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Neonates Born with Congenital Syphilis in CWM Hospital Suva, Fiji from 2018-2023

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Abstract: This retrospective study aimed to estimate the prevalence of congenital syphilis in Suva, Fiji, from 2018-2023. The study collected data from 2,525 neonates, analyzing the total number of suspected cases. The results showed a decline in the prevalence in recent years, with 1,009 being reactive and 1,296 being non-reactive. The Indigenous population (I-Taueki) had the highest percentage of reactive data. Fluctuations in trends were observed among different genders. The study underscored the importance of continuous surveillance for congenital syphilis in Fiji and the Pacific. Despite a decrease in global prevalence, the numbers remain high. Revising and strengthening MOHMS Fiji and policies for public health laboratories could help develop laboratory diagnostic capability for congenital syphilis, enabling early detection in pregnant women and their partners. Further research on a larger scale is needed to gain a comprehensive understanding of this issue and explore early detection methods and newer treatment options.

Keywords: *Congenital Syphilis, Neonates, Mother-to-Child Transmission, Prevalence.*

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I. INTRODUCTION

A. Background to the Research Problem

Syphilis is among the most common sexually transmitted infections (STIs) worldwide and is also one of the leading preventable and treatable causes of infant morbidity and mortality (Cardoso et al., 2023). Congenital syphilis is an infection caused by *Treponema pallidum* that occurs when the mother with syphilis passes the infection on to her baby during pregnancy (Sankaran et al., 2023).As stated by De Brito Pinto et al. (2022) it estimates nearly 1 million infants born with congenital syphilis each year, and is the second-leading cause of stillbirths worldwide, surpassed only by malaria.

According to Walker et al. (2019) congenital syphilis remains a major public health problem worldwide and in Pacific Island nations, and its prevalence is assumed to be increasing or decreasing in Fiji and other pacific countries, however, there is limited published information available that addressed syphilis. Stillbirths, neonatal deaths, preterm deaths, low birthweights, neuro-developmental problems and congenital infection are some of the outcomes of congenital syphilis. This infection can be prevented given the serological tests are done and treatment regime are followed and proper management of the mother's wellbeing is monitored (Gilmour & Walls., 2023). In its initiation and strategy for fighting mother to child transmission infection, World Health Organisation (WHO) has achieved promising successful rate.

Updated study estimation showed there is a slight decrease in the rate of congenital syphilis although still high in 2012-2016 (Cardoso et al., 2023). This decrease occurs due to, increase in antenatal care, screening test for syphilis during pregnancy, and treatment of maternal syphilis before it passes to the unborn infant. The rate of congenital syphilis can be also determined by socioeconomic factors strongly influence inequalities in public health sector, for example in Europe the rate of congenital syphilis was 0.10% compare to 0.86% in America and 1.52 in Africa (De Brito Pinto et al., 2022). This research aimed to find out the trend of all neonatal congenital syphilis cases in Colonial War Memorial (CWM) hospital, using screening Rapid Plasma Reagin (RPR) test and confirmatory Treponema pallidum particle agglutination (TPPA) assay.

B. Benefits of the Study

The impact of congenital syphilis can be devastating, leading to miscarriage, stillbirth, severe health problems, development delays, vision and hearing issues, bone and joint problems, nervous system complications and even death for the newborn.

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The benefits of undertaking this research are that it will highlight the increasing rates of neonates, reflect failures in the healthcare system, and emphasize the importance of timely testing and treatment approaches.

In Fiji the healthcare and the patients will benefit by curbing congenital syphilis and to provide improved healthcare outcomes. It will help identify areas for instance, data on each Sub-division with high prevalence and be utilized as targeted interventions for timely diagnosis and treatment. Strategies can be developed to address health disparities and improve access to healthcare for vulnerable population.

This research finding can be used to educate the health care providers and the general public about the risks of congenital syphilis and the importance of prenatal care and screening, provide available data for research when published, can improved our communication skills and experience thus benefiting the community and the country as a whole.

C. Research Question, Aim, Primary Objective or Hypothesis

➢ *Research question*

What is the prevalence of congenital syphilis in CWM Hospital from 2014-2023?

➢ *Aim*

According to a study it is stated that more than 1 million infants are born with congenital syphilis each year (Korenromp et al., 2019). Given that the infection is highly preventable through antenatal screening of the infection with proper treatment during pregnancy. Still these strategies are not followed in many countries. In Fiji these screening tests can only be done for people who have access to visit the main hospital or medical centers (CWMH and others) for people living in rural areas they cannot have access to proper antenatal care. Even though these screening tests are available the implementation is only done sporadically in Fiji, leaving the infection undetected and untreated among many pregnant women. Therefore, this study aimed to find out the total number of neonates born with laboratory-confirmed syphilis cases at CWM Hospital for the years 2018-2023.

➢ *Research Objectives*

- *The Objectives of this Research were:*

- To find the prevalence of laboratory-based neonates born with congenital syphilis in CWM hospital from 2018-2023 using screening and confirmatory tests (RPR and TPPA) in the Serology Department.
- To find out the demographic and geographic distribution of positive neonatal cases in CWM Hospital for the period 2018 to 2023.

II. STUDY METHODS

A. Study Design

This was a descriptive study design initially, which utilised the retrospective data, whereby the data of the positive neonates for the past six years (2018-2023) were collected and analysed.

