

Forecasting the Epidemic Trend of MSM Cases in the Philippines Using Symbolic Regression Analysis

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Abstract:

HIV/AIDS is one of the most serious public health challenges in the world. In the Philippines alone, staggering cases of HIV+ individuals were reportedly high specifically those men having sex with men (MSM) because they generally are the most reported sex-related transmitters of HIV. Hence, this study aimed to forecast the epidemic trend of MSM cases in the Philippines using symbolic regression analysis and determine whether the increase in the rate of Philippines' MSM cases will significantly contribute to global HIV/AIDS epidemic. This research is a data mining study, which employed descriptive research design and statistical modelling method. The researcher gathered data from the Philippine Statistics Authority, Department of Health, & World Data bank, and treated these data using Eureqa software. The results then projected that the trend for MSM cases in 1985 - 2019 was increasing due to the emergence of gay bars, access to pornographic videos through the internet, social media fad, increase engagement in pre-marital sex, increase same-sex cohabitation, socio-economic status of young men who can afford to pay for sex, and the decrease of usage of condom during anal sex. It was further revealed that the increase of MSM cases in the next decade would significantly contribute to global HIV/AIDS epidemic. Hence, stronger program interventions must be made to help reduce the MSM cases in the Philippines.

Keywords: HIV/AIDS, MSM (men having sex with men), epidemic trend, symbolic regression analysis, forecasting

I. INTRODUCTION

Public health concerns on the rise of HIV cases in the Philippines has been an issue the country deliberately fixes. The increase in number of HIV+ individuals in the country reported a 1,249 newly confirmed cases for January 2019 alone (DOH, 2019), which is a 70.22% increase from the December 2018 report. Moreover, alarming rate of newly reported cases showed an increase trend from homosexual sex specifically toward male-to-male transmission or men having sex with men (MSM). The Philippine Statistics Authority (2019) declared 50,164 newly reported cases of MSM last January 2019 – an 85% increase from January 1984 to January 2019 data. This incident was due to unprotected sex caused by availability of condoms, partner resistance, and reduced pleasure (Decoste, 2014). Hence, this study aimed to forecast the MSM cases in the Philippines for 2020 – 2030. It then sought to investigate the underlying reasons and the emerging implications of the forecasted MSM cases.

Men having sex with men (MSM) is one of the modes of HIV transmission predominant among other factors such as blood products, sharing infected needles, and mother-to-child transmission. Data suggested that 53% of MSM cases were young men, 25 – 34 years old (PSA, 2019). This age range was determined as the high probable cause on the increase HIV transmission since men this age explores their sexual capacity as a dominant sex in society as well as to show off masculinity among other gender preferences. Hernandez & Imperial (2009) strongly emphasized the role of men in the increase HIV cases in the country they practice unsafe sex for homosexual partners. The Philippine National AIDS Council (2011) stated that 13.8% of men had ever sex with another man involving anal sex. This mode of transmission has a high prevalence of HIV transmission since it can damage the mucous membrane layer that surround the anus, exposing men to fecal matter or blood that contain number of diseases.

Merrigan, et. al. (2011) supported that almost 4.2% of men in Nigeria were involved in anal sex and complete exposure to syphilis and HIV. Results also found by Farr and Wilson (2010) that this high efficient mode of HIV transmission among MSM individuals could generally represent ignorance on the long-term consequences of unprotected penile-anal sex. Although there have been studies and speculations concerning the disturbing increase of HIV cases in the Philippines, there were no studies which forecast the trend of epidemic increase of MSM cases in the country and determines the extent at which this trend contributes to serious public health issues and global HIV/AIDS epidemic.

To establish a clearer picture on the trend of MSM cases in the future, there is a dire need of evaluation on the existing data of MSM cases in the Philippines. Therefore, to fill in this gap, the researcher gathered data from the Philippine Statistics Authority, Department of Health, and World Data Bank. The research utilized Eureka software to treat these data and to project the MSM trend in the Philippines, and used symbolic regression analysis to describe its implications.

