

REDUCING VISION IMPAIRMENT IN CHILDREN THROUGH HEALTH SYSTEM  
ASSESSMENT AND STRENGTHENING APPROACH IN PAPUA NEW GUINEA

BY: Dr GEOFFREY WABULEMBO

MBChB (Makerere University)

MMed Ophthal (Makerere University)

Diploma Community Eye Health (University of London)

Fellowship Paediatric Ophthalmology Research (University of California Los Angeles)

Student number 213573636

Submitted in fulfillment of the requirements for the degree of

Doctor of Philosophy in Optometry

School of Optometry, College of Health Sciences

University of KwaZulu-Natal, Durban South Africa


## Preface

November 2018


The research work described in this thesis was conducted at Port Moresby General Hospital and Goroka Provincial Hospital between 1<sup>st</sup> October 2017 and 30<sup>th</sup> November 2017 with additional quantitative data during July 2018 under the supervision of Professor Kovin Naidoo and Dr Elena Schmidt.


This work has not been submitted in any form for any degree or diploma to any tertiary institution,

Where use has been made of work of others, it has been duly acknowledged in the text.

Wabulembo Geoffrey  Date: 14 November

As the candidates supervisor I agree to the submission of this thesis.

Professor Kovin Naidoo  Date: 14 November 2018

Dr Elena Schmidt  Date 14 November 2018

## Declaration

I Geoffrey Wabulembo declare that

- i. The research work presented in this thesis except where otherwise indicated is my original work
- ii. This thesis has not been submitted for any degree or examination at any other University
- iii. This thesis does not contain any other person's data, pictures, graphs or other information, unless specifically acknowledged as being from other persons.
- iv. Where other sources have been quoted their words have been rewritten but maintaining the same general information.

## **Dedication**

This thesis is dedicated to my wife and children who remained supportive all along this journey.

## **Acknowledgements**

Acknowledgements go to my supervisors Professor Kovin Naidoo and Dr Elena Schmidt. They guided and encouraged me as well as enduring to read through the script several times as it developed. I thank them for their patience and all the inspiration I have gained from working with them.

Thanks to the Executive Dean and Deputy Dean of academics at the School of Medicine and Health Sciences University of Papua New Guinea for approving this study.

My thanks go to the biostatistician team who supported me at different stages of the research. They include Mr Mtemeri at African Vision research Institute and Dr Edwin Masese at the University of Papua New Guinea Public Health division.

I am grateful to the team at African Vision Research Institute for their support in securing sponsorship, registration processes and other documentation, and to Dr Anthea Burnett for assistance with copyediting and referencing.

I thank Dr Robert Ko a Papua New Guinean for accepting to participate in the research as part of the capacity building for nationals which is a requirement in the approval process by the National Medical Research and Advisory Council of Papua New Guinea. He was instrumental in data collection at Port Moresby General Hospital. He also assisted in clarifying the cultural context of some of the responses from participants.

My appreciation goes to the staff both at Port Moresby and Goroka Hospitals for all their assistance in identifying participants and creating an environment conducive to conducting the study.

Thanks to the chief executive officers at Port Moresby General Hospital and Goroka Provincial Hospitals for allowing us to conduct the research at their Institutions.

All participants in this study are greatly appreciated for their consent and using some of their time at the hospital to be interviewed.

## Publications

### Publications during PhD candidature:

Wabulembo, G. (2013). Paediatric Ophthalmology care – A reflection on current status in Uganda. *Journal of Ophthalmology of Eastern Central and Southern Africa*, 3-5.

Robert, K., Colin, M., David, P., **Wabulembo, G.**, Oliver, S., Drew, K., Anthony W, S. (2016). Population-Based Trachoma Mapping in Six Evaluation Units of Papua New Guinea. [Ophthalmic Epidemiology](#). 2016; 23(sup1): 22–31

Kinengyere, P., Kizito Samuel., **Wabulembo, G.**, Kiggundu, John Baptist. & Ampaire, A. (2017, September). Burden, aetiology and predictors of visual impairment among children attending Mulago National Referral Hospital eye clinic, Uganda. *African Health Sciences*, 17(3), 877–885.

Lee, L., Fabrizio, D., Anthea, Burnett, Jambi, G., **Wabulembo, G.**, Samuel, P. **Koim.**, Keys, D. (2018, May). Rapid assessment of avoidable blindness in Papua New Guinea: a nationwide survey. *British Journal of Ophthalmology* 103(6)

### Publications prior to PhD candidature:

**Wabulembo, G.**, & Demer, J. (2012, September). Long-Term Outcome of Medial Rectus Recession and Pulley Posterior Fixation in Esotropia with High AC/A Ratio. [Strabismus](#). 2012 Sep; 20(3): 115–120.

## Contents

Preface.....	ii
Declaration .....	iii
Dedication .....	iv
Acknowledgements .....	v
Publications.....	vi
Contents.....	vii
List of Tables.....	xi
List of Figures.....	xii
ACRONYMS/ABBREVIATIONS.....	xiii
ABSTRACT .....	xv
CHAPTER ONE: INTRODUCTION.....	17
1.1 Introduction .....	17
1.2 Background.....	17
1.3 Statement of the problem.....	18
1.4 Significance of the study .....	19
1.5 Goal and Objectives.....	19
1.6 Specific Objectives.....	20
1.7 Structure of the thesis .....	20
CHAPTER 2: LITERATURE REVIEW.....	22
2.1 Introduction .....	22
2.2 Corneal Disease and Eye Injuries.....	24
2.3 Cataract .....	27
2.4 Retinopathy of Prematurity.....	29
2.5 Retinoblastoma .....	30
2.6 Impact of Childhood Blindness.....	30
2.7 Paediatric Eye Health Concerns in PNG.....	31
2.8 The WHO Health Systems Frame work .....	33
2.9 Country Profile .....	34

2.9.1 Demographics .....	35
2.9.2 Political system .....	36
2.9.3 The Economy .....	36
2.9.4 Education .....	37
2.9.5 Health System in PNG .....	38
2.9.6 Under-5 Mortality per 1000 live births .....	40
2.9.7 Maternal Mortality rate .....	41
2.9.8 Malaria .....	42
2.10 Health system and infrastructure .....	42
2.10.1 Health Units .....	42
2.10.2 Provincial Hospitals .....	43
2.10.3 District Hospitals and Health Centres/Clinics .....	43
2.10.6 Private Sector .....	43
2.11 Workforce for Health .....	44
CHAPTER 3: METHODOLOGY .....	47
3.0 Introduction .....	47
3.1 Study sites .....	47
3.1.1 Port Moresby General Hospital .....	47
3.1.2 Eastern Highland Provincial Hospital Goroka .....	48
3.2 Study design .....	48
3.3 Quantitative Study .....	50
3.3.1 Sampling Procedure: Port Moresby General Hospital .....	50
3.3.2 Data Collection .....	50
3.3.3 Data Management .....	51
3.3.4 Sampling Procedure: Goroka General Hospital .....	51
3.3.5 Data management .....	51
3.4 Qualitative Port Moresby and Goroka General Hospitals .....	51
3.4.1 Service Providers .....	51
3.4.2 Sampling Method and data Collection .....	52
3.4.3 Data Management .....	52
3.5 Service users/beneficiaries .....	53
3.5.1 Sampling method .....	53
3.5.2 Data Collection .....	53
3.5.3 Data Management .....	54
3.6 Ethics and Approvals .....	54
CHAPTER 4: RESULTS AND DISCUSSION .....	55
4.0 Introduction .....	55
4.1 Port Moresby General Hospital .....	55
4.1.1 Home province .....	55
4.1.2 Referral pattern .....	56
4.1.3 Age and sex distribution .....	57
4.1.4 Affected eye-right, left or both .....	59
4.1.5 Time before presentation after onset of symptoms .....	59
4.1.6 Visual acuity .....	60
4.1.7 Low vision and blindness with associated diagnosis .....	60
4.1.8 Disease pattern .....	62



4.2 Age profile of select diagnoses .....	63
4.2.1 Retinoblastoma .....	64
4.2.2 Lime Injury.....	64
4.2.3 Vitamin A deficiency (VAD).....	66
4.2.4 Trauma.....	67
4.2.5 Refractive error .....	69
4.2.6 Cataracts.....	70
4.3 Goroka General Hospital.....	72
4.3.1 Introduction .....	72
4.3.2 Results and discussion for Goroka Hospital .....	73
4.3.3 Limitations of the study .....	74
4.4 Results: Interviews with service providers.....	75
4.4.1 Characteristics of the service providers interviewed.....	75
4.4.2 Access to paediatric eye services .....	76
4.4.3 Human resources for eye health .....	76
4.4.4 Referral and Support.....	77
4.4.5 Leadership in paediatric eye health .....	77
4.4.6 Service delivery.....	77
4.4.7 Community eye work.....	78
4.4.8 Spectacle supply.....	78
4.4.9 Hospital data management .....	78
4.4.10 Budgeting .....	79
4.4.11 Procurement.....	79
4.4.12 Policy documents .....	80
4.4.13 Common child eye conditions .....	80
4.4.14 Factors affecting access to paediatric eye care.....	80
4.5 Discussion: Interview with service providers .....	81
4.5.1 Introduction .....	81
4.5.2 Human Resource for Eye Health .....	82
4.5.3 Hospital data management, budgeting, procurement and policy documents.....	82
4.5.4 Policy.....	83
4.5.5 Issues affecting access .....	84
4.6 Results: Strengths and weaknesses of the existing system.....	84
4.6.1 Demographics of service users (care givers) .....	84
4.6.2 Awareness about eye services .....	86
4.6.3 Duration of symptoms prior to coming to the hospital.....	86
4.6.4 Information about the children the service users brought.....	86
4.6.5 Services users experiences with services received.....	87
4.6.6 Eye health posters .....	88
4.6.7 Primary Eye care work.....	88
4.7 Discussion: Caregivers .....	89
4.7.1 Gender of caregivers.....	89
4.7.2 Education .....	89
4.7.3 Accessing eye services.....	89
4.7.3 Referral patterns .....	90
4.7.4 Limitations of the study .....	92
4.8 Document reviews .....	93
CHAPTER 5: CHILD EYE HEALTH STRATEGY.....	95
5.1 Introduction .....	95

5.2 Aim and objectives of the child eye health strategy .....	95
5.3 Child eye health strategy: Objectives 1 and 2 .....	95
5.3.1 Indicators (Objectives 1 and 2) .....	96
5.4 Child eye health strategy: Objective 3.....	96
5.4.1 Indicators (Objective 3) .....	97
5.5 Child eye health strategy: Objective 4.....	97
5.5.1 Indicators (Objective 4) .....	97
5.6 Child eye health strategy: Objective 5.....	98
5.6.1 Indicators (Objective 5) .....	99
5.7 Child eye health strategy: Objective 6.....	99
5.7.1 Indicators (Objective 6) .....	99
5.8 Summary of child eye health strategy recommendations.....	99
5.8.1 Critical assumptions .....	101
5.8.2 Threats .....	101
CHAPTER 6: SUMMARY, FUTURE RESEARCH AND CONCLUSION .....	102
6.1 Strengths.....	102
6.1 Weaknesses .....	102
6.2 Policies.....	103
6.3 Human Resource .....	103
6.4 Future Research and Next steps .....	104
6.5 Conclusion .....	105
REFERENCES.....	106
APPENDIX 1 CONSENT FORM FOR SERVICE BENEFICIARIES.....	141
APPENDIX II CONSENT FORM FOR SERVICE PROVIDERS.....	142
APPENDIX III INTERVIEW GUIDE QUESTIONNAIRE .....	143
APPENDIX IV SERVICE USER INTERVIEW QUESTIONNAIRE GUIDE .....	147
APPENDIX V PROVINCES OF PAPUA NEW GUINEA.....	149
APPENDIX VI ROAD NETWORK IN PAPUA NEW GUINEA .....	150
APPENDIX VII DISTANCE BETWEEN PORT MORESBY AND GOROKA 425KM....	151
APPENDIX VIII DEBATE ON BETEL NUT .....	152

## List of Tables

Table 1: Tuberculosis in PNG (WHO, 2016) .....	39
Table 2: Estimated TB incidence by age and sex (thousands) (WHO, 2016).....	39
Table 3: Childhood mortality rates per 1000 births (UNICEF, 2013) .....	41
Table 4: Children's home province (n=1185).....	56
Table 5: Referral patterns (n=535) .....	57
Table 6: Age of children .....	57
Table 7: Affected eye .....	59
Table 8: Visual Acuity (n=1,185) .....	60
Table 9: Low vision and blindness with associated diagnosis .....	61
Table 10: Age characteristics for select diagnosis .....	63
Table 11: Trauma causes and time prior to presenting post injury (n=360) .....	67
Table 12: Cataract.....	70
Table 13: Vision in the eye with better vision and management plan among cataract participants (by sex) .....	70
Table 14: Study participants (qualitative analysis) .....	76
Table 15: Characteristics of service users (n=40) .....	85