B. Study Settings

This research was undertaken at CWM Hospital, Serology Department. CWM Hospital is a major government hospital in Fiji, providing various health care services including emergency, pediatrics, urology, pathology, radiology, surgery, internal medicine, etc. The general public accesses it daily and it provides specialist care to neonates within the facility in the Neonatal Intensive Care Unit and pediatrics outpatients.

C. Study Population or Sample

This study utilised a purposive sampling method to recruit data for this research, all neonates' congenital syphilis cases, being the age of 0-28 days identified at CWM hospital for the study period of 2014- 2023.

The inclusion criteria were based on neonates between 0-28 days old from the year 2014-2023 (WHO, 2017). The exclusion criteria we excluded neonates with equivocal results, babies who were more than 20 days old and any CS data before 2014 and after 2023.

D. Sampling, Sample Size and Power

The data collection time frame for the study was within a 6-year from 2018-2023. The data collection technique used was non-probability, purposive sampling because the data were collected from the population directly through the syphilis worksheet via Laboratory Information System Software (LIS). The study subjects were all congenital syphilis requests referred to the laboratory from the various wards of the CWM Hospital where the neonates were admitted (in-house) or attended the pediatrics outpatients and Maternal and Child Health (MCH) clinic.

E. Definition of Key Terms, Concepts and Variables

Refer to the Glossary and Acronyms section.

Independent and dependent variables were used in this research, to find out the trend of congenital syphilis at CWM hospital for the duration from 2018-2023. Independent variables included, care given to patient which includes screening and treatment, maternal Syphilis status, the socio-economic status of the patient and, stage of diagnosis and medical intervention provided to the mother during pregnancy.The dependent variable was the prevalence of laboratory-based congenital syphilis cases at CWM Hospital for the duration from 201 to 2023.

F. Data Collection Techniques and Instrument

This was a secondary data collection technique using LIS/PATIS software to access the patients' demographics/geographic information. LIS is a laboratory

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system used to store patients' archival records, and PATIS is an electronic system for medical records storage.

We extracted neonatal' congenital cases data from the Serology department at CWM hospital after approval from CHHREC (ID:061.24) using congenital syphilis via the LIS electronic database. All data collection was carried out within a two-week time frame with the morning session allocated to data collection only (approximately from 0800hrs – 1200hrs) whereas the transferring, sorting, and processing into different log sheets was carried out in the afternoon (1400hrs-1600hrs). All the collected data were analysed using excel software and interpreted using frequency tables, graphs, and pie charts.We extracted Congenital syphilis case report data from the Laboratory Information Software from all the cases sent for testing at the Serology department. The data received as de-identified, line listed included the accession number, national hospital number, age, date and time requested, date and time results released, ward, and result of the cases. Because the neonatal age was calculated in the number of days the data provided did not specify if the numbers provided were the age or the number of years for the cases. These data did not include the exact date of birth, geographic details, and ethnicity of the cases. PATIS was used to extract all this remaining information. A second line list was then prepared and using the inclusion and exclusion criteria all the data was reanalyzed to include neonates falling in the 28-day and below age range. The third stage of data cleaning eliminated possible double entries of cases like hemolysis/ insufficient, and tests not available repeated requested for 2 weeks. All the data was then analysed and grouped according to the geographic and demographic cohort (Figure 1).