Moreover, this research forecasted the trend of MSM cases in the Philippines from 1985 – 2030 using symbolic regression analysis. Specifically, it asked the following questions:

1. What is the trend of the Philippines' MSM cases from 1985 – 1995, 1996 – 2007, and 2008 – 2019. Based on these data, what could possibly be the trend of MSM cases in 2020 - 2030?
2. What accounts for the forecasted trend in MSM cases between 1985–1995, 1996–2007, 2008–2019, and 2020–2030.
3. If the trend of MSM cases is increasing, does it have significant contribution to the HIV/AIDS cases in the world?

II. METHODS

Research Design

This study used descriptive research design. This design is deemed appropriate since this study is a data mining approach, which aimed to describe the reasons and the implications of the forecasted trend of MSM cases in the Philippines in 1985 –2030.

Data Gathering and Procedure

The researcher mined the data for the Philippines' actual MSM cases from 1985 – 2019 from the Philippine Statistics Authority (https://psa.gov.ph/sites/default/files/PHILIPPINE%20NATIONAL%20DEMOGRAPHIC%20AND%20HEALTH%20SURVEY%202017_new.pdf), Department of Health (https://aidsdatahub.org/sites/default/files/publication/EB_HARP_Report_January2019.pdf), and the World Data Bank (<https://data.worldbank.org/country/philippines?view=chart>).

Statistical Data Analysis

The researcher used Eureka software and statistical modelling method to project the epidemic trend of the actual MSM cases in 1985 – 2019, and the trend of the forecasted MSM cases in 2020-2030. The software is appropriate for the study since it is a scientific data mining software, which searches for mathematical patterns hidden in the data. This generates a genetically programmed algorithm that provides a model to forecast data.

Theoretical framework

This study is anchored on the Replication-Transmission Relativity Theory for Multiscale Modelling of Infectious Disease Systems (Garira, 2019). According to the replication-transmission relativity principle, disease dynamics are determined by interactions between the microscale and macroscale at any stage of organization of an infectious disease system. The theory is also emphasized on the fundamental principle that the reciprocal effect between the microscale and the macroscale creates a pathogen replication transmission multiscale cycle at any stage of organization of an infectious disease environment. This theory will help us better understand infectious disease systems in terms of sizes, levels of organization, and interrelationships.

In the case of the increasing number of MSM cases in the Philippines, the theory was deemed appropriate for this study since HIV cases are one that spreads on a drastic scale without even knowing. Since the virus is undetectable in the early stage of infection, this poses a threat to human health. Moreover, the variable to be used in this study lies mainly on the existing MSM data provided by the DOH, which will be used

to predict the trend in the year 2030. The study used symbolic regression analysis as this predictive model creates an algorithm for the trend hence, forecasts the trend of MSM cases in the Philippines

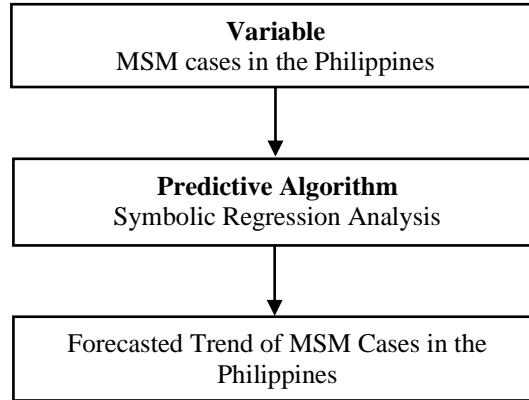


Figure 1. System Architecture

Symbolic Regression Analysis

The study used symbolic regression analysis to forecast the existing data of MSM cases in the Philippines. Davidson, Savic, & Walters (2003) studied symbolic regression analysis, which employs ephemeral random constants, whose values are fixed at the time of initialization and can only be changed by mutation. Non-linear equation forms, a broad range of function types, and even programming constructs like if-then statements can all be used in this approach. It is an efficient method in calculating symbolic sample variances, covariance, and correlation functions for data using a formula (Billard & Diday, 2002).

In this study, the author used symbolic regression analysis as it searches for mathematical patterns hidden in the data. This generates a genetically programmed algorithm that provides a model to forecast data. This algorithm will be used to forecast the MSM trend in the Philippines and will be used to establish predictive recommendations and analytical proposals to lessen the number of HIV cases, or in this study, the MSM cases to be exact.