## List of Figures

Figure 1: Map of Papua New Guinea (UN, 2004).....	35
Figure 2: Map of PNG (UN, 2004) with location of study sites represented by smiley ..	49
Figure 3: Age and gender distribution .....	58
Figure 4: Diagnosis categories (Port Moresby) .....	63
Figure 5: Diagnosis categories (Goroka).....	73
Figure 6: Duration prior to presentation at hospital clinic.....	86
Figure 7: Diagnosis categories of children .....	87

## ACRONYMS/ABBREVIATIONS

CBM	Christian Blind Mission
ChEH	Child eye health
CRC	Convention for the Rights of Children
DALYs	Disability Adjusted Years
ECSAT	Eye Care Service Assessment Tool
EHSAT	Eye Health Service Assessment Tool
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
GKA	Goroka
GP Model	General Practitioner Down-Referral Model
HIV	Human Immune deficiency Virus
IAPB	International Agency for Prevention of Blindness
IARC	International Agency for Research on Cancer
IVMP	Intravenous Methyl Prednisone
KRA	Key Result Area
LLINs	Long-Lasting Insecticidal Nets
LMIC	Low and Middle Income Countries
MBChB	Bachelor of Medicine and Bachelor of surgery
MMed	Master of Medicine
MRI	Magnetic Resonance Imaging
OD	Right Eye
OS	Left Eye
OU	Both Eyes
OCA	Optochiasmatic Arachnoiditis

Ophthal	Ophthalmology
PEC	Primary Eye care
PMV	Public Motor Vehicles
PNG	Papua New Guinea
PSP	Participant Service Provider in Port Moresby
PSU	Participant Service User in Port Moresby
RAAB	Rapid Assessment of Avoidable Blindness
RANZCO	Royal Australian and New Zealand College of Ophthalmologists
ROP	Retinopathy of Prematurity
SDG	Sustainable Development Goals
SiB	Seeing is believing
TBM	Tuberculous Meningitis
U5MR	under 5 Mortality Rate
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UPNG	University of Papua New Guinea
VAD	Vitamin A Deficiency
WHO	World Health Organisation

## **ABSTRACT**

A strong and efficient integrated health system is able to contribute to the reduction of vision impairment among children by ensuring preventive measures are implemented and timely access to care is done in case of morbidity. Children in Papua New Guinea presenting late for congenital cataract surgery, incurring avoidable eye injuries, living with uncorrected refractive error and some presenting with advanced retinoblastoma were of concern to the researcher. The overall aim of the study was to assess how the current health system in Papua New Guinea is addressing child eye health using Port Moresby General Hospital and Goroka hospital as case studies. It is envisaged that a health strengthening approach benefits children's eye health in the community.

### **Methods**

Both quantitative and qualitative methods were employed. Retrospective medical records review of children seen at the eye clinic in Port Moresby and Goroka Hospitals from January 2015 to December 2017 was conducted. In the qualitative method service providers and caregivers were interviewed to obtain their perspectives regarding performance of the health system.

### **Results**

At Port Moresby General Hospital trauma, conjunctivitis and corneal ulcers accounted for 21.6%, 18.9% and 9% respectively of all the diagnoses among children. Trauma was in the ratio of 1:1 ( $p=0.264$ ) male to female. And 7.3% ( $n=51$ ) of the children were blind (according to the WHO definition). Among the blind children optic nerve disorders accounted for 20.5% ( $n=14$ ) followed by both un-operated cataracts and uncorrected refractive error each at 13.2% ( $n=9$ ). Retinoblastoma presented at mean age 5.869 (SD4.5) and 6.02(SD 2.4) years for girls and boys respectively. The main causes of ocular morbidity observed at Goroka Hospital were corneal ulcers (24.9%), uveitis (9.3%) and foreign bodies (9.2%).

Service provider interviews revealed lack of policy on child eye health, shortage of health personnel and limited community eye health services. But among care givers lack of eye health information in the community, concerns about long waiting time at the hospitals and inadequate explanation about conditions affecting the children featured prominently.

### **Conclusion**

Findings show a higher percentage of blind children compared to similar hospital based studies elsewhere. To achieve universal eye health coverage, raising awareness about child eye health needs among leaders in health is urgent. Successes registered in the

past in Papua New Guinea in other child health efforts like immunisation suggest that a consistent and focused health system strengthening approach with greater integration may contribute to reduction of vision impairment among children. A proposed child eye health strategy based on the findings from this study is included in this thesis.

### **Key words**

Vision Impairment

Health Systems

Eye Health

Childhood blindness



## **CHAPTER ONE: INTRODUCTION**

### **1.1 Introduction**

This chapter introduces the topic of the thesis, provides contextual information and summarizes the health system strengthening approach used the analytical framework. The chapter focuses on how eye health relates to the broader health system in Papua New Guinea (PNG), with a specific emphasis on paediatric eye health. The chapter also outlines the thesis research objectives.

### **1.2 Background**

Advancements in approaches and forms of health care delivery make it difficult to have a common definition of a health system. However, for purposes of having a common understanding among different actors in health, and for purposes of this study, the WHO definition (WHO, 2007a) of a health system will be used. This definition includes all organizations, people and actions whose primary interest is to promote, restore or maintain health.

In more recent years, this definition has been further extended to include the prevention of household poverty due to illness (The World Bank Group, 2007a). Six core components in a health system are recognized (i) service delivery, (ii) health workforce, (iii) health information systems, (iv) access to essential medicines, (v) financing, and (vi) leadership/governance (The World Bank Group, 2007a). The interplay of these components vary from country to country and even within the same country, but some benchmarks can be used to determine the efficiency of the system, such as financing mechanisms; status of the human resource, health information system, infrastructure and health service delivery systems (WHO, 2007a)

Attention is given to childhood blindness not only because its causes are amenable to prevention and treatment, but because of the dire long term consequences if not addressed (WHO, 2019a). However, many of the children in need of these interventions are not accessing them. Some lessons were learnt from the WHO global action plan for Universal Eye health 2009-2013, including the importance of monitoring prevalence and causes of visual impairment, its variation over time, and how eye care and rehabilitation services are integrated in the overall health system (WHO, 2013a).

While VISION 2020—a global initiative that aims to eliminate the main causes of preventable and treatable blindness as a public health issue by the year 2020—has achieved a lot, there remains a lot to be done to meet its targets. (WHO, 2018c) Ackland (Ackland, 2012) argues that scaling up is dependent on success in key areas which include aligning its efforts more closely with health systems, forging closer partnerships with major health development movements and advocacy, primarily at the country level

In order to reduce childhood blindness and maintain good eye health for children a strong health system is essential, and WHO (WHO, 2013a) recommends strengthening eye care services through their integration rather than through a vertical programme approach.

In PNG considerable health gains were made in the first two decades after independence in 1975. However a number of key health indicators worsened since the mid-1990s to the extent that PNG does not compare favourably on the international scale (Department of National Planning and Monitoring, 2010). Communicable diseases, including malaria, tuberculosis, diarrhoeal diseases, and acute respiratory disease, are still the predominant causes of morbidity and mortality (National Department of Health, 2012). Additionally the poorest 20 per cent of the population and those who have a higher percentage of illness were less likely than wealthier households to seek treatment when having reported some health discomfort (Irava, Barker, Somanathan, & Hou, 2015). Child eye health can benefit from the broader policy of government which seeks to achieve an efficient health system that can deliver an internationally acceptable standard of health services by 2030 (Department of National Planning and Monitoring, 2010).

### **1.3 Statement of the problem**

There is limited data on childhood vision impairment and the performance of the eye health system in PNG. The information gap that exists suggests that people in need of eye care services are not adequately catered for by the health system. Multiple difficulties in accessing health including transport challenges and high costs of treatment were alluded to by Burnett (Burnett, et al., 2015). The mountainous terrain and island geography are significant obstacles for accessing eye care services by people in need, particularly so for children. Programmatic experience shows that an integrated strategy can be effective in achieving high treatment coverage and delivering high-quality care to children in the community (WHO/UNICEF, 2012). Eye health should be considered for integration within integrated community case management since blindness affects child survival.

However, there is almost no information on the integration of eye health services for adults and children in the broader health system in PNG, despite the existing evidence on the benefits of such integration for early identification and treatment of eye diseases (Morone, Camacho, Kocur, & Banatvala, 2012). This research explores the performance of the eye health system and its integration into the broader health system from the perspectives of those who provide the services and those who are served by the system with a specific emphasis on child eye health. Although much has been achieved globally in terms of delivery of eye care services for children (Gilbert & Muhit, 2012) evidence is needed on how the existing services could be improved in the poorer settings and for those who are most difficult to reach.

There is a need for more studies that focus on the user perspectives, with the view of engaging them to make the system work better. Moreover, in PNG, more data are needed to define the most pressing eye problems affecting children and to inform advocacy and planning efforts to ensure enough resources are available for implementation of child eye health activities.

#### **1.4 Significance of the study**

This study will shed light on the eye conditions affecting children in Papua New Guinea and how the health system in Papua New Guinea is responding to the eye health needs of children. It is envisaged a child eye health policy will be written and come into force to address visual impairment, its prevention and treatment among children. The evidence gained from this study will allow for further exploration of the most appropriate community-based interventions in form of a Child Eye Health Strategy and for establishing a well-functioning eye health system (Dawson, et al., 2008).

#### **1.5 Goal and Objectives**

The goal of the study was to generate information on paediatric eye care needs and the availability of services, using two hospitals as case studies in order to formulate a paediatric eye health strategy to address the current and future needs.

#### **Objectives:**

- I. To determine the eye conditions among children who presented at the two PNG hospitals from January 2015 to December 2017,

- II. To establish and describe how paediatric eye health services are being delivered and integrated in the general health system, using health system building blocks as an analytical framework,
- III. To explore the strengths and weaknesses of the existing system from the perspective of service providers and service users, and
- IV. To formulate a paediatric eye health strategy.

## **1.6 Specific Objectives**

This thesis aims to make important additions to the existing knowledge of how the health system in Papua New Guinea responds to eye health issues in children in order to reduce visual impairment and blindness.

Objective 1: Assess the pattern and magnitude of eye conditions among children that present to the eye clinics in PNG using Port Moresby General Hospital and Goroka Hospital as case studies,

Objective 2: Review the eye services available in the two selected hospitals and assess the extent of their integration into the broader health systems,

Objective 3: Focus on the perspectives of service beneficiaries, their views and experiences of the system and suggestions as to how its services can be improved, and

Objective 4: Use the findings from questions one to three contributed to develop a child eye health strategy for PNG.

## **1.7 Structure of the thesis**

*Chapter 2* reviews the existing literature on the important diseases associated with visual impairment in children and how they have been controlled in different countries. The contribution of different scholars to the subject of 'health system strengthening' in low and middle income countries (LMICs) is discussed. Later in the chapter the country profile of PNG and more specifically its health system is discussed. It describes the geographical features of the country and explains why these call for more innovative ways for reaching hard to reach populations, particularly children in remote places. It focuses on the status of human resources for eye care as a unique challenge and discusses how this can be addressed through medical education of those already in service. Examples of successful approaches to strengthening health systems are discussed. The chapter concludes

with the identification of the current knowledge gaps and justification for the selected research objectives.

Chapter 3 describes the methodology of this study, including study design, sampling, data collection methods, data analysis, and ethics.

Chapter 4 presents study results, discussion and key study limitations

Chapter 5 describes a strategic plan proposed in response to the findings of the study and addresses objective 4.

Chapter 6 outlines the main conclusions, recommendations and implications for future research.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Introduction

This chapter provides a background to the problem of vision impairment among children plus a review of literature on common causes in developing countries. It also highlights information of central relevance to this study and PNG where the study was conducted. The review is devoted to some approaches used elsewhere that may be applicable in PNG to reduce vision impairment among children. Potential opportunities for intervention and synergy within a health system are outlined.

Cuteness has emerged as an important factor for attracting caregiver attention and affection. Cuteness is not limited to visual infant features, but is also found in positive sounds and smells. Infant facial features serve as 'innate survival instincts for otherwise helpless and dependent infants (Kringelbach, Stark, Alexander, Bornstein, & Stein, 2016). This phenomenon presents an opportunity to the caregiver to detect abnormalities in a child's eyes early. Identifying the common eye problems affecting children in PNG and raising awareness about them may enable earlier detection of eye problem in children by the primary care givers.