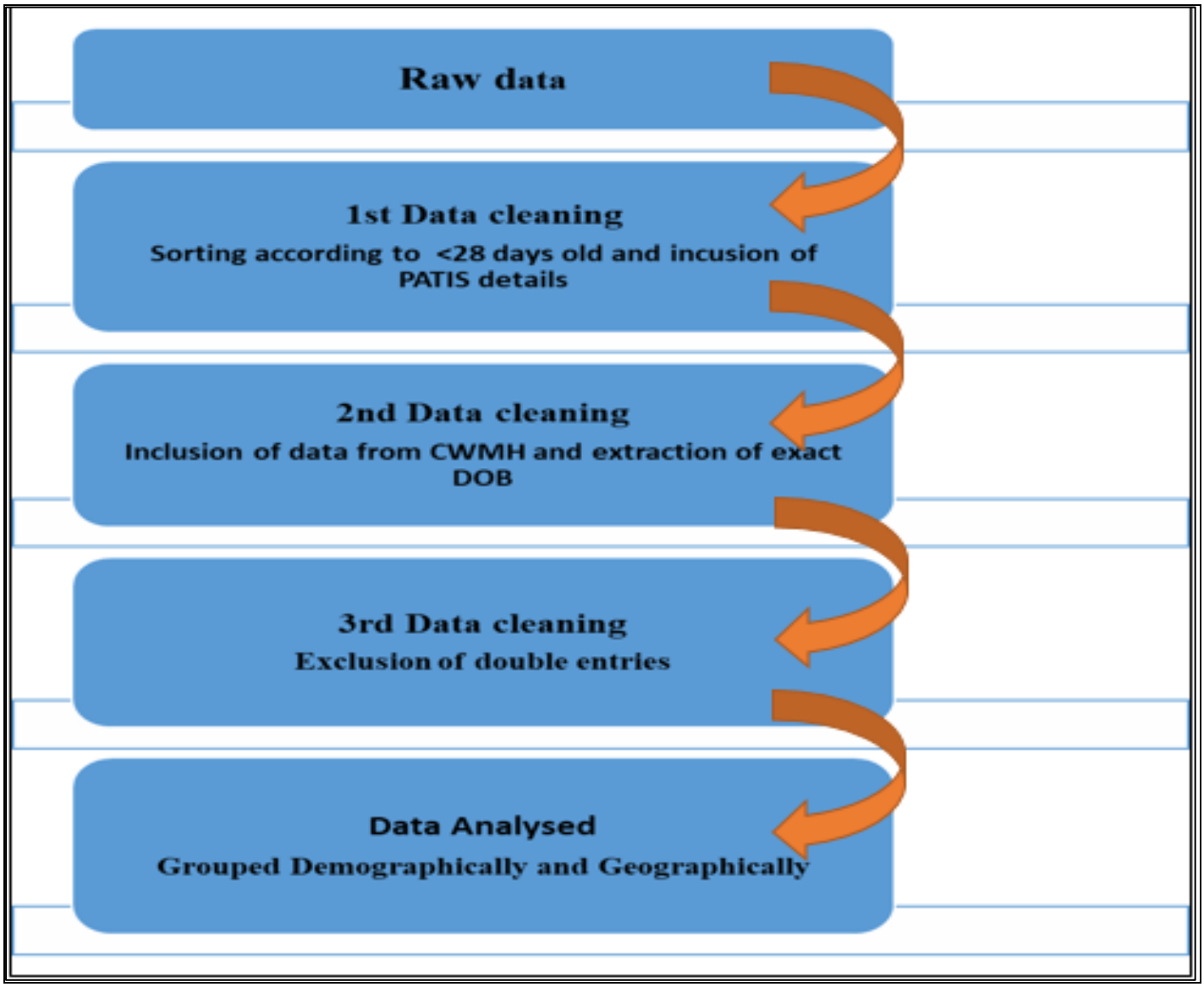

Fig 1: Data Sorting and Cleaning Flow

G. Reliability and Validity of Methods and Tools

Data collection was done in the serology department with help of senior staff/head of section, these data were correlated precisely for any human error with patients feasible and other variables. Recording of the data and calculation of the prevalence.

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H. Data Management

All collected information was converted into a unique code for storage. The data is stored on a password-encrypted USB device for added security. Excel log sheet served as the database for entering the data. Researchers and the Research Coordinator have access to the study data.

I. Data Analysis

After collecting of all the required data the analysis was done using Microsoft Excel software, calculated the prevalence rate:

$$\frac{\text{(Number of positive congenital syphilis) x 100}}{\text{(Total number of neonates screened)}}$$

The demographics were displayed using Excel software in the form of graphs based the number of positive congenital syphilis cases according to gender and ethnicity on yearly basis for the study duration. Geographical distribution was displayed using Excel software in the form of graphs according to the MOHMS zoning of areas with the highest number of positive occurrences yearly for the study duration.

J. Ethical Considerations

For the benefit of the participants and the researcher, all patients were protected. This research project was only directed after the approval from supervisors, the course convener, CHHREC and lastly the facility approval. This project ensured that all report cases collected were given unique codes instead of patient variables Case data received for the project were correlated for any human error and it was then stored in a locked cabinet for safe keeping and can only be accessed by research supervisors and the research investigators.

K. Confidentiality

Protecting patient confidentiality, this project ensured that all report cases collected were given unique codes instead of patient variables. All the data were only disclosed to the researchers and the supervisors in a relationship to trust. Confidentiality was ensured to all participants of this research (results) for congenital syphilis, that their report cases were collected and stored in locked cabinets, safe drawers and digital data entry was highly encrypted with access to only by the researchers and the course convener without using of names.

L. Anticipated Risks of Research and Planned Methods of Management of Risks

This research project did not include participant intervention; it involved low risk. Proper storage of data with primary supervisor, and is only available to investigators when needed, maintain de-identifying of patients by using codes for data entry and the researchers were always in proper PPE when inside the serology department for data collection.