III. RESULTS AND DISCUSSION

This section presents the results and discussion of the study. It vividly exposes the outcomes of thorough observation, investigation, and analysis. The order of data presentation is based on the objectives above: (1) the trend of the Philippines’ MSM cases from 1985–2030; (2) what accounts for the forecasted trend in MSM cases between 1985–2030; and (3) to determine if the trend of MSM cases in the Philippines have significant contribution to the HIV/AIDS cases in the world.

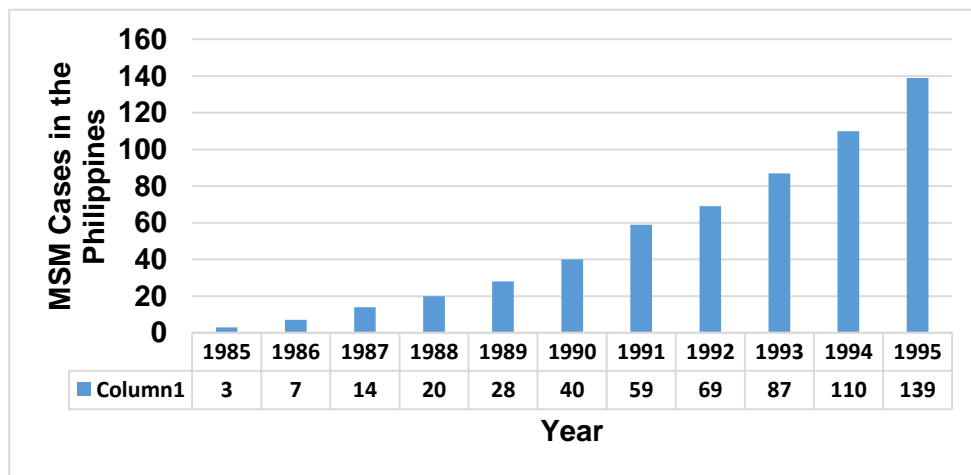


Figure 2. Graphical representation of MSM Cases in the Philippines from 1985 - 1995

The figure below contains the data for the MSM cases in the Philippines from 1985 - 1995. Using these data and with the help of Eureqa, the epidemic trend for MSM cases in the country was graphed in Figure 2. In the year 1985 was the first declaration of MSM case in the Philippines with only 3 men declared as HIV+. It then increased by 7 cases in 1986. In 1987, 14 MSM cases was declared and it increased in 1988 with 20 MSM cases. Little increase in 1989 was reported with 28 MSM cases only and then increased in 1990 by 40, which doubled the MSM cases in the Philippines.

Further, 87 MSM cases were reported in the year 1993 and almost reached a hundred MSM cases. Alarming, the MSM cases was declared to 110 – the first 100 cases for the past 9 years. Then in 1995, 139 cases of MSM individuals were declared. This gradual increase of HIV+ individuals specifically MSM individuals was not yet alarming and further reasons and implications were discussed on figure 3.