The advances in the field of ophthalmology in the past few decades have not necessarily been congruous with coverage, resulting in unacceptable levels of vision impairment among children in some communities (Jagat Ram, 2014). While disease patterns may vary from country to country children in all regions of the world are affected by a range of eye diseases and conditions, some of which may lead to permanent vision impairment in childhood, or later in life (WHO, 2013a). But as highlighted by Chadha and Subramanian (Chadha & Subramanian, 2011) the impact of childhood vision impairment is different to that of vision impairment in adults, because these will children endure a lifetime of disability, compounded by stresses on family, friends and relationships, across their lifetime. However because such children are few in number and, are often not as visible as adults, their cause is sometimes missed or ignored during planning.

WHO (WHO, 2014) estimates that globally 19 million children are visually impaired. Twelve millions of these are due to treatable uncorrected refractive errors, while around 1.4 million children are irreversibly blind but can have their quality of life improved through visual rehabilitation interventions including orientation and mobility training. It should however be noted that the current number of children with visual impairment or blindness may be much higher, as there have not been

many population based studies performed examining the prevalence in children, particularly recently.

Progress in level of eye care has increased success in the treatment of a number of conditions leading to vision impairment among children, for instance congenital cataracts. But as pointed out by Rahi and Dezateux (Rahi S & Dezateux, 1999) early diagnosis and surgery are crucial to a good outcome. This is an important challenge to address in the health system so that early detection and available interventions are easily accessible to the community. In places where vitamin A deficiency is still prevalent (Wilson, Pandey, & Thakur, 2003a), corneal vision impairment can be prevented by good nutrition and immunisation. Therefore identifying gaps to address child eye health issues in the health system contributes towards ensuring that desired outcomes for children's eye health are achieved. Child eye health can be piggybacked on other on-going interventions like Integrated Management of Neonatal and Childhood Illnesses (IMNCI) strategy, which has been adopted in nearly 100 Countries (Rudan, et al., 2016) and currently includes ears but not eyes except for conjunctivitis in measles (Malik, Mafwiri, & Gilbert, 2018). Since the IMNCI strategy is being implemented in PNG, advocacy needs to be considered at a national level for inclusion of strategies to address eye conditions that are common in PNG based on the information obtained through this study and others to follow.

The Eye Health System Assessment Tool (EHSAT) (Karl, Gilbert, Lindfield, & Crook, 2012) which facilitates better understanding of how health systems relate to eye health provides a framework for guiding conversations with health care providers. The PNG National Health Plan 2011-2020 (Department of Health, 2010) stipulates that every health worker in PNG can and must take action, within their own role, to improve the health of mothers and children, and that child survival is one of the priority areas of focus in the plan. The emphasis of the plan however is on 'killer diseases' like malaria, pneumonia and diarrhoea, largely because of the high associated rates of mortality (Liu, et al., 2015). While some of these conditions result in death some of the surviving children may remain with vision impairment as a sequel of depletion of body vitamin A reserves, associated with febrile illness and neurological damage from meningitis and cerebral malaria. In that respect the causes of blindness in children differs from those in adults requiring different strategies and control measures (Gordon, Minassian, Weale, & West, 2012). Dominant disease conditions in different countries influence the investments required to ensure that no child lives unnecessarily with vision impairment and a coordinated collaborative effort enables limited resources to go further. The trachoma consortium has so far proved to be an excellent example of

how multiple actors can work together to achieve concrete social goals. Lessons learnt and shared can be applied to other development areas for effective collaboration (Bartlett, Dominic, Simon, & Haddad, 2019).

This thesis sought to contribute to possible priority areas for investment in child eye health, and may require multi-stakeholder collaboration. A child presenting with corneal ulceration from vitamin A deficiency or following measles should not be managed as an individual case, and the health system ought to have a mechanism of investigating whether full immunisation was adhered to not only for that child but for other children in the community where the child comes from (WHO, 1999). Additionally, planning for interventions for those with vision impairment requires good understanding of the causes and magnitude of each condition. Faal (Faal, 2012) advocates for the need to focus on data collection and information on disparities within and between countries that may delay achievement of millennium development goals (MDGs). Keeping on track with MDGs provides opportunities for vulnerable sections of society like children and people with disabilities to receive attention.

Some of the common paediatric ocular morbidities in low and Middle income countries are described below.

## **2.2 Corneal Disease and Eye Injuries**

The cornea is the transparent front part of the eye. It serves the function of transmitting and refracting light rays into the eye. Various diseases affecting the cornea may result in blindness by causing opacification of the cornea. These vary in different geographical areas of the world (Whitcher, Srinivasan, & Upadhyay, 2001).

Studies show that trachoma (Zerihun & Mabey, 1997), onchocerciasis (Babalola, 2011), ophthalmia neonatorum (Foster & Klaus, 1995), use of traditional eye medicine (Lewallen & Courtright, 1995) xerophthalmia (Mishra, Gulati, Bhushan, Mohan, & Sinha, 2017) and trauma (Thylefors, 1992) are the most important causes of corneal blindness. Prophylaxis for ophthalmia neonatorum is widely practiced but it still represents a significant cause of childhood corneal blindness in developing countries (Ghahramani & Ghahramani, 2007). Systems in a hospital need to be reviewed to find out whether the labour ward has protocols for the prevention of ophthalmia neonatorum, or whether any information on ophthalmia neonatorum is given to mothers before being discharged. It is also crucial for immunizers to be able to explain, to mothers and other caregivers signs of



ophthalmia neonatorum and emphasize the need to seek prompt treatment. In addition, it is necessary to understand whether the personnel in the facilities are appropriately trained and whether the drugs for treatment of ophthalmia neonatorum are budgeted for and procured, so they can be obtained at the hospital pharmacy when prescribed. But budgeting should be guided by analysed data collected at service points of the health unit. This calls for a user friendly health information management system to be an integral part of the health system.

The health system needs to have a diversity of skilled people working together in a coordinated manner for effective case management to prevent complications and visual loss. Once some layers of the cornea are breached either through injury or infection, they heal with scarring and varying degrees of opacification. Burton (Burton, 2009) argues that investment in quality microbiology facilities to support accurate diagnosis is a worthwhile intervention strategy.

Additionally it is important to identify persons at risk (Padma, Kuzhupally, & Minu, 2016) and institute appropriate interventions to prevent visual complications. Fingernail injuries are recognized as potential sources of corneal abrasions (Ghadah & Abdullah, 2018) and trimming them reduces that risk significantly. A retrospective hospital based study in Nigeria showed that stones from catapults and stick injuries were the most common cause of corneal trauma among children (Omobolanle & Henrietta, 2012). In PNG more studies are needed to show whether injuries among children are purely accidental or the result of inadequate guidance and supervision. Hospital data on ocular trauma in Madang General Hospital revealed that lime burn was a common cause of corneal injury, accounting for 8.3 % of all ocular trauma and 50% of these cases were in children less than 10 years old (Ko, 2016). This is a unique form of chemical injury associated with the adults' habit of chewing betel nut, a practice that is common in almost every family in PNG. Lime additive while chewing the nut enables release of the stimulant that is contained in betel nut. For breast feeding mothers it sometimes inadvertently falls into the eyes of the babies on their laps causing chemical burns on the ocular surface. The ulceration resulting from this often heals with scarring, resulting in vision impairment. Lime burns involving the conjunctiva may result in healing with symblepharon formation. The effect of this is restricted eye movement and interference with tear production and drainage, all of which can result into severe vision impairment. This can be prevented through behavioural modification among adults. Whether there is an appreciation by the community of how hazardous lime is in the eyes may be worth investigating. Many parents today come to learn about this hazard only after it has happened to their own children. A simple message to address this, if widely disseminated, may raise awareness and bring about a

reduction in such accidents. It is worth considering having betel nut vendors participate in either distributing fliers or displaying posters at their sale places showing some of the hazards of lime to eyes. This principle has been applied in the cigarette industry with a warning message on the cigarette packet. Currently the most visible posters about the deleterious effects of betel nut consumption are with regard to its strong association to oral cancer. This is a potential collaboration opportunity, as PNG is reported to have the highest burden of oral cavity-oropharyngeal cancer (OCC-OPC) worldwide (Pollaers, Kujan, Johnson, & Farah Camile, 2017).

Knowing the causes and patterns of corneal injuries will ensure that preventive health education packages developed and used remain relevant to the community. Some injuries involve the cornea and other internal parts of the eye. But injuries in the home lack a specific pattern of aetiology and are therefore the most challenging to prevent. Therefore creating general awareness about the safe use of domestic chemicals, kitchen equipment or gardening tools is essential. Safety standards for toys, tools and home equipment might also be needed in some countries (Patel D. , 2015). Most of the children in rural areas do not have industrial or purpose made toys so in their curiosity sometimes play with sharp objects, which results in eye injuries. The concept of having children supervised all the time may not be well known in cultures where the norm in homesteads is for children to play on their own, and communally, while adults go about their household chores.

A survey in 2007 conducted in schools for the blind in East Africa (Malawi, Kenya, Tanzania and Uganda) showed that the cornea was the leading site of blindness (19%) followed by the whole globe (15.7%), the retina (15.4%) and the lens (13.1%) (Njuguna, et al., 2009). Similar information for PNG specific to children is not yet available and will ideally constitute future research. Keratitis and trauma during childhood were the leading causes of corneal blindness in a population based study in Andhra Pradesh, India (Dandona & Dandona, 2003). A further illustration of how different the main causes of ocular morbidity can be in different countries and warrants studies to be conducted in each country

In PNG a study performed across different provinces (WHO, 1995) found that 0.59% of respondents suffered clinically from vitamin A deficiency. It would be important to know the current status by conducting follow up field studies. This is essential because malnutrition remains a big problem in PNG (Aipit, Aipit, & Laman, 2014). It may still be necessary to ask pregnant mothers whether they have night blindness. Rabindran recommends 10,000 IU of vitamin A orally for 2 weeks for a pregnant woman with night blindness or Bitot's spot and after delivery

she should receive 3 doses of vitamin A 200,000 IU on day 1, day 2 and day 8 to ensure adequate supply in her breast milk (Rabindran & Gedam, 2016). Otherwise her baby will be at risk of being deficient in Vitamin A with possible visual complications. As part of health system strengthening midwives need to be provided with this information, as pregnant women with night blindness are likely to have midwives as their primary health care providers. Previous accomplishments in child health in PNG can be considered for possible emulation. For example PNG achieved a polio-free status in 1997 (certified in 2000) (WHO, 2018a) (Masterson, 2019). There may be lessons we can learn from how this was achieved. Estimates in 2011 found that measles deaths in PNG reduced by 98% between 2000 and 2009 (WHO, 2018b). This suggests that improvements in provisions for child eye health by the health system are achievable.

### **2.3 Cataract**

Cataract is clouding of the normally clear crystalline lens resulting in varying degrees of reduced vision. Sometimes the vision is reduced significantly, and can result in blindness in the affected eye.

Paediatric cataracts are considered 'congenital' if present at birth or within the first year of life, or 'developmental' if present after infancy, or due to trauma (Medsinge & Nischa, 2015). Cataract is important as it constitutes the primary cause of treatable childhood blindness worldwide (Wu, Long, Lin, & Liu, 2016). The incidence of various forms of paediatric cataract ranges from 1.8 to 3.6/10,000 per year (Sheeladevi, Lawrenson, Fielder A, & Suttle, 2016) with the median prevalence about 1.03/10,000 children, range (0.32–22.9/10,000) (Khokhar, et al., 2017). The prevalence of non-traumatic cataract in children will vary according to availability or lack of services (Courtright, Childhood cataract in sub-Saharan Africa, 2012). Currently no prevalence figures are available for PNG.

In order to prevent the development of the irreversible stimulus-deprivation amblyopia, early diagnosis and treatment is necessary (Medsinge & Nischa, 2015). Studies show that children with severe vision impairment tend to be obscure (Gilbert, Clare; Foster, Allen, 2001), sometimes neglected and unable to access timely treatment, and may die early. Some of children are not only neglected but abused (Kvam, 2005). Efforts to find such children are rewarding and should always be pursued so they can receive specific intervention. Consistent with Dawodu's (Dawodu, 2011) observations elsewhere, routine eye examinations of all new-born babies to detect any abnormalities that would prevent the development of good vision is yet to be implemented in PNG. However, surgery alone is not

enough. Follow up for proper visual rehabilitation is essential. Visual rehabilitation requires a well-coordinated system for both appropriate referral, procurement of interventional surgical equipment and supplies and access to visual rehabilitation services and devices. Prideaux (Prideaux & Beg, 2008) describes a deeply entrenched informal social support system in PNG 'wantok' (one talk) or kinsmen in which people share the happy times and tragedies through physical togetherness and money and material contributions in times of need. This attribute can be explored for identification and follow up of children with vision impairment in the community.