III. RESULTS

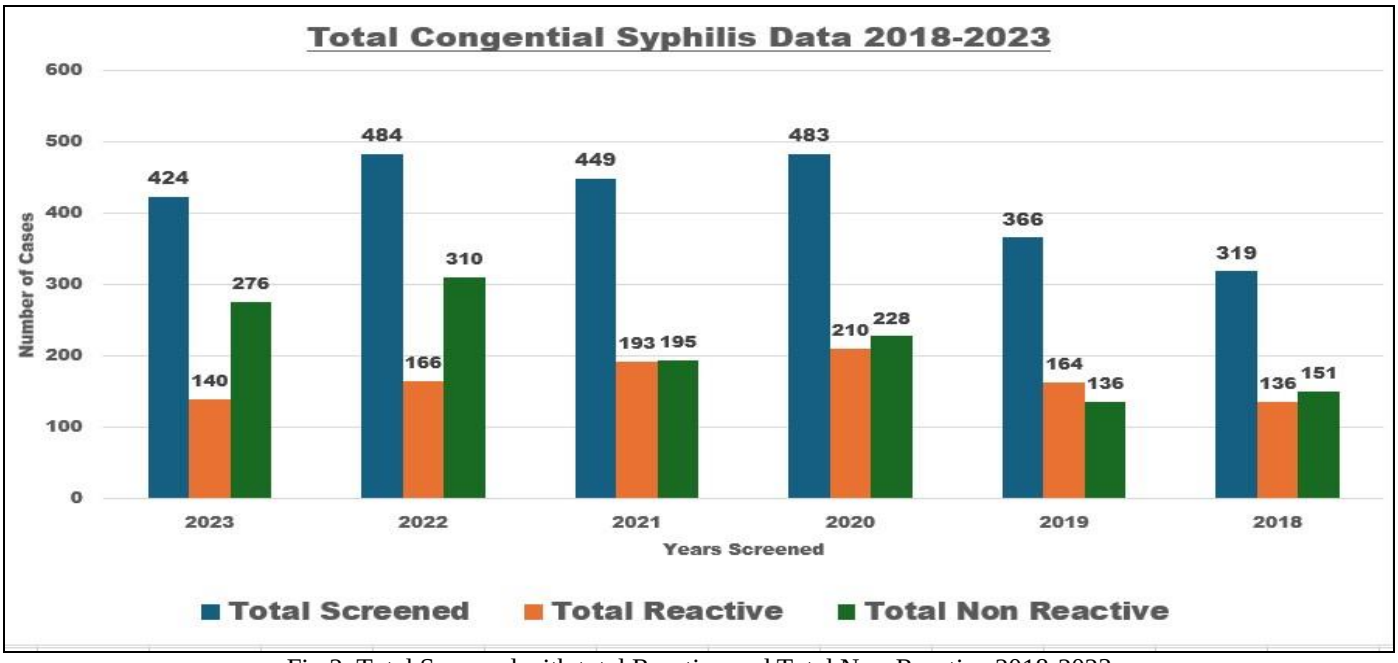

Fig 2: Total Screened with total Reactive and Total Non-Reactive 2018-2023

The results demonstrate the prevalence of neonates with congenital syphilis cases at CWM Hospital. Firstly, the data of 2525 suspected cases CS was analysed to determine the confirmed cases of congenital syphilis from the year 2018 to 2023 (Figure 2). The findings suggest that 44% (n=1009) were reactive compared to 56% (n=1296) of non-reactive cases (Figure 3).

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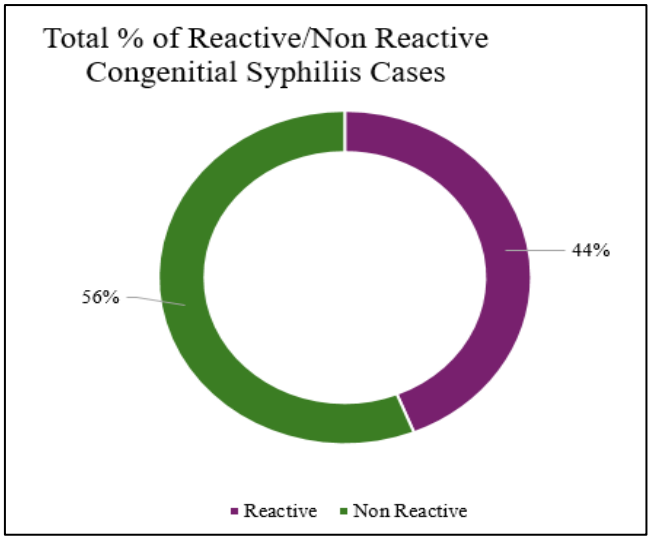

Fig 3: Total Percentage of Reactive Total Non-Reactive 2018-2023

Moreover, a slight increase in the prevalence trend from the year 2018 (43%) to 2019 (46%). A slight and steady decline in the percentage of congenital syphilis cases followed in the years 2019. Additionally, a similar decline was observed for the years 2020 and 2021. Notably, a significant drop in the prevalence trend for the recent years 2022 and 2023 (Figure 4).

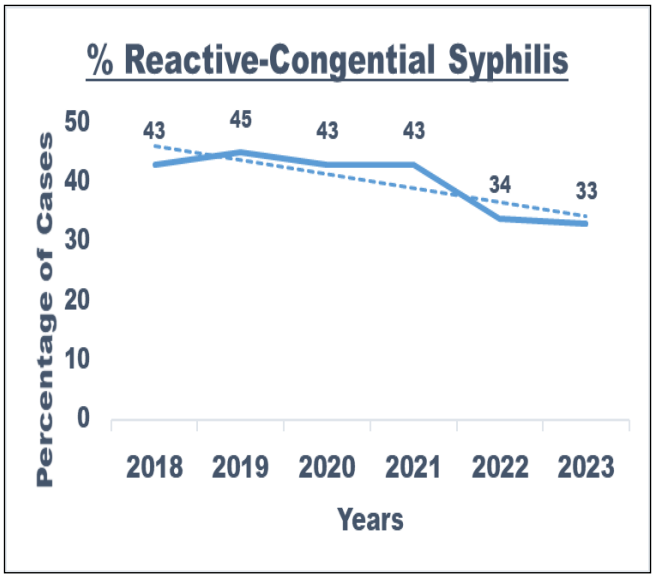

Fig 4: Trend of Reactive Cases of Congenital Syphilis from 2018-2023 in %

Comparing the ethnic distribution of the reactive cases of congenital syphilis in percentage, there was a slight difference among the three major ethnic groups in Fiji. The I-Taukei (IT) population had the highest percentage of reactive cases 42% (n=932) while the second largest ethnic group was the "Fijian of Indian Descent" (FID) had the lowest incidence of 33% (n=44). The last is the minority group which is labeled as "Others" and includes ethnic groups for example Rotuman, Part Europeans, and Chinese had the second highest incidence of 36% (n=15) of congenital syphilis for the period of 2018-2023 (Figure 5).