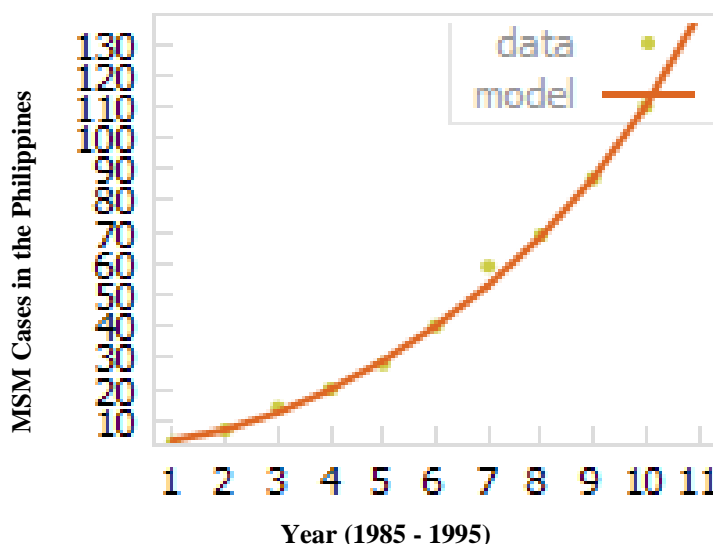


Figure 3. Trend of the Philippines' actual MSM cases from 1985 - 1995

Results revealed that the MSM cases in the Philippines was gradually increasing from 1985 – 1995. During the year 1985, three (3) MSM cases was reported following the first HIV case that was declared in 1984. The emergence of these three MSM cases was attributed to the practice of anal sex and prevalence of health-seeking behavior among friends (Mateo, Sarol, & Poblete, 2004). The number of MSM cases then increased in 1986 by four (4), which amounts to seven (7) MSM cases in the country. It was then declared that the progress of MSM cases were slightly alarming when during 1987, 1988, 1989, 1990, 1991, 1992, and 1993, a significantly increasing number of MSM cases were declared with 14, 20, 28, 40, 59, 69, and 87 HIV+ individuals specifically MSM individuals, respectively. This accounts for the emergence of gays bars in the Philippines, where stand-up comedians and singers who are mostly gay men entertain men clients (Hernandez & Imperial, 2009). Moreover, during 1994 and 1995, the number of MSM cases finally reached 110 and 139, respectively. This increase was attributed to the first availability of internet in the country that was established last March 29, 1994. It was declared that in 1994 and 1995, 62.31% and 62.72% of the population, respectively (World Data Bank, 2018) used the internet for surfing pornographic videos, obscene materials, and chatting strangers in the internet for casual sex. Eaton et. al. (2013) strongly suggested that pornography contents particularly those pornographic videos of unprotected and protected sex affect sexual risk-taking behavior. This behavior generally encourages men to explore sex beyond man-to-woman intercourse. Hence, exposing men to STIs and STDs.

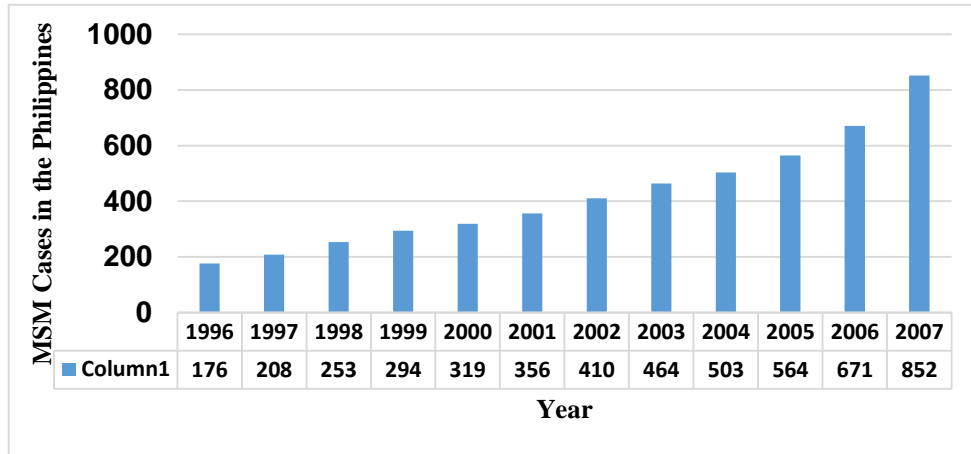


Figure 4. Graphical representation of MSM Cases in the Philippines from 1996 - 2007

The figure above contains the data for the MSM cases in the Philippines from 1996 - 2007. Using these data and with the help of Eureka, the epidemic trend for MSM cases in the country was graphed in Figure 4. Based on the graph above, in 1996, the continued increase of MSM cases in the Philippines was unstoppable with 176 MSM cases declared. In 1997, the MSM cases in the Philippines finally reached 208. Further, at the end of the decade, the MSM cases in the Philippines reached 319. On the onset of 2001, 356 MSM cases were declared with further increase of 410 cases then in 2002. The first 500 cases in the past 22 years. It was gradually increasing by 564 MSM cases in 2005 and 671 and 852 cases in the years 2006 and 2007, respectively.