Management of children with cataracts presents some challenges because of the increased intraoperative difficulties, propensity for increased postoperative inflammation, changing refractive state of the eye, common postoperative complications and a tendency to develop amblyopia (Wilson, Pandey, & Thakur, 2003a). This means that additional training for ophthalmologists is essential to equip them with skills so as to minimise complications and to ensure that every child seen will have a management plan for both the short and long term. There is still a deficit of ophthalmologists in many developing countries but in addition to the already long training required for an ophthalmologist, dealing with cataracts in children requires additional training (Wilson, Pandey, & Thakur, 2003a). Unlike in adult cataract surgery, where the majority of the patients are operated under local anaesthesia, handling paediatric cataract requires additional services of a well-trained anaesthesiologist. All this requires a supportive health system which enables people of different competencies to work as a team. Such a team is crucial in ensuring that children with congenital cataracts are managed in a timely manner and followed up sufficiently long enough to ensure a good outcome. In the context of PNG, this also means consensus on where to establish tertiary paediatric eye services, and where to train the human resources needed.

A study conducted in Uganda revealed cataract to be the single largest cause of visual loss among children due to non-comprehensive interventions, making improved management a major target for reducing childhood blindness (Waddel, 1998). Improved management in Uganda entailed training ophthalmologists in busy departments in techniques for cataract surgery in children. In addition intra-country regional centres of excellence were established, and staffs were trained in the different competencies that comprise complete paediatric eye teams. Vision 2020 recommends that in order to provide children access to specialists in glaucoma, retina, cornea and oncology, the essential team consists of: a paediatric oriented ophthalmologist, 3 paediatric nurses, an orthoptists, a multiskilled refractionist or optometrist if available, a dispensing optician/technician, a low vision specialist,

and a paediatric counsellor within a health system network (Vision 2020, 2010). This model may be applicable in PNG where the number of ophthalmologists is still very limited and ophthalmology subspecialties not yet be well developed.

While prevention of cataract would be the preferred approach in light of the complexity of management, a study in Western India revealed that among non-traumatic cataracts, 7.2% were due to hereditary factors, 4.6% were due to congenital rubella syndrome, 14.5% were secondary cataracts and more than 50% of cases were idiopathic (Johar, Savalia, Vasavada, & Gupta, 2004).

These findings emphasize the importance of having a health system that can provide interventions for those conditions that cannot be prevented. The ultimate goal in paediatric cataract is early detection and early surgery combined with follow up visual rehabilitation (Gilbert, Canovas, Hagan, Rao, & Forster, 1993). In Tanzania, Mwende found that the major delay occurred between recognition and presentation of cataracts, rather than between the presentation and treatment (Mwende, Bronsard, Mosha, Bowman, & Geneau, 2005) . But careful planning and well-targeted funding can have a real impact on childhood vision impairment. The East African Child Eye Health (ChEH) project, a four-year project funded by Standard Chartered Bank's Seeing Is Believing (SiB) programme (IAPB, 2017) was able to bring government on board, and attained sustainable practices in health financing, management and information systems in select regions. There may be lessons to learn that are applicable to PNG

## **2.4 Retinopathy of Prematurity**

Prematurity being responsible for 18% of under 5 mortality rate worldwide (UN Inter-agency, 2018) motivated governments to address this issue by increasing the availability of neonatal services. This resulted in increased survival of preterm babies and increased risk of developing retinopathy of prematurity. Retinopathy of prematurity (ROP) is a retinal neo-vascular disease of premature infants characterized by failure of retinal blood vessels to grow and develop normally (Mannan, Sadeka, & Shahidulla, 2014). Despite major advances in management, it continues to be an important cause of childhood blindness throughout the world (Quinn E. G., 2016). Since ROP screening by trained ophthalmologists may be unavailable, even large infants in the developing world can be at risk for blinding ROP (Sommer, et al., 2014). Low gestational age and low birth weight for gestational age are major risk factors for retinopathy of prematurity (Fierson, 2018). Both factors are related to the extent of immaturity of retinal neural and vascular development at birth. In some cases factors that cause preterm birth might also

affect intrauterine retinal neurovascular development (Ann & Lois, 2013). Rates of disease requiring treatment also tend to be higher in middle and low income countries, suggesting that some of the risk factors like excessive use of oxygen are better controlled in developed countries (Gilbert C. , 2008). In PNG, screening protocols for retinopathy of prematurity are not yet embedded in the health system. Accordingly, there are no data for current prevalence or incidence levels of ROP, nor is there evidence that screening of preterm infants is regular in PNG, which should be a subject of future research. Although recent initiatives indicate some preterm babies have ROP and are in need of treatment (Mangot, Wabulembo, Barnabas, & Gamini, 2019).

## **2.5 Retinoblastoma**

Retinoblastoma is the most common of primary intraocular malignancy of childhood. It is discussed, not as a major cause of visual impairment but because of its importance in child survival and quality of life. Whereas the overall survival rate of retinoblastoma in Germany was reported to exceed 95% when children were diagnosed early with localized intraocular phase (Temming, et al., 2012), delayed diagnosis and treatment, which is common in developing countries, often results in visual loss and death (Huimin, et al., 2018). Anecdotal observation in PNG shows that children present with advanced disease when vision is already lost in the affected eye, sometimes with extra ocular extension of the tumour. No systematic studies have been conducted on retinoblastoma in PNG. Public media campaigns to increase public awareness have been launched in some countries since it was hypothesized that the general population frequently ignores leukocoria because they do not recognize it as a sign of disease, or as cancer in children (Guillermo, et al., 2010). Some results from Honduras showed a reduction in the number of cases with extra ocular disease from 73% in the pre-media campaign period to 35% in the post media campaign, following media campaign efforts to show the importance of leukocoria (Leander, et al., 2007). A similar approach could be explored in PNG where multi-media approach was used, for topical issues like gender-based violence (Pacific Media Assistance Scheme, 2013) and more recently polio vaccination (WHO , 2019)

## **2.6 Impact of Childhood Blindness**

Deprivation amblyopia and the resulting lifelong vision impairment (Lloyd I C, 2007) among children with paediatric cataract are compelling enough to ensure child eye health is included in the agenda of the health system. However, in 2010 the global

financial and health burden of visual impairment was estimated to be US\$3.0 trillion, and amounted to 118 million disability-adjusted life years (DALYs) with costs projected to rise if no action is taken to reduce the prevalence of blindness and low vision (Gordois, et al., 2012). At the individual level, the financial and health burden of vision impairment in a child is even greater. As many of the conditions associated with blindness in children are also causes of child mortality (e.g. premature birth, measles, congenital rubella syndrome, vitamin A deficiency, and meningitis) (Gilbert, Clare; Foster, Allen, 2001), additional vision impairment and blindness is likely to result in further social and economic disadvantages for affected individuals, and can contribute to plunging individuals further into poverty. The association between poverty and eye health can undermine the achievement of the Sustainable Development Goals (SDGs) (UNDP, 2016) and Universal Health Coverage (WHO, 2013a) (Naidoo K. S., Jaggernath, Øverland, & Ramson, 2014). Therefore enhancement of the health system to deliver interventions that prevent or cure visual impairment translates into improved child survival rates and poverty alleviation.

While prevention of vision impairment and blindness in childhood is an international priority, many countries do not have current information about incidence and causes, to guide planning (Jugnoo & Noriko, 2003). In countries that are resource constrained it is likely that affirmative action will be required for children to benefit from the scarce resources. This entails collecting data to document causes and as well as the magnitude of vision impairment. While efforts to improve their independence and quality of life would reduce the overall economic burden for the community, systematic interventions and follow up plans should be articulated in a paediatric eye health strategy.

Vision impairment should actually be viewed in the context of economic development, knowing that a healthy and productive population will realize the SDGs faster. Investments in eye health (The Commonwealth, 2017) have the benefits of; increased economic productivity and improved academic achievement in children.

## **2.7 Paediatric Eye Health Concerns in PNG**

In 2010 (Department of Health PNG, 2010) it was estimated that one child in every 13 born in PNG would die before the age of five years, a rate far greater than in any other country of the Pacific region. This changed only slightly in 15 years with estimates of 1 in 17 in 2016 (WHO, 2017).

Currently there is no eye unit in PNG with amenities that adequately cater for children with vision impairment. Some vital personnel in visual rehabilitation like paediatric ophthalmologists, optometrists, low-vision therapists, orthoptists are either not available or very few and difficult to access. In fact some of the positions are not in the public service structure, creating significant barriers to access for the majority of families in PNG. Comprehensive services that offer a one stop centre for children with vision impairment are absent.

The lack of designated children's eye clinic days at eye departments means that adults compete with children in the general eye clinics. Previous studies conducted in PNG (Garap, et al., 2006) and the recent RAAB (Lee, Burnett, Wabulembo, Garap, & Keys, 2019) addressed mainly visual impairment in adults above 50 years of age and focused primarily on cataract backlog. The available human resources for eye health are already overstretched and preoccupied with the cataract backlog. As result children with vision impairment may not be getting the attention they deserve (Gordon, Minassian, Weale, & West, 2012).

Studies (Gilbert, Anderton, Dandona, & Foster, 1999) show that the most affected children with vision impairment are in the countries with less economic power. There is growing optimism that economic development in PNG may come with benefits of increased ability to reduce visual impairment among children. But this may be affected by some setbacks resulting from a slump in oil and gas prices which are important sources of revenue for the government (Department of Treasury, 2017). In order to address vision impairment among children there is need for advocacy and resource mobilisation for paediatric eye health.

However PNG may be similar to other countries where studies on knowledge, attitudes and practices did not favour prompt interventions. A multicentre study (Ramai, Ryan, Shoshana, & Tejas, 2015) reported that almost all participants from Ghana, Honduras and India said they would take their child to the hospital or clinic only if a problem arose. But some vision problems can be identified through screening children who might appear to be normal. Studying the pattern of eye morbidity among children in the eye clinic may reveal common conditions that may guide health promotion and preventive efforts in PNG. Known interventions like Primary Eye Care (PEC) for children and key components of the continuum of care (Malik, Mafwiri, & Gilbert, 2018) have not been fully implemented in PNG.

Since not much is being done yet with regard to eye health promotion interventions, PNG presents an opportunity to have a relevant and country specific strategy informed by research findings (Hubley & Gilbert, 2006) of what people



currently think about eye health. The PNG national eye plan strongly recommends more studies aimed at quantifying the burden of eye disease (Department of Health, 2010), as this is an acknowledgement of the difficulty in planning without relevant data.

## **2.8 The WHO Health Systems Framework**

The WHO Health System Framework which formed the basis for the health system assessment in this study is one of several that have been implemented over time. It has six building blocks which include leadership/governance, service delivery, health work force, health information management system medical products, vaccines and technologies and financing. The Alma Ata declaration in 1978 (WHO, 1978) envisaged a reasonable state of health for all by the year 2000. Increased resources were expected to be mobilised from disarmament and promotion of peace. However, there were problems in the implementation details of this ambitious plan. These include new wars that erupted and the emergence of the AIDS/HIV pandemic, which coalesced to divert resources that should have gone into primary health care programmes. Changing technologies dictated new capital investments. Changing disease patterns required more training for the health workforce to effectively adapt to these changes. Some diseases like onchocerciasis with hyper endemic regional distribution necessitated vertical programmes in some countries and this called for more financial resources to implement. The desired outcome was not achieved by the year 2000 as had been anticipated in 1978

In China the health system framework of 'bare foot doctors' (Hu, 2017) seemed to work well for nearly thirty years, starting from 1951. High population densities favoured this approach because the barefoot doctors were able to serve many people in relatively small geographical areas each. The service had an element of voluntarism initially, and then some little compensation was introduced. Eventually there was massive desertion during the rural to urban migration in the mid-1980s. The gap they left behind needed new approaches.

Roberts et al (Roberts M. J., 2002), argue that health sector reform has a crucial role to play in health and development however they point out that systematic and systemic analysis is often lacking. As a result anticipated results of reform are sometimes not realized. The current WHO Health System framework provides a common framework for analysis. The analytical framework uses the 6 building blocks. Chunharas and Davies (Chunharas & Davies, 2016) consider leadership as the ability to identify priorities, set a vision, and mobilize the actors and resources

needed to achieve them. Leaders in health systems in under resourced economies like Papua New Guinea have an immense task to be able to deliver universal quality health care. They need to review the priorities from time to time as resources are often not sufficient to adequately address the health burden. Their capabilities are crucial to the performance of the health system and periodic assessment ensures that identified shortcomings can be strengthened.

The control knob health system framework (Van Olmen, Marchal, Van Damme, Kegels, & Hill, 2012) puts emphasis on financial sustainability. Financing as one of the 6 building blocks in the WHO framework, is a subject of discussion since government funding for most countries is not adequate to meet the health care needs of the respective populations. Health insurance schemes, user fees, out of pocket or a combination of two or all are being implemented to a different degree in different countries. In Papua New Guinea the government provides free health care in the public hospitals. This is a policy that can be used to finance child eye health. Some developing countries like Rwanda (Makaka, Breen, & Binagwaho, 2012) have been able to achieve more than 90% insurance coverage for the population. This is attributed more to the political and health system leadership than to purchasing power of the population (GDP per capita 772.9 USD.2018) (The World Bank, 2019).