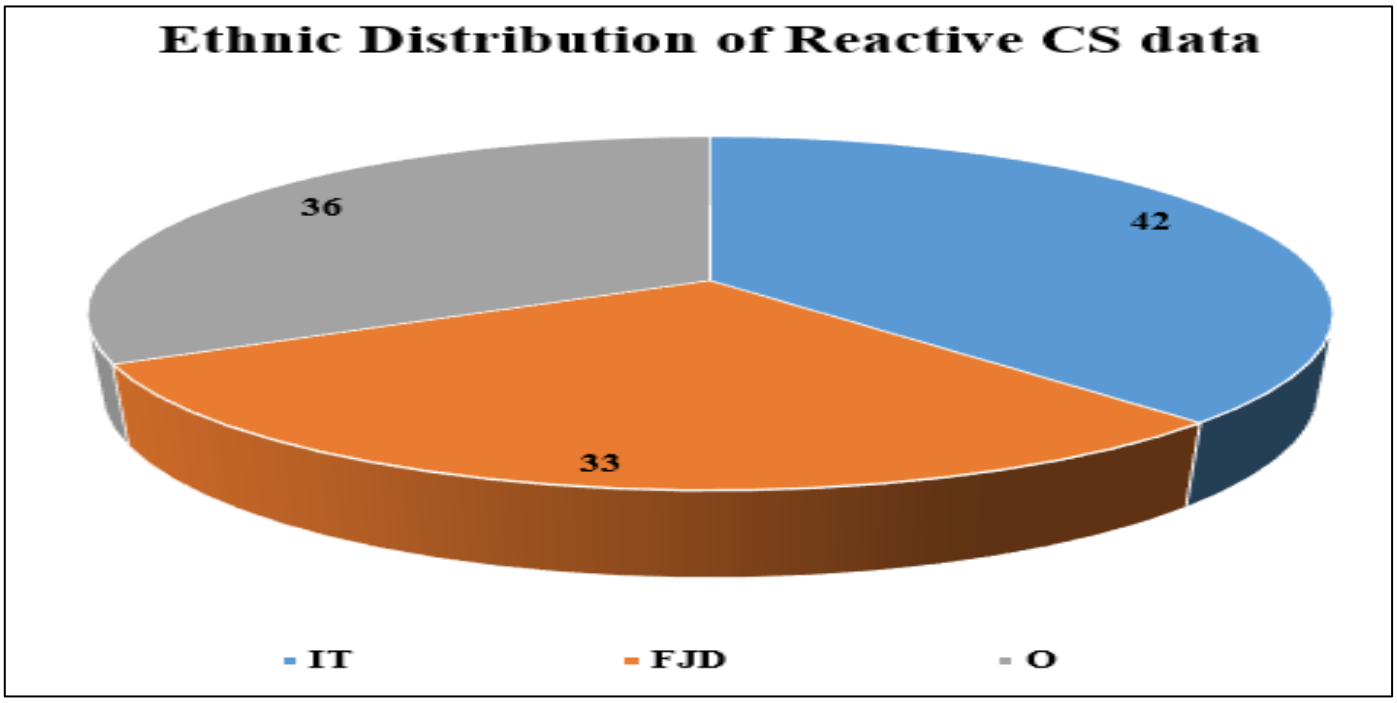

Fig 5: Ethnic Distribution Reactive Cases of Congenital Syphilis in %, 2018-2019

Gender distribution of the reactive cases of congenital syphilis reflects that the male cohort of neonate born between 2018 to 2023 were higher by 2% when compared to the female cohort for the same duration (Figure 6).

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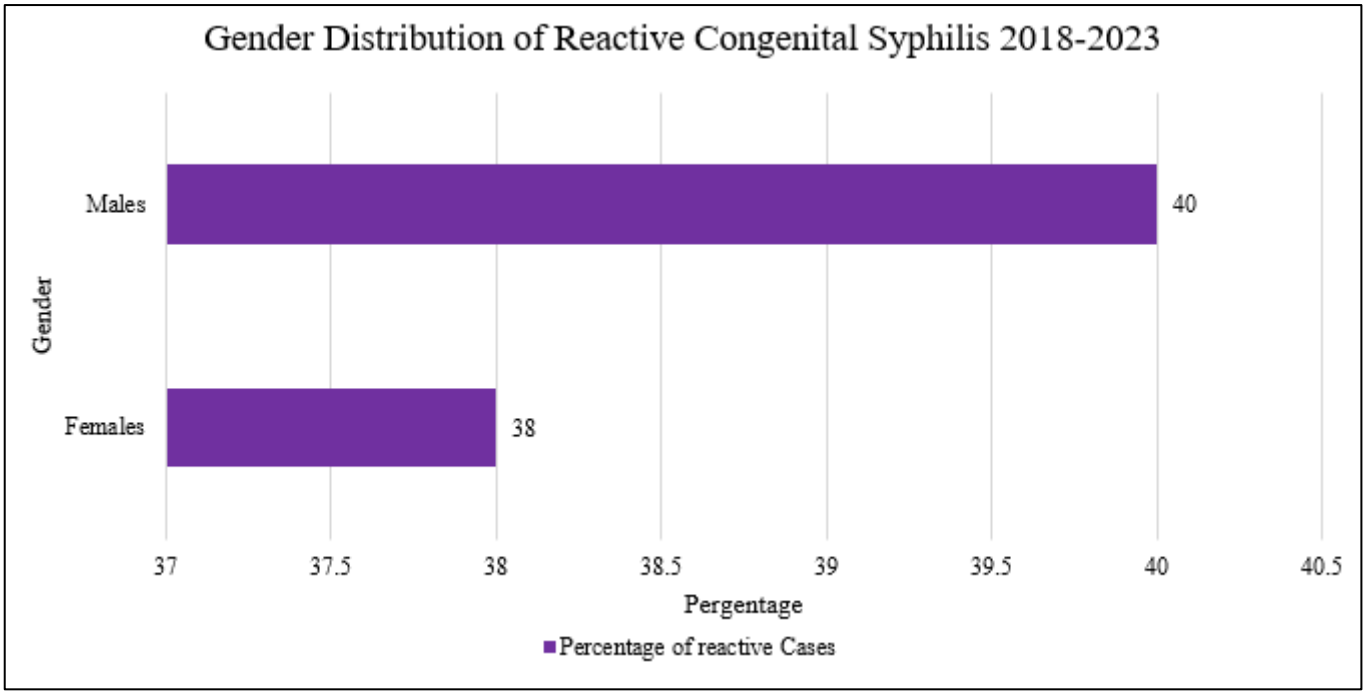