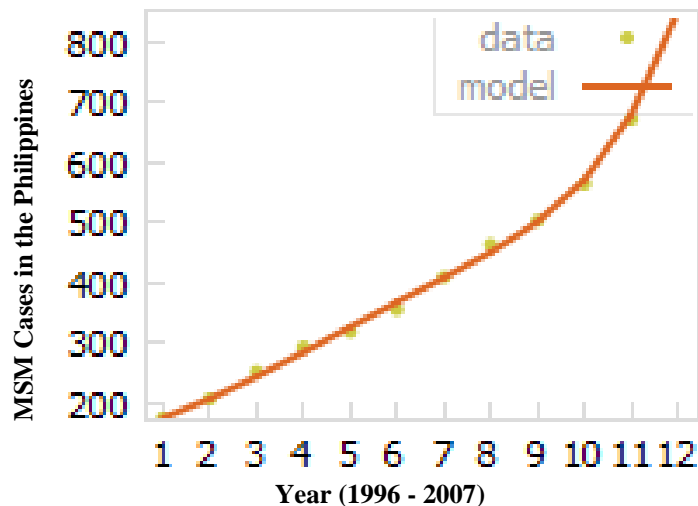


Figure 5. Trend of the Philippines' actual MSM cases from 1996 - 2007

The trend presented on figure 4 emphasized the disturbingly alarming increase of MSM cases in the Philippines in the year 1996 – 2007. In 2004, it was reported that the MSM cases in the Philippines reached 503. Data proved that in 2004, sexually active Filipino men engaged in unprotected anal sex with 13% only of the population who used condom. The Joint United Nations Programme on HIV and AIDS (2004) emphasized the importance of condom use to prevent HIV diseases. The Canadian AIDS Treatment Information Exchange (2018) further clarified that condom use is a highly effective strategy to reduce the risk of HIV transmission. However, studies showed by Rutakumwa (2015) that men generally do not like the idea of condom use during

anal sex since it reduces the sexual feeling and arousal. Hence, exposing men to dirt and fecal matter during unprotected anal sex. Moreover, Ross et. al. (2015) found out that the year 2007 was the pivotal year for the increase of HIV epidemic in the Philippines including the increase of MSM cases. It was reported that a shift in the predominant mode of transmission from heterosexual to homosexual contact among men had a rapid acceleration in the transmission rate of HIV diseases. The Integrated HIV Behavioral and Serological Surveillance System (2009) supported this data and reported a peak of MSM cases in the Philippines because 70% of men had engaged in the same sex contact.

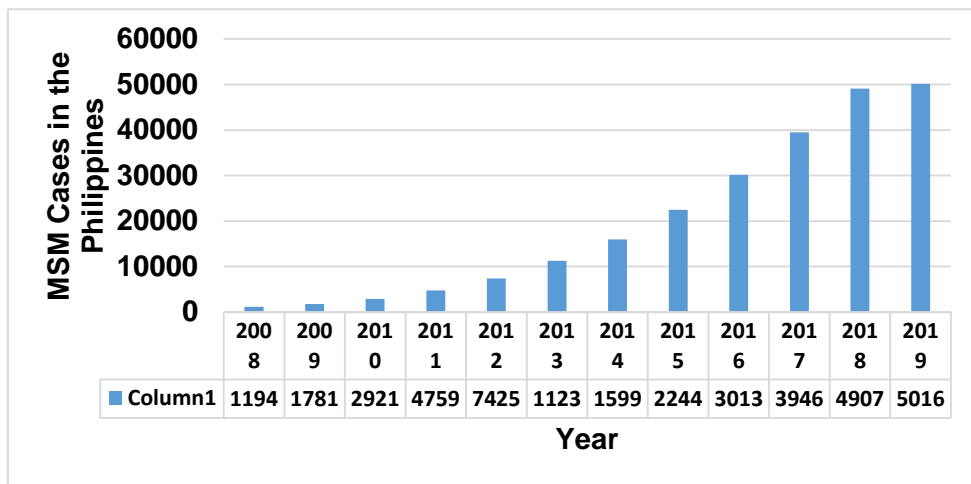


Figure 6. Graphical representation of MSM Cases in the Philippines from 2008 - 2019