Every health system framework needs a health work force in order to meet its set goals. There is need for a more balanced workforce that is tailored to each country's needs (WHO, 2015). Existence of budgetary provision for in-service/continuing education training is an important indicator when considering strengthening interventions. The existing work force can be modelled through continuing medical education to meet current and future needs of their community. The current WHO health system framework of the six building blocks provides an inclusive set of pillars along which a health system can be assessed.

## **2.9 Country Profile**

PNG occupies the eastern half of mainland New Guinea (Figure 1) and is the largest nation in the South Pacific, both in terms of its area (462,840 square kilometres) and its population (The World Bank Group, 2019). The Country's geographical features are dominated by extensive mountain ranges, rainforests, coral atolls and river systems. About 50% of the total land area is mountainous and as a result many areas of the country are inaccessible by road (CIA, 2016-2017). Existing cultural traditions are closely aligned to about 830 languages spoken in the country. The two main languages spoken are Tok Pisin and Motu, while

English remains the main medium for administration, commerce and education (National Statistical office, 2006). Today close to 2 million people in the country are proficient in Tok Pisin (Dasgupta A. , 2014).

Figure 1: Map of Papua New Guinea (UN, 2004)



### 2.9.1 Demographics

As of June 27, 2019, the population of PNG was estimated to be 8,291,009 people. (Countrymeters, 2019). It comprises 4,229,467 men and 4,061,836 women. PNG has a young population with 46.0% being 19 years or younger, 50.2% between the ages 20 and 64, and 3.9% of population is over 65 (Population of.Net, 2018). Most of the country's population live in rural communities and are faced with significant challenges in health, education and economic opportunities. Agriculture, forestry, and the fishing sector, which engages the majority of the labour force, primarily informally; and the minerals and energy extraction sector which accounts for the

majority of export earnings and Gross Domestic Product (GDP) account for most of the economic activities in PNG (The World Bank Group, 2017).

### *2.9.2 Political system*

PNG became an independent parliamentary democracy in 1975 (Moody's Analytic Economic Indicators, 2018). PNG is a constitutional monarchy which recognises Queen Elizabeth II as head of state, and represented by a governor-general who is nominated by parliament and who serves for a term of six years (Royal family, 2015). Legislative power is vested in both the government and the unicameral parliament. The parliament consists of 109 members, and elections are held every five years with universal adult suffrage (Commonwealth network, 2018).

The National Executive Council, presided over by the prime minister, has executive powers. Each of the country's 22 provinces has its own elected government, which may levy taxes to supplement grants received from the national government (The Economist intelligence unit, 2014).

The PNG identity remains tenuous; with most citizens retaining a stronger allegiance to, and trust in, sub-national groupings, notably clans or 'wantoks', rather than the national identity (Pryke & Barke, Lowy Institute, 2017). This suggests that working with the national groupings may bring greater gains in implementing programs. But the diversity of the national groupings also means that more time would have to be spent understanding the dynamics within individual ethnic groupings.

### *2.9.3 The Economy*

In spite of agriculture employing up to 85 per cent of the population about 60% of the GDP comes from natural resources such as oil gas, gold and copper. (Trading Economics, 2018). The economy's small formal sector is focused on exports of commodities such as gold, copper, oil, and natural gas (The Heritage Foundation, 2018). The GDP Annual Growth Rate in PNG averaged 4.03 per cent from 1995 until 2017, reaching a record low of -6.34 per cent in 1997 and an all-time high of 13.30 per cent in 2014 (Trading Economics, 2018). The GDP in PNG expanded 2.20 per cent in 2017 from the previous year. PNG's rural majority (around 80 to 85 per cent of the population) don't seem to have experienced significant improvements in standard of living. PNG has failed to achieve any of the Millennium Development Goals and it is currently ranked a lowly 154 out of 188 countries on the UN Human Development Index, compared with Fiji's ranking of

91, Vanuatu's of 134 and Solomon Islands' of 156 (Osborne, Harden, & Hoy, 2017). The country's GDP per capita is estimated at USD 3 700 (Moody's Analytic Economic Indicators, 2018).

Economic growth will not automatically lead to improved population health. Lange and Vollmer contend that additional resources generated through economic growth should be used in a way that is most beneficial for population health (Lange & Vollmer, 2017). Understanding aspects of how the health system is benefiting or responding to the economic dynamics is crucial for ensuring that the deliberate steps that have to be taken to improve service delivery are identified. Gwatkin et al state that for health, 'the economic dimension is by no means the only one that matters, some would consider other dimensions even more important' for example, the political environment influences how healthcare is dispensed (Gwatkin, Detels, McEwen, Beaglehole, & Tanaka, 2002)-

Taylor (Taylor, 2009) argues that it is not only how much money there is available, but whether it is channelled into socially productive ends, and the degree to which different social groups benefit from those investments. Children by virtue of their age may have an additional barrier to access since they don't participate in the decision process of resource allocation, either at the family level or all the way at the national level. The health system strengthening approach provides the opportunity to identify aspects of health care such as child eye health that may not be getting adequate attention. Child eye health is not specifically mentioned in some of the most important documents of the department of health (Department of Health, 2010) (Department of Health of Papua New Guinea, 2005) (National Department of health, 2013).

#### *2.9.4 Education*

PNG was one of the first countries to ratify the Convention on the Rights of the Child, adopted in 1989, which recognises that education is a right that belongs to all children without any form of discrimination. In addition, the country is committed to achieving global education goals (Papua New Guinea Department of Education, 2016). The National Constitution of PNG makes it explicit that all children have the right to quality education and government's responsibility to make the benefits of education available to all citizens (PNG legislation, 2014)

At 6 years of age all children begin their basic education in an elementary school in a language that they speak. At 9 years of age children continue their basic education in a primary school (National Executive Council, 2009). If visual

screening is made mandatory prior to enrolment some of the children with vision impairment would be detected early and receive appropriate interventions. No field studies have been done in PNG to establish the main causes of vision impairment among preschool children. Hornoch (Hornoch, et al., 2013) found that among Asian and Non-Hispanic white children in the United States more than 90% of decreased visual acuity with an identifiable cause is related to refractive error, which is a strong argument for screening at enrolment. While currently there is no universal vision screening for preschool in PNG, a study in Nepal showed that this service is feasible in developing countries using simplified tests by trained non-optometrist health workers (Adhikar & Shrestha, 2011). This may be an important strategy to reduce visual impairment among children, since there are more children now enrolled in school than ever before as a result of the Government's school fee abolition initiative (PNG Insight, 2016). The overall gross enrolment rate for basic education improved to 96 per cent in 2014, compared to 71 per cent in 2000 (Department of Education, 2016). Despite this it is reported that there are still some children who are not attending school (National Executive Council, 2009). However additional positive developments of inclusive education being part of the pre-service teacher education program in all colleges (UNICEF, 2017), provides an opportunity for linking the health system with education for continued care of children with severe vision impairment. This partly addresses some of the barriers that arise from gender inequality, and disability among children.

The school system if linked to the health system in a coordinated manner presents an opportunity for screening children for vision impairment and dissemination of health promotion messages. In addition increased enrolment in school comes with many benefits to the health of children as it empowers girls and women and therefore mothers (Shunmuga, Sekar, & Subburaj, 2014). Some benefits from increased education of girls include lower fertility rates, lower infant mortality rates, improved nutrition, increased life expectancy and better opportunities for their children in the next generation (Kane, Eileen, 1995). It has been reported that children of mothers with secondary education or higher are twice as likely to survive beyond age 5 years as those whose mothers have no education (UNESCO, 2011). The education policy of universal primary education will ultimately contribute positively to combating vision impairment in children.

#### *2.9.5 Health System in PNG*

Severe data deficits exist in PNG, which are often makes answering fundamental questions difficult. This includes questions such as trends in national sector

expenditure, workforce or infrastructure. In the health sector disease patterns and prevalence rates for eye conditions are not adequately documented. This can significantly change the discussion of particular issues and therefore affect the ability to sustain cohesiveness in planning and implementation of policy (The World Bank Group, 2017).

The delivery of health services in PNG is guided by the National Health plan 2011-2020 (Department of Health, 2010). The plan defines what needs to be done, in what manner, for which reasons, and by which players, to enable fundamental improvements in the health system. Strengthening the Health System and Governance is a key result area of the National Health plan 2011-2020 (Department of Health, 2010). Eye health can benefit from this key result area by availing evidence of the gaps that need to be addressed. Interventions to reduce morbidity and mortality can have important implications for poverty and inequality (The World Bank Group, 2017). Morbidity from moderate to severe vision impairment needs to be addressed among children not only to fulfil their right to health but to ensure that the cycle of poverty and severe visual impairment is disrupted. By so doing the health system is able to work towards attaining SDG number one, which focuses on ending poverty in all its forms everywhere, as well as ensuring health of children as aspired in SDG number 3 (United Nations, 2018). Data from other sectors of health make the strengthening of the health system and governance key result area an unequivocal necessity as shown by examples in Table 1 and Table 2.

*Table 1: Tuberculosis in PNG (WHO, 2016)*

<b>Estimates of TB burden, 2016</b>	<b>Number (thousands)</b>	<b>Rate (per 100,000 population)</b>
Mortality (excludes HIV + TB)	3.6 (2.4 – 5)	44 (29 – 62)
Mortality (HIV + TB)	0.82 (0.45 – 1.3)	10 (5.5 – 16)
Incidence (include HIV + TB)	35 (28 – 42)	432 (352 – 521)
Incidence (HIV + TB only)	3.6 (2 – 5.5)	44 (25 – 68)
Incidence (MDR/ RR-TB)	1.9 (1.2 – 2.6)	23 (15-32)

*Table 2: Estimated TB incidence by age and sex (thousands) (WHO, 2016)*

<b>Sex</b>	<b>0 – 14 years</b>	<b>&gt;14 years</b>	<b>Total</b>
Female	1.8 (1.4 – 2.1 )	11 (8.7 – 13)	13 (10 – 15)
Male	2 (1.6 – 2.4)	20 (16 – 24)	22 (18 – 27)
Total	3.8 (3 – 4.5)	31 (25 – 37)	35 (28 – 42)

In this table we note the devastation among children caused by tuberculosis (TB) and HIV. The implication is that there is a great burden on resources which should be benefiting eye health.

It is important to note that vision impairment is a serious complication of tuberculous meningitis (Sinha, et al., 2010). Ophthalmologists and paediatricians need to be aware of the paradoxical response to anti TB therapy (ATT). One must predict optochiasmatic arachnoiditis (OCA) in children suffering from TB meningitis (TBM) who present with severe visual loss, without systemic deterioration, but with high CSF protein, pleocytosis and perichiasmatal exudates on MRI. Prompt treatment with intravenous methyl prednisone (IVMP) followed by oral steroid may salvage vision in these children (Nitin, Verma, Singh, & Virendra, 2014). Strategic plans and budgets of ministries of health sometimes don't include child TB activities, despite the fact that current TB vaccines protect young children only against the most severe forms of TB (WHO, 2012). Strengthening the health system to combat TB in children includes improved prevention, detection, diagnosis and management of TB in children (WHO, 2012). To realize this, linkages that work towards synergy need to be established within the health delivery system. That includes sharing data from contact tracing, follow up for children that live in households with TB infected adults, monitoring vision of those who are on anti TB therapy and regular systematic up skilling of health workers. Additionally, the rapid increase in drug-resistant tuberculosis in PNG reinforces the need to develop a more resilient and inclusive health system that extends to rural areas, establish a sensitive early warning system, and invest in more intensive prevention and control strategies (The World Bank Group, 2017). These are potential opportunities for integration of child eye health in the health system.

#### *2.9.6 Under-5 Mortality per 1000 live births*

Child Mortality figures (Table 3) are unacceptably high given that every death is a tragedy in the family. The under 5 mortality (63) is higher than the other Pacific islands such as Fiji with 22, Solomon Islands 26, Tonga 16 and Vanuatu 28 (The World Bank Group, 2018). But when put in context, there has been a steady drop in child mortality rate over recent years. The child mortality rate in PNG fell gradually from 158.9 deaths per 1,000 live births in 1967 to 54.3 deaths per 1,000 live births in 2016 (Knoema team, 2018). A good understanding of how the drop was achieved may serve to reveal some of the lessons that can be applied in addressing vision impairment.