Fig 6: % Gender Distribution of Reactive Cases of CS from 2018-2023

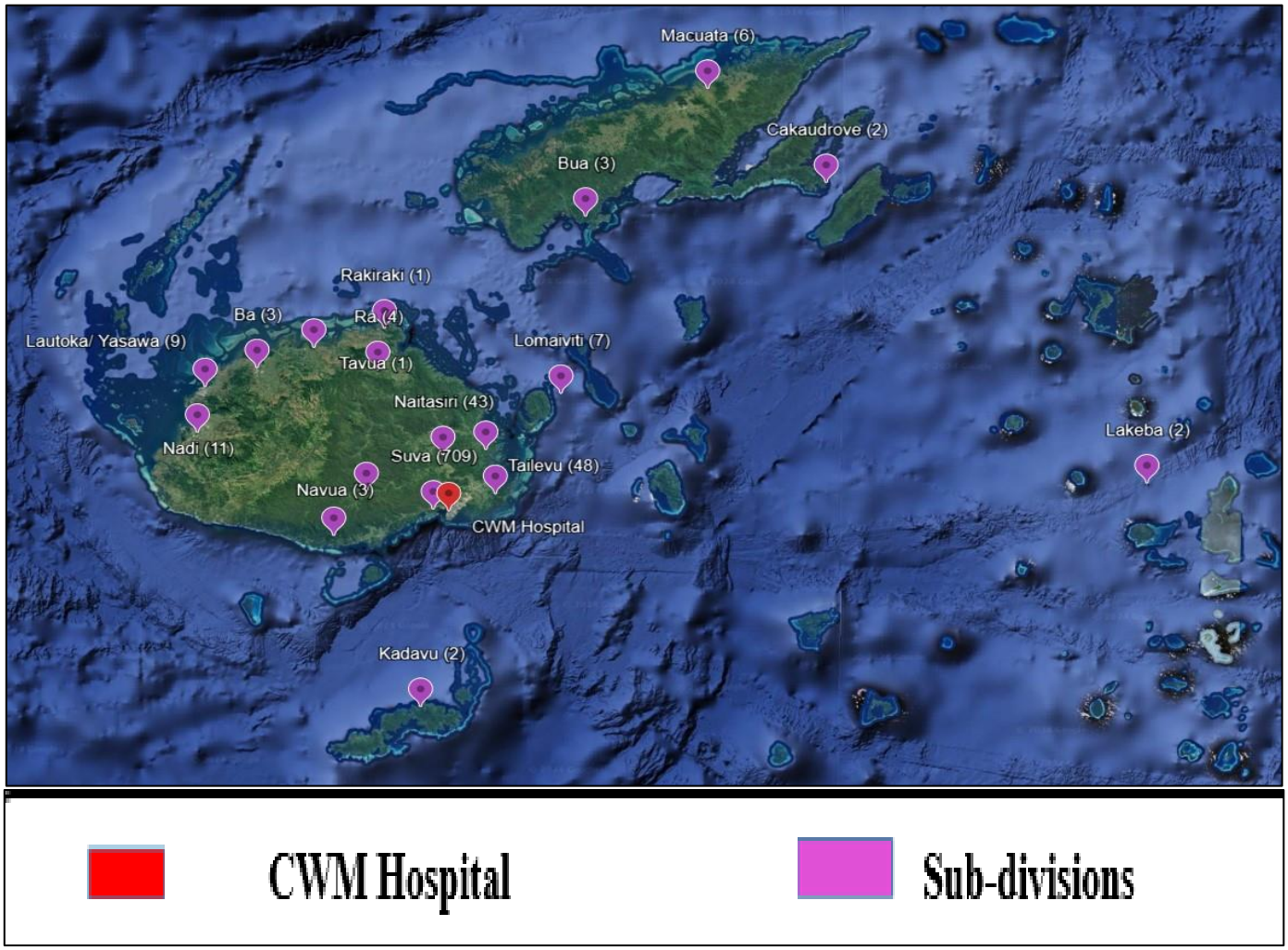

Fig 7: Geographic Distribution of Reactive Cases 2018-2023 at CWM Hospital
Source https://www.google.com/maps

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Table 1: Summary of all the Congenital Syphilis Reactive Cases as Per Sub-Division from 2018-2023 at CWM Hospital