The figure above contains the data for the MSM cases in the Philippines from 2008 - 2019. Using these data and with the help of Eureka, the epidemic trend for MSM cases in the country was graphed in Figure 6. It was found out that the MSM cases from 2008 – 2019 was increasing and never had it decrease for a single year. In 2008, there were already 1,194 MSM cases in the Philippines. In 2009, 1,781 MSM cases was declared in the Philippines. It then extremely increased in 2010 with 2,921 MSM cases – almost 3,000 cases at the end of the decade. Further, the MSM cases in 2011 doubled from the 2010 data of 4,759 MSM cases. In the year 2012, there were 7,425 reported MSM cases. Moreover, the MSM cases quadrupled in number with 11,239 MSM cases. In 2014, there were 15,999 MSM cases were declared, 22,449 cases in 2015, 30,139 cases in 2016. In 2017, 39,462 cases were declared then in 2018 and 2019, 49,078 and 50,164 cases were reported respectively. Further reasons and underlying implications will be discussed.

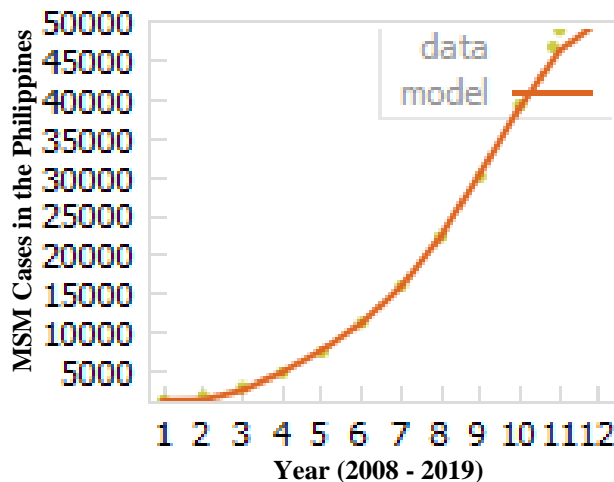


Figure 7. Trend of the Philippines' actual MSM cases from 2008 - 2019

On the onset of 2008, there were already 1,194 MSM cases in the Philippines. This disturbing increase of MSM cases was because of the engagement in premarital sexual intercourse of men to another man. The PSA (2009) reported that 89% of men who are never married had sexual intercourse with other man.

Moreover, in 2010, almost 5,000 MSM cases were declared and it showed a 1,700% increase from the 1985 data. It was revealed the presence of social media were attributes to this increase. The DOH (2011) concluded that there were correlation on the presence of social media on the rise of MSM cases in the Philippines in which it was reported that the easy access and use of social media for both dating and casual sex paved way for this problem. These sites can upload personal profile and search for others as well, which will have more opportunities for unsafe sex with multiple partners.

However, the increase of MSM cases did not stop there because from 7,245 cases in 2012, the MSM cases in 2013 increased to 11,239 – a 3,994 increase from the 2012 data. This is also related to the reason regarding on social media because according to the (WDB, 2013), 75% of Filipino men are internet users and have easy access to gay dating sites allowing them to find other men for casual sex. Apart from that, the increase on the engagement in same-sex relationship paved way for this pressing issue. There was also a law regarding on the prevention of HIV increase, which is the Philippine AIDS Prevention and Control Act of 1998. However, the law was ineffective since increasing same-sex relationship is still prevailing and is constantly occurring. But in 2015, MSM cases reached to 22,449. This increase was attributed to young sexually active MSM that is considered to be the core transmitters in the spread of HIV in the Philippines. This subpopulation of HIV-society is a hidden subpopulation group that is why the trend among young men who have sex with men is not constant and is drastically increasing. Farr and Wilson (2010) posed that with this social stigma against MSM individuals did not help them because they were scared to be judged. In addition, the current MSM cases reached to 50,164 and this increase was determined based on the socioeconomic status of these young men.

According to the American Psychology Association (2020) high percentage of these young men are from comparatively advantaged socioeconomic backgrounds. SES is a reason since these young men can afford to have sex with other men. A portion also of impoverished young men is also a contributor on the increase of MSM cases. Limited economic chances and periods of homelessness have been associated with risky sexual practices, such as exchanging sex for money, drugs, housing, food and safety. Ultimately, these practices can place individuals at risk for HIV (Riley, Gandhi, Hare, Cohen, & Hwang, 2007).

