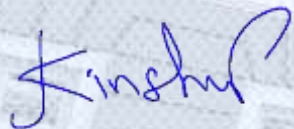# Certificate of Attendance

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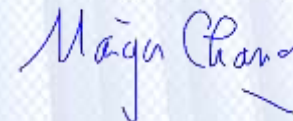
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Assessing the Impact of Public Health Campaigns Through Epidemiological, Communication and Education Indicators

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Abstract—Syphilis, a sexually transmitted infection, is a growing public health concern. Communication strategies have been applied to alert and educate the population of the risks of the disease. This applied study aims to investigate the impact of public health campaigns through several indicators. For this, a tool is being developed to capture, store and analyze this data, in order to make this information available clearly and accurately to decision makers, facilitating the development of new education, communication and disease prevention strategies. A case study is being conducted. Data from the "Syphilis No!" campaign and disease notification data provided by the Ministry of Health in Brazil are being analyzed in conjunction with others indicators, such as the growth of Internet news, social networks messages and interest searches through Google Trends. The results show that the volume of news about the disease is increasing, having peaked during and shortly after the campaign period. In addition, the subject was widely researched on the Internet.

Index Terms—Data Science and Analysis, Google Trends, Edu-communication, Technologies for Education, Syphilis

I. INTRODUCTION

Syphilis is a systemic, curable and exclusive Sexually Transmitted Infection (STI) of the human, being caused by the bacterium Treponema Pallidum. The growing increase in the number of cases of acquired syphilis, syphilis in pregnant women and congenital syphilis (when the mother transmits the infection to the baby during pregnancy) in Brazil represents a challenge for public health and makes prevention of this aggravation a priority of the Ministry of Health (MH) [1].

In the fight against the growing increase in cases of syphilis, the MH has prepared (in 2016) the Agenda for Strategic Actions to Reduce Syphilis in Brazil. This document resulted in the initiative of a parliamentary amendment of approximately \$ 63.500 million to implement a rapid response project for syphilis in 100 priority municipalities, which account for approximately 65% of the disease cases in the country.

In this aspect, the MH sponsored the *Sífilis Não!* (Syphilis No!) campaign, that carries the Test, Treat, and Cure concept and aim to remind people the importance of syphilis prevention. This campaign was performed between Nov, 2018 to May, 2019. At this period, a large amount of material has been produced and disseminated. Among them we can mention: television, radio, streaming platforms, printed media, magazines, live broadcasts during events, posters, informative booklets and stickers. On the Internet, there was the dissemination of related content on sites directed to pregnant women, sites devoted to coverage of news, social networks, relationship apps, and insertion of content on digital pages of magazines.

In this context our research aims to map the dissemination of informational and educational materials on syphilis, analyze its impact after publication in mass media (newspapers, magazines, books, radio, television, film and Internet) and social networks and make this information available clearly and accurately to decision makers.

To collect and assess this data, we have developed a system called Hermes, which is responsible for storing data related to public health campaigns and mining data on the web using the Google Search API, Google Trends and social networks. Besides that, Hermes should be able to store data related to health care and epidemiological notifications of Syphilis released by MH in Brazil. Thus, it should helps policy makers to be able to adapt new health care strategies through public communications, in order to adjust the impact caused and cover the areas discovered.

Our motivation to perform this research is based on some questions: i) Has there been an increase awareness news about STI on the Internet? ii) Is it possible to find analytics models from the assess of this data? iii) Did the "Syphilis No!" awareness campaign boosted the public's interest in the subject on the Internet?

The rest of the paper is organized as follows. Section II presents a summary of the key concepts and related works. Section III characterizes the system's features and functionalities. In section IV, we report how we apply our strategy to a real case study followed by discussions in the section V. Finally, in section VI, we report our findings and the works in progress.

II. BACKGROUND

The Internet is an important source of health information and advice. Some research has been developed to track cases of infectious diseases using data from the Internet.