Sub-division	Total Number of Reactive Congenital Cases
Suva	709
Rewa	113
Serua/Namosi	23
Tailevu	48
Naitasiri	43
Navua	3
Lomaiviti	7
Lautoka/Yasawa	9
Nadi	11
Ba	3
Ra	4
Kadavu	2
Macuata	2
Bua	3
Tavua	1
Cakaudrove	2
Rakiraki	1

IV. DISCUSSION

This study reports the prevalence of congenital syphilis at CWM Hospital for the years 2018-2023. In the study, the prevalence showed a slight increase from 2018 (43%) to (45%) in 2019, maintaining a consistent trend of 43% from 2020-2021 and a slight decrease in 2022 and 2023. A study done in the States that the factors associated with the increase in Congenital syphilis cases can be attributed to low maternal education levels, high-risk sexual behavior, substance abuse (methamphetamine) use, and the socio-economic status of the patient. This finding is similar to a study undertaken in Brazil whereby congenital syphilis increased for the years 2019-2020 (Lannoy et al., 2022). The lack of available data on the indicators for the year 2014-2016 fails to provide a 10-year prevalence trend which was initially proposed for this study. Estimates in the Western Pacific Region are of 13,000 babies infected by congenital syphilis however clinical studies are few from the region and none are recent (Maxson et al., 2020). Fiji was hit with the second wave (April to December 2021) and the third wave (December 2021- June 30, 2022) of the Covid-19 pandemic, and the whole country was in lockdown or restricted movement and public gatherings and may have contributed to the consistent and notable declining trend in Congenital syphilis cases for the later years.

The results show a significant relationship between the reactive data and the non-reactive data of congenital syphilis. From the years 2018 to 2021 an average of 12 case data differences with non-reactive data being higher, and from this perspective, a Brazilian study showed that low income and vulnerability associated with poverty are also associated with obstacles such as inadequate prenatal care (Benedetti et al., 2017). Other studies also point out that unemployed pregnant women or those with lower incomes and lower levels of schooling or academic training are more likely to have a child with congenital syphilis due to disparities in access to healthcare (Macêdo et al., 2017). According to WHO, a worldwide shortage of Benzathine penicillin G (BPG) which is the only drug to treat and prevent mother-to-child transmission of syphilis, out of the 114 countries approached, 41% reported a shortage in the year 2014-2016 including Australia and New Zealand (Nurse-Findlay et al., 2017). In Fiji, however, we can only perceive this information as a contributor as not much-published data is available to compare. A steady decline in the average case data of reactive in comparison to non-reactive data in the years 2022 and 2023 following similar trends in countries like Argentina, Bolivia, Colombia, Peru, etc., via the triple elimination initiative of mother-to-child transmission (EMTCT) of HIV, hepatitis B, and syphilis through a coordinated approach (WHO, 2017).

Furthermore, the highest congenital syphilis rate was diagnosed among the I-Taukei ethnic group in comparison to the FJD and the others, and as per a study done in the United States, similar findings were seen whereby infants of Black and Hispanic women had a slightly elevated proportion (Martin et al., 2022). A comprehensive explanation for this rate could be due to the elevated proportion of live births among the I-Taukei ethnicity. Therefore, a partial but insufficient explanation could also be due to the socio-economic status of the IT where financial difficulties act as barriers to timely diagnosis of maternal syphilis (Fuertes-Bucheli et al., 2024). fo

In addition, the gender distribution of the reactive cases of congenital syphilis reflects that the female cohort is higher from the years 2018, 2020 and 2022 when compared to the male cohort. In 2019, 2021 and 2023 however, the male cohort had a higher rate of incidence than the female cohort. This trend a fluctuating and when the overall picture of the reactive cases of congenital syphilis reflects that the male cohort of neonate born between 2018 to 2023 were higher by 2% when compared to the female cohort for the same duration (Figure 6).

CWM is the nation's largest hospital and the principal referral center for the eastern region of Fiji's most populated island, Viti Levu. The region is called the central division consisting of various sub-divisions according to their geographical location (Thompson at al., 2014). MOHMS, Fiji provides free or very low-cost health care including primary and preventative care to the population. The different subdivisions in Fiji are shown in Figure 7 highlighting the laboratory confirmed CS data from CWM Hospital. Suva subdivision caters to the areas from Lami town to Nakasi Health Center in Davuilevu and has recorded the highest number of CS data, with the Rewa subdivision as the second highest for 2018 to 2023. One reasonable explanation for elevated data could be the vicinity of CWM Hospital hence maternity care was utilised at this location. This could be said for the other subdivisions that also recorded elevated CS data, as these subdivisions are close to CWM Hospital making it easily accessible to the pregnant women residing in these areas (Table 1). On the other hand, sub-divisions that are situated further away from CWM Hospital also recorded CS data which were generally below 5, with the possible reasoning that either the pregnant women were traveling during the 3rd trimester or they were of "high-risk" cases and

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were referred to CWM Hospital's maternity department for childbirth.

V. CONCLUSION

Importantly, this research describes the prevalence of CS data in CWM Hospital for the duration of six years. The findings of the current study highlighted the importance of continuously implementing relevant surveillance for CS in Fiji and the Pacific. Despite the decrease in the global prevalence of CS, the numbers remain significantly high. Revising and strengthening MOHMS Fiji, policies for public health laboratories may help the development of the laboratory diagnostic capability of CS enabling early detection in pregnant women and their partners. Once the cases are diagnosed, then proper treatment can be administered. More importantly, the results reflect the potential burden associated with CS at CWM Hospital.