With reference to the data being presented, it is clear that the emerging problems and reasons on the increase of MSM cases attributed to this problem. However, as the years passed by and as evident in Figures 2, 4 and 6, it seems that the MSM cases will most likely increase in 2020 – 2030. These values can be determined using the actual data in 1985 - 2019. This was made possible using the following algorithm generated by the Eureka software. This section presents the genetic programmed algorithm or model that will predict future causal relationship and population. The algorithm below forecasts the predicted MSM cases in the Philippines for the next ten years from 2020 – 2030, which generated a trend found in figure 8.

$$y = 28.7661125875169 + 0.000138462965940462*t + 66.5284681393792 / (2.44065541367599 + 0.0092929191165879*t) + \cos(2.1803384108022 + 35.5317246233717 / (2.9010155956658 + 0.00814630377958391*t))$$

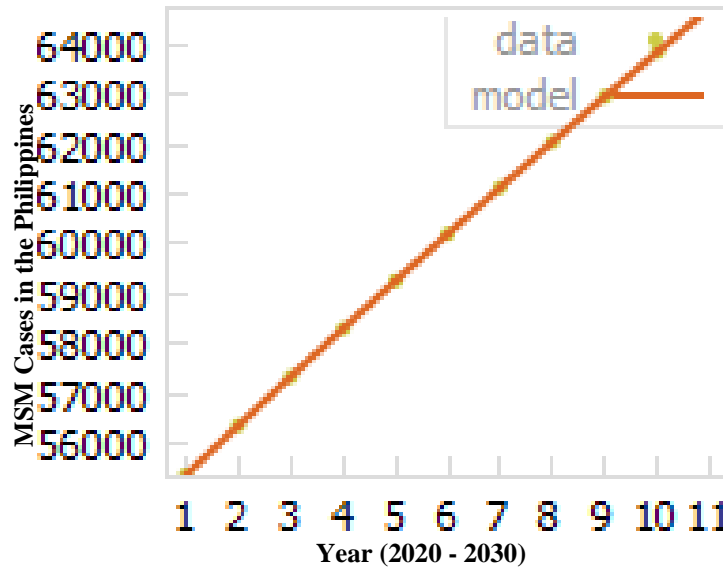


Figure 8. Trend of the forecasted MSM cases in the Philippines from 2020 - 2030.

The y in the model is defined as the value for MSM cases in the Philippines while t represents the time the MSM cases were forecasted. The value for y was computed when the t was substituted with the intended time to be forecasted. With this, t was subsequently substituted with 36, 37, 38, 39, 39, 40, 41, 42, 43, 44, 45, and 46, which served as the labels for the year in which the MSM cases were projected. That means, for the first attempt – projecting the MSM cases in 2020 for instance – all the t in the model was substituted with 36. The same process was employed until the emissions for 2030 had been forecasted.

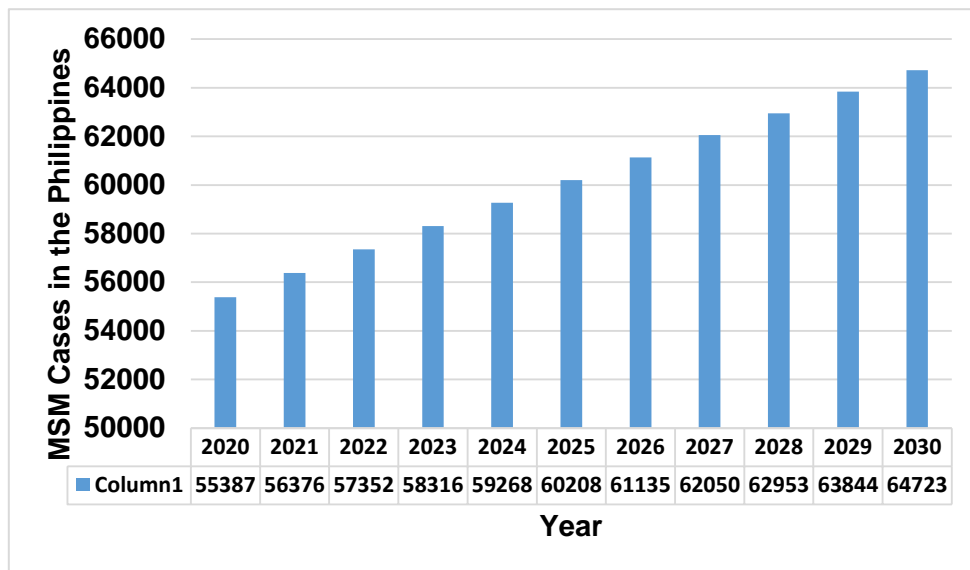


Figure 9. Graphical representation of the forecasted HIV Cases in the Philippines from 2020 – 2030

