton cloth as a filter to clean water helped to provide drinkable water. Infections were recognized as one of the main causes of maternal and child mortality. Although in India there is a huge decline in number of maternal deaths caused by infection from 1990 to 2017, still India has the highest number of maternal mortalities caused by infection. Medical textiles such as antimicrobial linens, gowns, and scrubs played significant role in reducing maternal mortality in the world.
This research can be extended by further analysis of in-depth learning on the best practices to find out why some solutions are effective in specific countries and explore if if they can then be implemented into other countries' practices.

6. REFERENCES

1. Hector Caraballo & Kevin King. Emergency Department Management of Mosquito-Borne Illness: Malaria, Dengue and West Nile Virus. Emerg Med Prac. 2014; 16(5):1.
2. Malaria fact sheet by UNICEF New York. http://www.unicef.org/media/media_81674.html, 2015.
3. Control of residual malaria parasite transmission Guidance note – September 2014 by WHO. http://www.who.int/malaria/publications/atoz/technical- note-control-of-residual-malaria-parasite-transmission- sep14.pdf. 16 September, 2015.
4. Raja, A. S. M., Kawlekar, S., Saxena, S., Arputharaj, A., & Patil, P. G. (2015). Mosquito protective textiles-A review. International Journal of Mosquito Research, 2(4), 49-53.
5. Diarrhoea: Why Children are still Dying and What Can Be Done. UNICEF/WHO; Geneva, Switzerland: 2009.
6. Report of the Joint Monitoring Programme: Progress on Sanitation and Drinking-Water. UNICEF/WHO; New York, NY, USA: 2013.
7. Progress on Drinking Water and Sanitation Joint Monitoring Programme. UNICEF/WHO; Geneva, Switzerland: 2012.
8. Fayehun O.A. Household Environmental Health Hazards and Child Survival in Sub-Saharan Africa. [(accessed on 15 May 2013)]. DHS Working papers, Demographic and Health Research 2010, No. 74. Available online: http://dhsprogram.com/pubs/pdf/WP74/WP74.pdf.
9. The Physical School Environment: An Essential Element of a Health-Promoting School. WHO; Geneva, Switzerland: 2003.
10. Fort A.L., Kothari M.T., Abderrahim N. Association between Maternal, Birth, and Newborn Characteristics and Neonatal Mortality in Five Asian Countries. [(accessed on 29 December 2012)]. DHS Working Papers 2008, No. 55. Available online: http://www.path.org/publications/files/MCHN_dhs_nnm_asian.pdf.
11. Aiello A.E., Larson E.L., Sedlak R. Hidden heroes of the health revolution Sanitation and personal hygiene. Amer. J. Infect. Control. 2008;36:S128–S151. doi: 10.1016/j.ajic.2008.09.008.
12. Fink G., Günther I. The Impact and Cost of Water and Sanitation Infrstructure. Development Economics Prospects Group, World Bank; Zurich, Switzerland: 2011.
13. Colwell, R.R. et al. Reduction of cholera in Bangladesh villages by simple filtration. Proc Natl Acad Sci, Published online DOI: 10.1073/pnas.0237386100, (2003).
14. King, M. W., Guidoin, R., & Gupta, B. S. (Eds.), *Biotextiles as medical implants*. Retrieved from https://ebookcentral.proquest.com, (2013).
15. Snow J., *On the mode of communication of cholera*. John Churchill; (1855).
16. Nightingale, F., *Notes on matters affecting the health, efficiency, and hospital administration of the British army: founded chiefly on the experience of the late war*. Harrison and Sons, St. Martin's Lane, WC, (1858).