We can cite the work of Young et al. suggesting that social media [2] and search engines [3] may be a tool used to predict public health outcomes such as syphilis and complement existing surveillance tools. The group also correlated search engine big data for predicting new HIV diagnoses [4].

Zhang et al. used the Internet search data to predict new HIV diagnoses [5]. Johnson and Mehta [6] used Google Trends to determine the relationship between sexually transmitted infections rates and search engine trends.

On the other hand, some studies analyze the impact of population awareness campaigns on diseases. In this way, E. Hasanov et al. [7] assess the effect of a awareness campaign for a neglected disease (rabies). The researchers demonstrated that awareness campaign was effective in improving knowledge, or remind those that already had good knowledge, of rabies symptoms.

S. Lu et al. [8] claim that education and occupation were the two most significant factors in tuberculosis awareness, showing the farmers and people with a low educational level were disadvantaged in all aspects of tuberculosis knowledge.

In this sense, H. Liu et al. [9] discuss about public awareness of three major infectious diseases (HIV, tuberculosis and hepatitis B) and also highlight that age and education were significantly associated with awareness of these diseases. They remember the main sources of health education were television, newspaper and magazine, which may be difficult for the elderly and minimally educated subjects to understand.

These studies are part of the growing association between Internet engine searches and population awareness campaigns of infectious diseases. Our research follows this line of investigation by adding even more evidence to these cases, as it adds data not only related to Internet searches, but population awareness campaigns, social networks, health care and epidemiological data.

III. HERMES SYSTEM

The Hermes system is being designed for decision makers to analyze impact of awareness campaign in a given region. The system is being built to store data related to awareness campaigns and miner related data in the web using Google Search API, Google Trends and Social Networks. In addition, Hermes should store data from health care, provided by MH in Brazil, in order to correlate through regression analysis.

The Fig. 1 shows the system data flow. It is started when the stakeholder create a new campaing in the system and store informations related to advisement actions, invoices and target audience. After that, he/she can create a online Search to be performed by Google Search API. Thus, the system will search for online news and store this data that includes: title, link, html content, summary and key-words (extracted using Natural Language Process). Derived data could be informed by the stakeholder when analyze those results, such as: kind of

media collected (text, audio, video) and classification (whether the news is sponsored, spontaneous, scientific paper or other classification defined by the user).
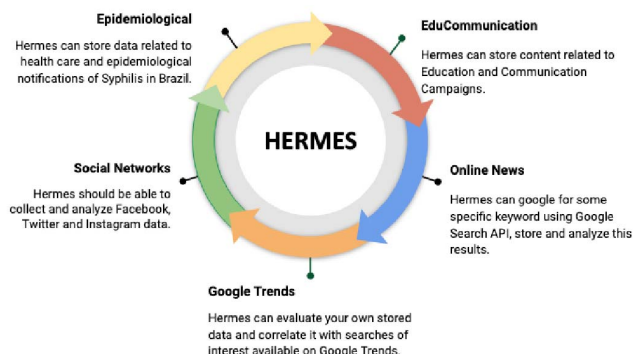

Fig. 1: Data Flow Obtained and Stored in Hermes.

In other hand, Hermes can check information on Google Trends based on key-words defined in his online search created by the stakeholder. Data such as city, range of dates and score of interest can be stored. This data can indicate interest over the time about the subject defined.

Besides that, social network data should be collected in order to check if this subject is in trend topics over the time, which region and which social network (Facebook, Twitter or Instagram). The main content stored is: age, gender, message, posted date and city.

Finally, all data collect should be checked and assess with the imported data about health care and epidemiological notifications released by MH. This data should includes: date of notification, date of diagnosis, city, age of patient, gender, race and educational level. Furthermore, we look for information about how many patients used Benzathine Penicillin, how many patients underwent rapid syphilis testing or VDRL by period and region. This informations is also released by MH in Brazil.