*Table 3: Childhood mortality rates per 1000 births (UNICEF, 2013)*

<b>Mortality</b>	<b>Per 1000 births</b>
Under-5 mortality rate (U5MR), 2012	63
U5MR by sex 2012, male	68
U5MR by sex 2012, female	58
Infant mortality rate (under 1), 2012	48
Neonatal mortality rate 2012	24

Malnutrition is emerging as the most important cause of childhood mortality in PNG (Aipit, Aipit, & Laman, 2014). But survivors of malnutrition are at risk of developing vision impairment associated with vitamin A deficiency. Prevention and early treatment of malnutrition contributes to the reduction in visual impairment among children (WHO, 2018). A health system that is able to institute sustainable preventive and treatment interventions for malnutrition will go a long way in ensuring children maintain good vision.

#### *2.9.7 Maternal Mortality rate*

The maternal mortality ratio in PNG was estimated at 500 per 100000 live births (Mola & Kirby, 2013) but more recently updated to 215 per 100000 births (CIA World Factbook, 2018). Studies show that the death of a mother greatly impacts the health of the children (Williams, 2014). The death of a mother introduces a strong possibility of some form of adoption of the orphaned child. Adoption in PNG is not without risk and has the potential for serious adverse effects on the child's well-being including risk of developing malnutrition (Pameh, Ripa, Vince, & Mueller, 2002). Some of the reasons for maternal deaths also apply to reasons for delayed presentation of children with visual impairment. These include fundamental in-country systemic issues, including leadership and governance, a dispersed population in the rural highlands, shortage of health workers, limited access to water and information systems, fragile health infrastructure, poor focus on the social determinants of health, and limited access to safe surgery and anaesthesia (Dennis, 2018). All those factors affect both the unborn and born children by increasing their risk for developing vision impairment from malnutrition and difficulty in accessing eye health services. Therefore maternal health issues remain important and relevant to efforts to improve child eye health, and suggest a systemic approach is required for health system strengthening. With proper documentation appropriate health system strengthening responses can be planned (Williams, 2014).

### 2.9.8 Malaria

A significant reduction in malaria incidence in PNG is yet another example of a successful intervention amidst a sparse population and difficult terrain with several communities only accessible after long treks on foot. This has been attained through the near-universal distribution of long-lasting insecticidal nets (LLINs), surveillance, diagnosis and treatment of malaria in PNG (WHO, 2017).

Malaria is the main cause of morbidity in many health facilities in lowland areas of PNG, but is much less prevalent in much of the highlands (Manuel, et al., 2015). While endemicity varies widely, all four human malaria species exist. Previously *Plasmodium falciparum* locally reached holo-endemic levels (Müller, Bockarie, Alpers, & Smith, 2003). A previous study showed that children with severe anaemia and *P. falciparum* malaria were more likely to be vitamin A deficient than the severely anaemic aparasitemic children (Manning, et al., 2012). The attendant vitamin A deficiency poses a risk to vision in these children implying that effective control of malaria partly addresses the problem of vitamin A deficiency. There are lessons to learn from the successes in malaria control including systems for data collection and analysis. We still do not have a consistent data collection system for children with vision impairment in PNG. This makes it difficult to advocate for resources which are essential for effective interventions.

## 2.10 Health system and infrastructure

Substantial downward revisions to government revenues have necessitated cuts in public spending across all sectors (including health) (The World Bank Group, 2017). However there are some strengths in the health system, from which child eye health can benefit through the health strengthening approach. PNG health radio network is one of the largest in the world linking 1300 facilities across the country. There is also a good, though expensive, telephone system and mobile telephone system that has wide coverage and is steadily increasing (Department of Health, 2010). The National Broadcasting Corporation of PNG has won support from communities across PNG, leading in News and Current Affairs (National Broadcasting Corporation, 2015). Health promotion information on child eye health can reach most of the population through these media options.

### 2.10.1 Health Units

Administratively PNG is divided into 22 provinces with four geographical regions; Southern Region, Highland Region, Momase Region and Island region (National

Statistical office, 2017). The health delivery system in PNG is presented below (WHO and the National Department of Health, Papua New Guinea, 2012)

### *2.10.2 Provincial Hospitals*

There is one provincial hospital in each province including Port Moresby General Hospital in the National Capital District which is also the national referral hospital. Currently all hospitals are funded by the government. Core clinical services and subspecialty clinical services are provided by respective medical specialists and specialist nurses on-site. Port Moresby General Hospital now serves a population larger than its capabilities resulting in an overstretched human resource, particularly in the emergency department (Grierson, Macdonald, Prentice, Symon, & Mikac, 2013).

### *2.10.3 District Hospitals and Health Centres/Clinics*

District Hospitals provide full basic health services including medical, surgical, obstetric, paediatric, trauma and 24-hour emergency care for both inpatients and outpatients. District hospitals cover a population of 40,000 to 300,000 depending on availability and accessibility of other health facilities nearby (WHO and the National Department of Health, Papua New Guinea, 2012). Urban health clinics provide similar services as health centres.

Rural health centres and sub centres provide services including management of chronic and acute conditions, basic surgical care, deliveries, and paediatric care, and function as intermediary referral points between district lower level facilities and district hospitals. Health centres serve a population of 5,000 to 20,000 people (WHO and the National Department of Health, Papua New Guinea, 2012).

Rural aid posts comprise more than 70 per cent of all health facilities and deliver basic health care, including mother and child care, and community-based health promotion, staffed by community health workers with two years training. Aid posts are designed to cover a population group of about 1,000 people each (WHO and the National Department of Health, Papua New Guinea, 2012).

### *2.10.6 Private Sector*

Private sector organizations include for-profit enterprise-based services or employment-related health care programs, small for-profit private sector facilities,

women's and youth organizations, NGOs and an undocumented number of unregulated traditional healers.

None of the above health entities have comprehensive paediatric eye health services and yet children constitute 40% of the population (National Statistical office, 2006).

## **2.11 Workforce for Health**

PNG has low numbers of health professionals per head of population: 5.3 nurses/midwives and less than 1 doctor per 10,000 people. Community health workers and nursing officers comprise almost 35% and about 30% of the total health workforce respectively, while medical officers and health extension officers (intermediate level workers bridging the gap between doctors and nurses) together comprise less than 8% (WHO and the National Department of Health, Papua New Guinea, 2012).

The health sector has inadequate data available to inform planning, and project the need for human resources, however there is a mismatch between the supply and demand of health workers (Macintyre, 2019). However, it is known that there is an ageing work force and inequitable distribution of health workers between rural and urban areas and across the administrative regions of the country (National Department of health, 2013). Even though attrition is present, data on this is difficult to find. Specialist health workers tend to prefer to work in the private sector which pays better and is better equipped (National Department of health, 2013). This distorts the distribution of specialist services causing patients including children with vision impairment to travel very long distances to get specialized care or sometimes give up and stay resigned to fate. Challenges that need to be addressed will include, resolving pay disputes to regenerating an aging workforce. In order to address these issues Howes et al (Howes, et al., 2014) propose expanding the health salary bill, and expanding the capacity of training institutions as some of the health strengthening ideas. Child eye health service development should be an integral part of the broader revamping of the health sector.

This study provides an opportunity to document some of the current gaps of child eye health. There are lessons to learn from some innovative models elsewhere that have been used to address shortage of human resource in the health sector. In South Africa The General Practitioner Down-Referral Model (GP Model) has been used to augment capacity by using the private sector to meet gaps in the provision of health-care services for HIV patients in the public sector. Donor

funding was provided for 10 years to cover the consultation fees of the general practitioners participating in the GP Model (Niekerk, et al., 2017). In PNG, it might be worth considering that the existing private health care providers participate in offering primary eye care for children, with fees covered by public resources. This would expand the referral system and may address many of the conditions that only need the correct antibiotic to be prescribed as well as prompt and proper referral if needed.

Currently eye sector activities in PNG are mostly funded by international organisations in partnership with government institutions. Some degree of collaboration exists under the umbrella of the National committee for prevention of blindness, where all the development partners in eye health are represented. The levels of cooperation and coordination are not yet sufficient to offer maximum benefits of synergy. More will be achieved through enhanced transparency of intent and purpose among the different development partners. Moreover there is opportunity for enhancing system-wide governance or “soft” organizational capacities – such as communication, trust building, diplomacy, and networking, making sense of complex social situations, political advocacy, and leadership – that are critical for improving institutions and systems (Swanson, et al., 2015). Child eye health is not an ophthalmology issue alone but a broader child health issue and an even broader health system problem requiring more attention. Conditions need to be created to allow leadership to emerge in eye health that will harness the current capacity as well as enhance it.

Strengthening structures of accountability to communities and introducing mechanisms to ensure that users have a voice in the local health system can influence priorities that are likely to be important in encouraging good performance. In Burkina Faso, participation by community representatives in public primary health care clinics was able to increase the coverage of immunization, the availability of essential drugs, and the percentage of women who get two or more prenatal visits, while in Ceara, Brazil, strengthened community accountability mechanisms helped improve service delivery (Mills, Anne; Rasheed, Fawzia; Tollman, Stephen, 2016).

The uniqueness of each country dictates the need for developing solutions based on local assessments and experience and to progress at a pace commensurate with their situations. That’s why we cannot copy and paste child eye health interventions currently employed in other countries in PNG without investing in analytical and operational research (Mills, Anne; Rasheed, Fawzia; Tollman, Stephen, 2016), which is needed as part of program and systems support in the

formulation of a local child eye health strategy. This is why data collection and analysis of the health system should be supported as they will provide relevant policy formulations that respond to gaps in the system.

## CHAPTER 3: METHODOLOGY

### 3.0 Introduction

In this chapter an overarching description of how the study was conducted is given including study design, selection of participants, data collection methods, data analysis and ethics. Prior to commencement of the study, the researcher sought and obtained permission from the chief executive officers of both Port Moresby General Hospital and Goroka Provincial Hospital. The staffs at the eye clinic in both hospitals were briefed about the study. A comprehensive description of the study sites is included.

### 3.1 Study sites

This study was conducted at two hospitals Port Moresby General Hospital and Goroka General Hospital, as case studies to address the objectives as outlined in Chapter 1. There was purposive selection of the case study hospitals based on their location. Port Moresby General Hospital, the national referral hospital located in the National Capital District provided an urban setting, and was expected to have the most comprehensive health services in every discipline. Goroka Hospital was selected because it is surrounded by a rural population and has a long history of a functional eye care service.

#### *3.1.1 Port Moresby General Hospital*

Port Moresby General Hospital is a public hospital located in the capital city of PNG Port Moresby. It is the National Referral Hospital for PNG and teaching hospital for the University of PNG School of Medicine and Health Sciences with a bed capacity of about 1200. Specialists are available in the following disciplines: obstetrics and gynaecology, general surgery, orthopaedics, urology, neurosurgery, cardiothoracic surgery, internal medicine, paediatrics, ear nose and throat, and ophthalmology. The eye department has three fulltime eye consultants and four registrars. The outpatient clinic has 2 ophthalmic clinicians.

Out of fifty-four beds in the general surgical ward, only six are allocated to the eye patients. The ward has a total of 13 nursing officers who work in three shifts. They are supported by 10 community health workers. The outpatient's clinic has a theatre exclusively for eye patients where operations under local anaesthesia are carried out. The eye department is allocated one operating room, one day per

week in the general theatre, for patients who require general anaesthesia. Access for emergencies is possible anytime throughout the week.