Importantly, public health awareness programs should be raised to pass information on the adverse effects of congenital syphilis, the advantages of early detection, and curb transmission. In addition, retaining the trust of community, institutions and leaders, especially religious leaders and health care professionals are pivotal in addressing the lack of awareness of Congenital Syphilis. Leaders and healthcare professionals play an important role in the acceptance of an intervention in a community by conducting discussions in English, Hindi, and I-Taukei to transmit information to a wider public

Furthermore, screening tests should be provided to those planning to become pregnant including the partner to provide an early diagnosis. Intensive testing, contact tracing, and timely treatment prevent further infection spread. Social Media platforms such as Facebook and Zoom is recommended to spread information to a wider public. Increase outreach services at all facilities from tertiary to primary levels to ensure easy accessibility and also to standardise care across all level. Moreover, further strengthening of government Fiji Pharmaceutical and Biomedical Services (FPBS) procurement policies and emergency procedures to ensure continuity and availability of reagents and kits during pandemics and natural disasters.

VI. LIMITATIONS

The limitations of this research are that the sample size is too small and focused on CWM Hospital laboratory data. The research period was proposed from the year 2014-2023 (10 years) however, data received was from 2017-2023 (6 years) due to unavailability of data.

A further limitation was that the raw data did not specify the exact date of birth, gender, and ethnicity of the patients hence, PATIS was used to obtain the information. Another drawback of the research is that the results used an old code for sample login in LIS (SS), showing the VDRL test whereas the actual test conducted was RPR. In addition, during internet outages and instances whereby the LIS/ PATIS software maintenance, patient samples login was carried out manually without capturing the demographic and geographic details hence data was not included in the research. Moreover, another limitation of this study was that during data collection and data analysis of the year 2020, we realized that approximately 14 of the tests requested were not processed due to the unavailability of the test kits and reagents. This was during the first wave of the Covid-19 pandemic in Fiji and the whole country was under lockdown.

FUTURE RESEARCH

Based on the outcomes of the research presented in this paper, several future research areas have been identified as follows, collective research for Congenital syphilis should be carried out at all the major Hospitals in Fiji to provide the exact prevalence of the country as a whole. Further research needs to be conducted to determine the relationship between early detection/ treatment to reactive mothers versus the results of babies born. The current study has demonstrated the laboratory-based Congenital syphilis data thus, the expansion of the number of case reports can be obtained from wards in situations where the neonates were diagnosed clinically. Further investigation is required to determine whether socioeconomic status of the patients is also a contributing factor. Social Media platforms such as Facebook and Zoom is recommended to spread information to a wider public. Increase outreach services at all facilities from tertiary to primary levels to ensure easy accessibility and also to standardise care across all levels.

Finally, further strengthening of government (FPBS Fiji Pharmaceutical and Biomedical Services) procurement policies and emergency procedures to ensure continuity and availability of reagents and kits during pandemics and natural disasters.

LIST OF ACRONYMS

- ABO Adverse Birth Outcomes
- ANC Antenatal care
- BCG Benzathine penicillin G
- CWM Colonial War Memorial Hospital
- CS Congenital Syphilis
- DOB Date of Birth
- ETMCT Triple elimination initiative of mother-to-child transmission
- FID Fijian of Indian Decent
- FPBS Fiji Pharmaceutical and Biomedical Services
- HIV Human Immunodeficiency Virus
- I-T I-Taukei
- LIS Laboratory Information System
- MCH Maternal and Child Health Clinic
- MOHMS Ministry of Health and Medical Services
- MTCT Mother-to-child-transmission
- NHN National Hospital Number
- Other Minor Ethnic Groups (Rotuman, Part Europeans, Chinese)
- PATIS Patient Information System
- RPR Rapid Plasma Reagin

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- SS LIS Test Login Panel (VDRL, TPPA, HBV, HIV)
- VDRL Venereal Disease Research laboratory
- WHO World Health Organisation
- TPPA Treponema pallidum particle agglutination

GLOSSARY OF TERMS

- Accession number- a unique number assigned by LIS to locate specific information.
- Assay- a laboratory procedure to measure specific substances (analytes)
- Congenital syphilis- a disease that occurs when the mother with syphilis passes the infection on to her baby during pregnancy.
- Laboratory information system- a system that stores all medical information of a patient in a lab.
- Masquerader- referred to as masked in distinguishing.
- Neonate- A newborn infant under 28 days of age.
- Non-treponemal-detect antibodies directed against lipoidal antigens, damaged host cells, and possibly from treponemes.
- Prevalence of Disease-Number of cases of a disease, infected people, or several people with some attribute of the disease present during a given time interval.
- Rapid plasma reagin- a screening blood test for detection of syphilis antibodies (non-treponemal)
- Sporadically- occasionally or in an irregular pattern.
- Systemic infection- infections that is in the bloodstream and affect the entire body rather than one organ.
- Tabes dorsalis- is a late consequence of neurosyphilis, characterized by the slow degeneration of the neural tracts primarily in the dorsal root ganglia of the spinal cord.
- *Treponema pallidum*- Microaerophilic spirochetes bacterium with subspecies that cause the disease syphilis.
- Treponema pallidum particle agglutination-confirmatory rapid test for the detection of syphilis reactive antibodies (treponemal).
- Treponemal test-serological testing to detect antibodies to T. pallidum proteins.
- VDRL (Venereal Disease Research Laboratory test)- is a blood test for syphilis and related non-venereal treponematoses.
- Serology Department- is the study of blood serum with the purpose of detecting antibodies and antigen.

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