Hermes is a information system with responsive layout, which provides automated support to some requirements proposed. It was developed in the Python language using the Django framework and Postgres database and the NLTK [1] (Natural Language Toolkit) library for Natural Language Processing (NLP).

IV. CASE STUDY

A case study is being conducted to validate this research. Campaign data "Syphilis No!" is being included in the system by stakeholders. Preliminary data point to the accomplishment of 685 actions in all states of Brazil, totaling more than $ 14.603 million. These actions are distributed by Macro Product: Radio & Streaming Platforms had more actions (195), followed by Outdoor Media (144), Television (129), Digital Media (122), Printed Media (88), Melee Awareness (7).

The states that benefited most from the actions were Rio de Janeiro (RJ, n=327), São Paulo (SP, n=306), Rio Grande

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[1]http://www.nltk.org/

do Norte (RN, n=304), Piauí (PI, n=302), Rio Grande do Sul (RS, n=291) and Distrito Federal (DF, n=289). An average of 265 actions per state. Many of these actions were performed simultaneously in all states of the country, thus, the same action was counted 27 times (26 states and the federal district).

In parallel, the system was configured to perform queries using the Google Search API from January 1, 2016 to October 31, 2019 and stored this information. There is a gradual increase in syphilis-related news and the large increase during and after the campaign period. Because the 3rd Saturday of October has been instituted the National Day to Combat Syphilis and Congenital Syphilis in Brazil, the month of October accumulates more news than the others. However, the volume of news produced in October 2019 is much higher compared to the others.

In addition, through Hermes it is also possible to obtain data from Google Trends to assess the population's interest in the theme during the advertising campaign period. With this, we could observe chronologically the growing interest in the subject, as well as the interest by geography.

V. Discussion

Naturally, increasing syphilis testing is considered a more realistic goal for impact analysis of a successful campaign [10] [11] due to population awareness of the problem, but not all campaigns are successful after the airing period. Winnipeg Regional Health Authority developed a campaign in March 2014 highlighting the syphilis outbreak and the importance of seeking testing. According to Ross et. al. [12] there was no significant difference in testing before versus after the that campaign.

In this sense, analyzing only the increase in syphilis tests may not be the ideal indicator. The diverse set of indicators should correctly assess the impact of an awareness campaign. This applied research suggests a set of concepts and relationships, some of which have been suggested by other works, as presented in the section II. Our work, however, differs from others in that it focuses on expanding knowledge areas, seeking evidence that awareness campaigns have affected completely different areas.

The system being developed is already capable of storing data related to awareness campaigns, online news, Google Trends, social networks, health care and epidemiological data. The next steps in the system evolution aspect are: i) to include the collection and storage of social network data; and ii) develop analytical models to correlate the obtained data.

Further research needs to be done to see how Natural Language Processing can assist in automating tasks, such as: i) suggesting keywords for news search in Google Search and Google Trends; ii) use of Sentiment Analysis algorithms to distinguish and catalog the news found; iii) use of Artificial Intelligence algorithms to learn to classify news without human interference, based on previous learning, identifying for example if a news is sponsored or spontaneous; iv) use similarity algorithms to identify if, among the news obtained, there are news originating from others.

VI. Conclusion

This paper presents an applied research for evaluation of public health campaign in syphilis cases in Brazil. A information system was developed to organize data related to advertising campaigns, online news, Google Trends, social networks and epidemiological notifications. Based on this information, the system is going to provide a dashboard, correlating the data obtained, helping policy makers to check the campaing impact and adapt new health care strategies through public communications.

Preliminary results from the case study of the "Syphilis No!" campaign show that the volume of news about the disease is increasing, having peaked during and after the campaign period in Brazil. Also, in this period, the subject was widely searched on the Internet, as can be seen in the data obtained by Google Trends.

It is important to remember that we seek to allow the system to be generic enough to work with any type of disease. In this sense syphilis notifications and the "Syphilis No!" campaign are presented as a case study.

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