It was revealed on figure 8 that the MSM cases for the next decade (2020 – 2030) will most likely increase. The propaganda and movement of the LGBT community caused this drastic increase and will so

continue if left unchecked. Earlier this 2019, a group of individuals filed a bill to the Supreme Court about the Same-sex Marriage (House bill 6595). This act recognizes the civil partnership of couples, providing for their rights and obligations. Many revolutionary movements paved way for the increase in same-sex relationship. According to Joe et. al. (2018), same-sex relationship increases the vulnerability to be an HIV+ individual. Majority of MSM individuals are hiding into this practice and have less access to available health care services due to social stigma.

Further, social stigma had become the most prevalent judgment men who have a relationship with other man because it connotes a non-acceptable social norm. UNAIDS (2005) said that stigma and discrimination have fueled the transmission of HIV among MSM individuals and have negatively affected the global HIV/AIDS epidemic. Because of this, it encourages denial among MSM individuals and caused delay of urgent medical treatments. Factors on the social stigmatization associated among MSM individuals creates a lack of understanding of illness, misconceptions about how HIV is transmitted, lack of access of treatment, irresponsible media reporting on the epidemic, the incurability of AIDS, and prejudice and fears relating to a number of socially sensitive issues including sexuality, disease, and death

Moreover, reproductive health care law in the Philippines had several restricted issues embodied in the Responsible Parenthood and Reproductive Health Act of 2012 (Republic Act No. 10354, known as the RH Law), which prohibits condom purchases by individuals under the age of 18 without parental consent. As a result, it can resort to unsupervised and unprotected sex because these youth are prohibited to buy condoms. Without condoms, high risk of HIV transmission is possible. Hence, to combat high rate of HIV transmission in the Philippines, the International Condom Day was established to remind people that wearing condom could prevent pregnancy and possible HIV transmission. However, this also connotes a negative impact on the mindset of young people since condom distribution is prevalent these days. They have been given the idea to have sex at an early age because condoms are freely given publicly. Hence, this would likely increase the probability of HIV transmission among young people. Thus, alarming HIV rate is expected

Given the trend that was projected in figure 7, it was evident based on the underlying reasons that there is an increase of MSM cases in the Philippines if this not given immediate action. This will likely contribute to the cumulative HIV cases in the Philippines and of the world. In a report on how Philippines worsen the global HIV/AIDS epidemic, the World Health Organization (2019) said that the Philippines is one of the fastest growing number of HIV/AIDS cases, which contributed to the 0.2% of HIV/AIDS epidemic in the Southeast Asian regions among Singapore, Thailand, Vietnam, and Indonesia. With an overall 25% HIV prevalence rate, Philippines has the most serious HIV epidemic in the world. This suggests that the Philippines will be a significant contributor to the global HIV/AIDS epidemic particularly on men having sex with other man. Hence, the government must improve its policies and decisions as to the ways to reduce the number of MSM cases in the Philippines.

IV. CONCLUSION

Based on the findings on this research, it came up with the following conclusions. First, the trend for MSM cases in 1985 – 2019 is increasing due to the emergence of gay bars in the country, access to pornographic videos through the internet, social media fad, increase engagement in pre-marital sex, increase same-sex cohabitation, socio-economic status of young men who can afford to pay for sex, and the decrease of usage of condom during anal sex. Second, the trend for the year 2020 – 2030 is also increasing with the Philippines growing acceptance to same-sex relationship for both male and female partners, LGBTQ propaganda and movements, social stigma among HIV+ individuals particularly among men having sex with men, and the prohibition of condom usage among youth. Lastly, the increase in the country's MSM cases in the next decade will significantly contribute to global HIV/AIDS epidemic particularly in MSM epidemic if the country would not immediately respond to the alarming rate of MSM cases in the Philippines.

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