### *3.1.2 Eastern Highland Provincial Hospital Goroka*

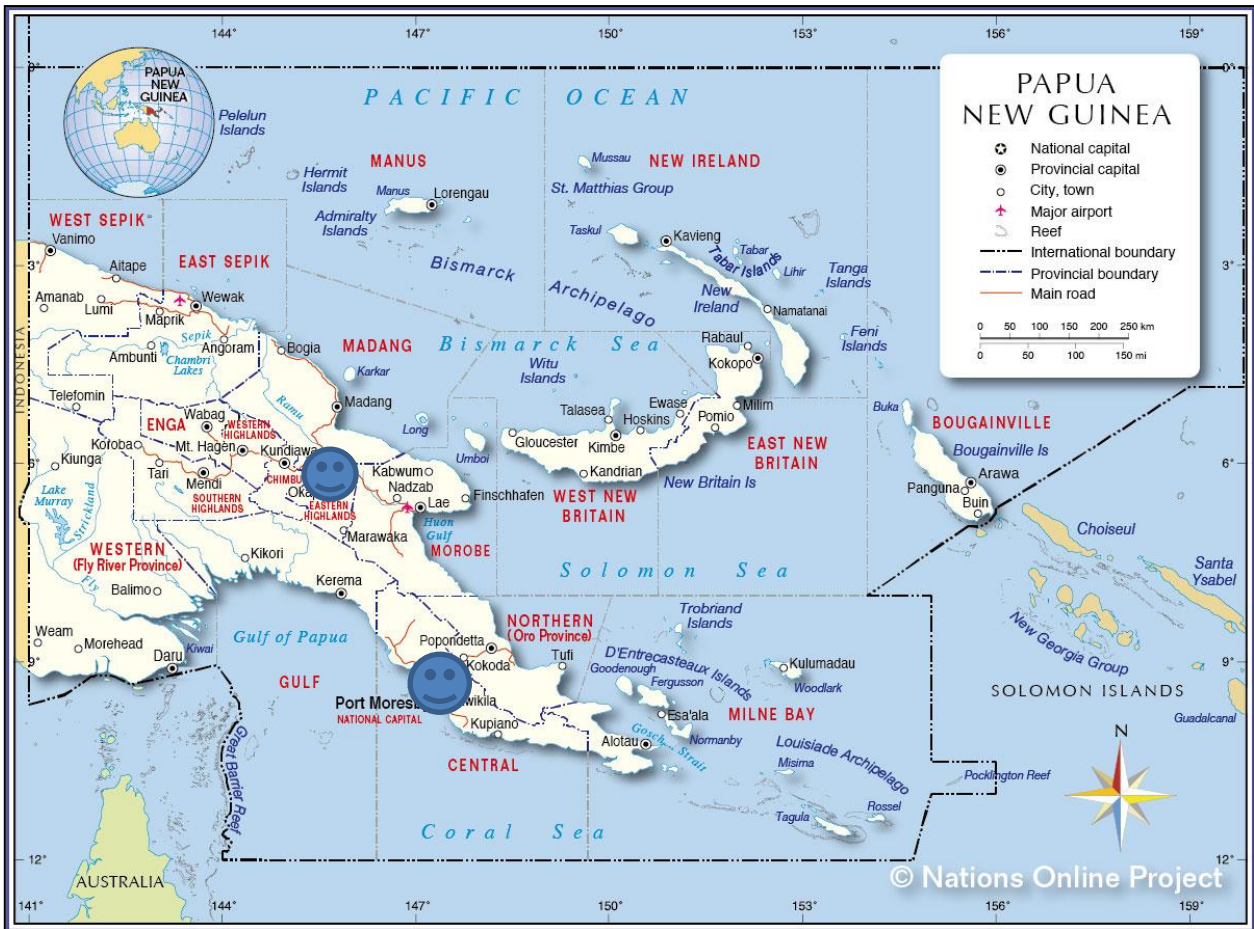
Goroka general hospital is a public hospital located in Goroka city in the Eastern highlands of PNG. It's about 425 km from the capital city Port Moresby. There is no road connection between the two cities. There are 4 flights daily between the two cities serviced by two local carriers. The eye department is one of the specialized services at the hospital. The eye clinic had expatriate fulltime ophthalmologists supported by Christian Blind Mission (CBM) from 1996 to 2014. Currently the hospital receives intermittent visits from an expatriate ophthalmologist who offers surgical and consultation services for one week every month. There are two ophthalmic clinicians, two general nurse and two community health workers. There is a designated eye ward with 10 beds and an exclusive and well equipped eye theatre for surgeries under local anaesthesia. The eye department is allocated one day a week in the main theatre for patients who require general anaesthesia.

## **3.2 Study design**

Given the objectives of the study a mixed method study design with both quantitative and qualitative methods was employed. The quantitative and retrospective design was used to be able to determine the diagnostic categories and their magnitude among children attending Port Moresby and Goroka General Hospital eye clinics (Figure 2). This was necessary because there is no specific published primary data on the clinical pattern of eye disease among children in PNG which could be used as reference in assessment of child eye health services. Additionally the children who present at the clinic are a small percentage of all eye patients and a retrospective period covering three years was found optimum to yield trends for analysis.



Figure 2: Map of PNG (UN, 2004) with location of study sites represented by smiley 😊



The qualitative method targeted two groups of people; (a) A cross section of the leadership in the two hospitals, in order to get precise and current information about the status of child eye health in the health system using the health system building blocks as outlined in the eye service assessment tool (WHO, 2015) as an analytical framework, and (b) A sample of care givers was interviewed so as to get their perception of how the health system was addressing child eye health. Interviewing users of a service in a probing manner may reveal feelings and motivations that may not ordinarily be expressed spontaneously. Such information indirectly empowers the service users to contribute to the improvement of the system that serves them.

Two different questionnaires developed and tested prior, were used to guide the one on one interview for the two groups

### **3.3 Quantitative Study**

Objective 1 was to determine the causes of eye disease among children who presented at Port Moresby General Hospital and Goroka General Hospital for the period January 1<sup>st</sup> 2015 to December 31<sup>st</sup> 2017.

#### *3.3.1 Sampling Procedure: Port Moresby General Hospital*

The practice at Port Moresby General Hospital eye clinic is that patients present to the eye clinic, are registered and given a card on to which medical records are written. When the assessment is finished the card is kept at the clinic. At the end of each day the cards are archived according to the hospital number. Registration details are entered into a computer that is kept at the eye department. The quota sampling method was used based on the age of the patients and the year they were seen at the clinic. Clinical charts of children age 0 to 18 years inclusive, that presented to Port Moresby General Hospital between January 2015 and December 2017 were retrieved and studied in a retrospective manner.

#### *3.3.2 Data Collection*

The researcher had the opportunity to train a high level assistant (ophthalmologist). The assistant was trained in the use of an audio recorder to conduct the interviews and how to transcribe the recordings. Data collection was done by the assistant and the researcher.

The data clerk provided a list of all the children that had been served during 2015, 2016 and 2017. Between 1<sup>st</sup> October and 30<sup>th</sup> November 2017 and during July 2018, a retrospective review of all cards of persons whose age was zero to 18years was undertaken. The following information was entered in an excel sheet: patients registration number, date of presentation, gender, age, whether referred or walk in and duration of symptoms prior to presentation. In addition the residence of the patient was recorded as well as their ethnicity, laterality of the problem, presenting visual acuity and diagnosis while for trauma cases the cause of injury was recorded. Vision was analysed and classified according to the international council of ophthalmology report of 2002 (Colenbrander, 2002).

The cards were inspected by the investigator and assistant only. Patients' privacy was observed and maintained by the use of only their registration numbers for identification in the excel sheet and not names. Each batch of cards after inspection was returned to the archives as soon as information had been recorded.

### *3.3.3 Data Management*

Summary statistics and tables were generated from participant characteristics using STATA statistical software version 12 (StataCorp LP, 2011). Patient characteristics were tabulated using frequencies, while Student t-tests for continuous measures and chi-square tests for categorical measures were also generated as appropriate. A p-value of <0.05 was considered statistically significant. The results from the analysis were presented in tables and graphs.

### *3.3.4 Sampling Procedure: Goroka General Hospital*

Preliminary inspection of hospital records at Goroka revealed that the routine practice is for patients to obtain an exercise book upon registration in which the clinical notes are subsequently written. After they have been assessed they take the book with them. It wasn't possible to get similar detail about the children who were seen in the same period described above. The information available was from summary reports that remain at the hospital and included name, age diagnosis and gender. Age was not consistently recorded with many appearing as child but this in itself was considered an important finding in health system assessment as it reveals a big deficit in health information management.

### *3.3.5 Data management*

The data from the summarised hospital records was tallied and analysed to get totals and percentages.

## **3.4 Qualitative Port Moresby and Goroka General Hospitals**

### *3.4.1 Service Providers*

Objectives 2 and 3 were: (2) to establish and describe how paediatric eye health services are being delivered and integrated in the general health system, using health system building blocks as an analytical framework(3) to explore strengths and weaknesses of the existing system from the perspective of service providers.

A qualitative study was conducted for service providers between 1<sup>st</sup> October 2017 and 30<sup>th</sup> November 2017.

### *3.4.2 Sampling Method and data Collection*

A non-probability and specifically purposive sampling approach was used to select service provider participants. These were officers in managerial positions with varied competences including ophthalmologists and eye nurses. The participants were drawn from the National Department of Health headquarters, Port Moresby General Hospital and Goroka. The sample size was influenced by the number of key leadership positions and consideration of theoretical saturation. A combined total of 14 officers were invited to take part in the interviews and all of them agreed. The assistant conducted the interviews in Port Moresby General Hospital while the researcher conducted the interviews at Goroka Hospital. A structured questionnaire developed along the themes of the WHO Eye Care Service Assessment Tool (ECSAT) (WHO, 2015) was used to guide oral interviews. The interview focused on the six building blocks of the health system and how they influence the paediatric eye health needs within the health system. During the course of the interview some time was spent on explaining some of the titles of different eye health cadres in the questionnaire. For example, what an ophthalmologist is and what an optometrist is, since both of these are listed as human resources for eye health. On average each interview lasted 45 minutes. The interview was conducted on a one on one basis and audio recorded at the officers' respective offices, or at the eye clinics for those who had shared offices. Two officers from the department of health headquarters requested to have a combined interview because they felt their opinion would be more accurate if they supported each other in responding to the questionnaire. Their request was granted. Transcribing of the audio interviews was done at the end of each day and a written verbatim transcript was produced at the end of each day.

### *3.4.3 Data Management*

The responses were reviewed in a meeting with the assistant to be sure the audio recording and the transcribed material carried the same message. The responses for each participant were coded to have them thematically grouped using a deductive approach. Analysis followed the steps described by Schilling (Schilling, 2006), where level 1 was to transcribe the audio tapes to raw data verbatim. The raw data was condensed to themes directly or by deduction. These themes were coded so that we were able to generate information on how frequent a particular theme was emerging. The modal frequency was generally the majority opinion, but other opinions were considered in the reporting of results. The different themes were refined, by entering into a table with subheadings corresponding to the

question under consideration. Some of the questions in the questionnaire only required a 'yes' or 'no' or 'don't know' response, and these too were reflected in the summary table.

### *3.5 Service users/beneficiaries*

Question 3 was to explore strengths and weaknesses of the existing system from the perspective of service providers and service users. Information on the perceptions of caregivers of children that presented to the hospital with eye problems not only provide information on consumer satisfaction but may provide useful indicators of the performance of the health system.

To fulfill the above objective, the qualitative study for service users was carried out at both Port Moresby and Goroka general Hospitals eye clinics between 1<sup>st</sup> October 2017 and 30<sup>th</sup> November 2017.

#### *3.5.1 Sampling method*

A convenience sampling method was used to select participants from the outpatient eye clinic. Caregivers who brought children to the eye clinic during the study period were purposefully and consecutively selected to participate in the study to give their perspectives of how they view the health system with regard to child eye health. A target of 20 participants at each study site was made, and saturation rather than proportionality was the main concern in determining the final sample size. The assumption was that the opinions obtained from these participants would be able to articulate how they perceive the health system while seeking eye services for their children.

Participants were invited to participate after the child had been treated, and before they left the clinic.

#### *3.5.2 Data Collection*

Data collection at Port Moresby general Hospital was collected by the assistant while that at Goroka eye clinic was collected by the researcher.

After obtaining consent, using a questionnaire guide a semi structured interview was conducted and audio recorded. The interviews were conducted on a one-on-one basis except for participants that needed translation from English to Pidgin or another language, in which case a third party was present in the room. The audio

recording was transcribed verbatim. Some characteristics of the children they brought were also recorded, according to the questionnaire guide.

### *3.5.3 Data Management*

The response to each open ended question was summarized into an idea and the ideas grouped into themes. These themes were then entered into a table and ranked according to frequency. Answers to closed questions were tallied to generate frequencies.

Responses to closed questions, and children's characteristics were recorded in an excel sheet and then analyzed with STATA statistical software version 12 (StataCorp LP, 2011). Summary statistics and tables were generated for participant characteristics. Characteristics of the children they brought were tabulated using frequencies and proportions in a thematic manner.

### *3.6 Ethics and Approvals*

Approval was sought from the ethics committee of the University of PNG and was granted. Approval application for the study to the University of Kwa Zulu Natal Biomedical Research Committee was made and approval reference number research BE362/17 was obtained. The leadership of Port Moresby General Hospital and Goroka gave written approval to have the study conducted at their respective institutions. The supreme body that gives oversight to biomedical studies in PNG the Medical Research Advisory Committee similarly approved but advised that a PNG national be incorporated in the study activities at the level of co-investigator (assistant). The research methodology and core research was conducted by the principal investigator and the co-investigator played a supportive role in data collection and transcribing. Participant information regarding study activities and an appropriate consent form both in English and in Pidgin was developed. During data collection and throughout the data management process only numbers were used for identification to ensure confidentiality of individual participants.

## CHAPTER 4: RESULTS AND DISCUSSION

### 4.0 Introduction

In this chapter results are presented and discussed in order to determine the eye conditions among children who presented at the two hospitals from January 2015 to December 2017 (Objective 1).

### 4.1 Port Moresby General Hospital

A total of 28,241 eye patients were served at the hospital eye clinic from January 2015 to December 2017, out of which 4.2 % (n=1185) were children aged 0-18 years.

#### 4.1.1 Home province

Central province was the modal province of origin of the children seen probably because of proximity to the Hospital (Table 4).

Details about the home province were missing for 483 (40.7%) participants. This shows some of the inconsistencies in the recorded information in patients' cards, due to the absence of a standardized template. Templates with details of all required information to be obtained from the patient and findings from the structured clinical examination findings need to be considered.

Strengthening health information management systems can help to ensure that data for planning, implementation, monitoring and evaluation of the health system activities are readily available.

Table 4: Children's home province (n=1185)

Province	Female (%)	Male (%)
Bougainville	3 (50.00)	3 (50.00)
Central	101 (46.54)	116 (53.46)
Simbu	27 (55.10)	22 (44.90)
Eastern Highland Province	28 (53.85)	24 (46.15)
Eastern New Britain	4 (25.00)	12 (75.00)
Eastern Sepik	5 (50.00)	5 (50.00)
Enga	27 (51.92)	25 (48.08)
Gulf province	28 (43.08)	37 (59.92)
Hela	8 (36.36)	14 (63.64)
Jiwaka	3 (75.00)	1 (25.00)
Milne Bay Province	5 (45.45)	6 (54.55)
Madang	1 (25.00)	3 (75.00)
Manus	8 (53.33)	7 (46.67)
Morobe	13 (48.15)	14 (51.85)
National capital district	6 (20.00)	24 (80.00)
New Ireland Province	3 (42.86)	4 (57.14)
Oro	0 (0.00)	8 (100.00)
Southern highlands	24 (44.44)	30 (55.56)
East Sepik	5 (62.50)	3 (37.50)
Western highlands	14 (50.00)	14 (50.00)
Western New Britain	5 (55.56)	4 (44.44)
West Sepik	1 (33.33)	2 (66.67)
Western	3 (60.00)	2 (40.00)
No Record	213 (44.10)	270 (55.90)

#### 4.1.2 Referral pattern

*Information about referrals received was only available for 535 (45.1%) Most of the referrals were from other health units (*

Table 5). This is an important finding, because health professionals that initially see children can have a positive impact on visual outcomes, if they are equipped with appropriate eye health promotion information. Vision outcomes are likely to be improved when better initial treatment is given and/or prompt referrals are made. The education of health professionals on eye health may be incorporated into on-going continuing medical education with professional education points awarded.



Table 5: Referral patterns (n=535)

Referral categories	Female	Male	p-value
From children's clinic	89(46.35)	103(53.65)	0.558
Self- referral	39(46.99)	44(53.01)	
From other health units	109(41.92)	151(58.08)	

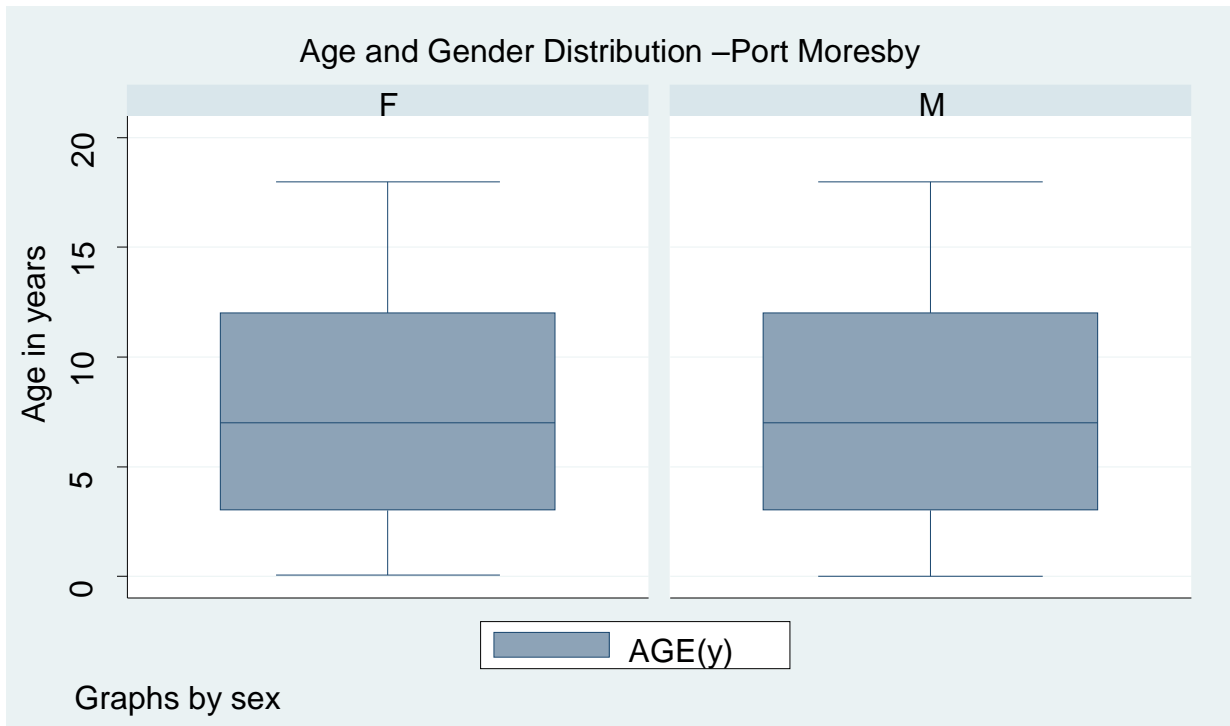
#### 4.1.3 Age and sex distribution

The mean age (Table 6) of the children seen was 7.8 (SD 5.5) and 7.55 (SD5.3) for female and male children respectively. The difference between the mean age between genders was not statistically significant (p=0.425), as illustrated in Figure 3.

Table 6: Age of children

Characteristic	N	Female	Male	p-value
Age assessment (%)	1185	535 (45.2)	650 (54.8)	
Mean Age (SD)	7.66 (5.38)	7.80 (5.5)	7.55 (5.3)	0.425

Figure 3: Age and gender distribution



These findings are similar to those found in a hospital study in Palestine (Banayot, 2016) where the mean age was mean 7.1 years. In spite of the difference in definition of a child (16 years and below) for the Palestine study while this study considered 18 years and below, the similarity may be due to some cross cutting vulnerability to accidents when children are not closely supervised. While the mean age here was higher than the 6.1 years reported in Peshawar (Sadia, Mohammad, Ibrar, & Tajamul, 2008), it was found to be lower than the 8.19 years reported in India (Qamruddin, 2017). However some differences in study design make comparisons difficult. For example, children with prior surgery were excluded in the Peshawar study, while the study in India excluded children with normal eyes. Both were prospective while the current study was retrospective. Other factors that may account for differences include awareness level, economic status of the communities and utilisation of the public health system versus private. Quite often data from private health facilities is not published. In all the above studies sex difference was not significant. One study in the United Kingdom (UK) showed that at 3 years, 5.7% (95% confidence interval, 5.2–6.3%; n = 881) of children had  $\geq 1$  eye condition and 0.24% (0.15–0.3%; n = 45) were reported to have associated

visual impairment. In the majority of cases, time of onset was reported to be within the first year of life (Cumberland, Pathai, & Rahi, 2010). Universal eye screening of babies in the U.K facilitates early diagnosis of eye conditions in children and may account for the younger age of children with an eye condition. In PNG, up-skilling the midwives and nurses who carry out immunisation to identify signs of eye problems and refer appropriately may contribute to earlier diagnosis and intervention. The immunisation workforce is vital in PNG where more than 60% of childbirths occur outside of facilities (WHO, 2018), but where the immunisation coverage is about 70% (WHO and UNICEF, 2018) providing an opportunity for contact with health personnel during the first year of life.

#### 4.1.4 Affected eye-right, left or both

There was no significant difference (p-value =0.260) between girls and boys in terms of the eye affected (Table 7). The results suggest that the eye affected is random with equal chance for left and right eye being affected. But the existence of morbidity in both eyes for 371 (31.3%) children underlines the importance of ensuring good intervention is available to prevent complications that may lead to severe bilateral vision impairment.

Table 7: Affected eye

Characteristic	N	Female	Male	p-value
Affected eye	1185	535 (45.2)	650 (54.8)	
Right eye (OD)		178 (42.3)	243 (57.7)	0.260
Left eye (OS)		177 (46.3)	205 (53.7)	
Both eyes (OU)		177(47.71)	194(52.29)	
No Record		3(27.27)	8(72.73)	
Time prior to presentation	1185			
<1 week		159(42.18)	218(57.82)	0.068
>1 week		296(48.37)	316(51.63)	
No Record		80(40.82)	116(59.18)	

#### 4.1.5 Time before presentation after onset of symptoms

There were 612 (61.8%) of the patients with available records on time of onset, who presented to the clinic more than a week after the onset of symptoms (Table 7).

Final visual outcome for some of the eye conditions depends on how quickly intervention is received. Considering road coverage in the country (Appendix VI) it

is likely those poor roads, or a complete lack of roads in some instances may have contributed to the late presentation. In order to prevent avoidable blindness, the importance of seeking eye care services (Ntsoane & Oduntan, 2010), must be promoted broadly, and the implications of delayed intervention need to be emphasized.

#### 4.1.6 Visual acuity

Out of 1185 children (Table 5) 691 (58.3%) had their visual acuity evaluated and recorded. Due to some of the deficits in the health system already mentioned, no record of visual acuity was found for the remainder of the children's cards during inspection. In Table 8, the better eye refers to the eye with better vision.

Table 8: Visual Acuity (n=1,185)

<b>Visual acuity in the better eye</b>		<b>Female</b>	<b>Male</b>
Normal vision	(20/12-20/25)	230(47.17)	304(56.93)
Mild vision impairment	(20/32-20/63)	39(54.93)	32(45.07)
Moderate	(20/80-20/160)	7(38.89)	11(61.11)
Severe	(20/200-20/400)	5(29.41)	12(70.59)
Profound	(20/500-20/1000)	2(50.00)	2(50.00)
Near total blindness	(<20/1000)	7(29.17)	17(70.83)
Total Blindness	(NLP)	12(52.17)	11(47.83)
No record of visual acuity		233(47.17)	261(52.83)

The high percentage of participants with no recorded visual acuity calls for urgent changes in the evaluation of children with eye problems and their documentation in the current system. Its possible visual acuity was not attempted or attempted but failed, or that some children had severe pain and would not cooperate. Some emphasis on continued professional development for the clinic staffs may be needed, in order to share skills in comprehensive clinical evaluation of children with eye conditions at different levels across the referral chain

#### 4.1.7 Low vision and blindness with associated diagnosis

The common causes of low vision and blindness were refractive error (n=16), un-operated congenital cataracts (n=11) and optic atrophy (n=11). When vision in the better eye was considered, of the 691 children with record of visual acuity, 7.3 % (n=51) of the children were blind (according to the WHO definition of blindness which includes children with profound blindness, near blindness or total blindness) at the time of presentation. This is higher than 4.4% found in a similar study in

Ethiopia (Demissie & Demissie, 2014). Some of the blindness and low vision found was considered potentially reversible subject to findings after more detailed evaluation since 12 out of the 86 children (Table 9) with low vision and blindness had un-operated cataracts, while 16 had refractive error.

*Table 9: Low vision and blindness with associated diagnosis*

<b>Diagnosis</b>	<b>Moderate</b>	<b>Severe</b>	<b>Profound</b>	<b>Near Blind</b>	<b>Blind</b>
Allergy	0	0	0	1	0
Traumatic cataract	0	0	0	1	0
Congenital Cataract	2	0	1	6	2
Corneal opacity	0	2	0	2	0
Corneal ulcer	0	1	1	0	0
Cortical blindness	0	0	0	0	3
Genetic disease	1	0	0	0	0
Infection	3	0	0	2	2
Nasolacrimal	1	0	0	0	0
Neurological	2	2	1	0	2
Normal	0	0	0	1	0
Optic atrophy	0	0	1	3	7
Optic neuritis	1	1	0	0	3
Other	0	0	0	5	0
Refractive error	7	7	0	2	0
Retinoblastoma	0	0	0	0	2
Squint	1	3	0	0	1
Trauma	0	0	0	1	0
Uveitis	0	1	0	0	1

A hospital based study in Doula (Cameroon) found cataract to be the leading cause of blindness in children, followed by cortical blindness and congenital glaucoma (Eballe, et al., 2011). But a population based study in Nepal revealed amblyopia (42.9%) was the leading cause of blindness followed by congenital cataract (Adhikari, Shrestha, Adhikar, Maharjan, & Shrestha, 2015). Cataract featuring as a major cause of blindness among children, is often indicative of gaps in the health system regarding early eye screening of and surgical capacity for congenital cataracts. While much progress has been made in the management of congenital cataracts, significant barriers remain in many parts of the world (Lenhart, et al., 2015). In PNG these include lack of an eye screening programme for neonates, low awareness levels about child eye health and logistical barriers (inadequate road connectivity). Refractive services are not widely available and there is no training programme for optometry in the country. This increases the risk

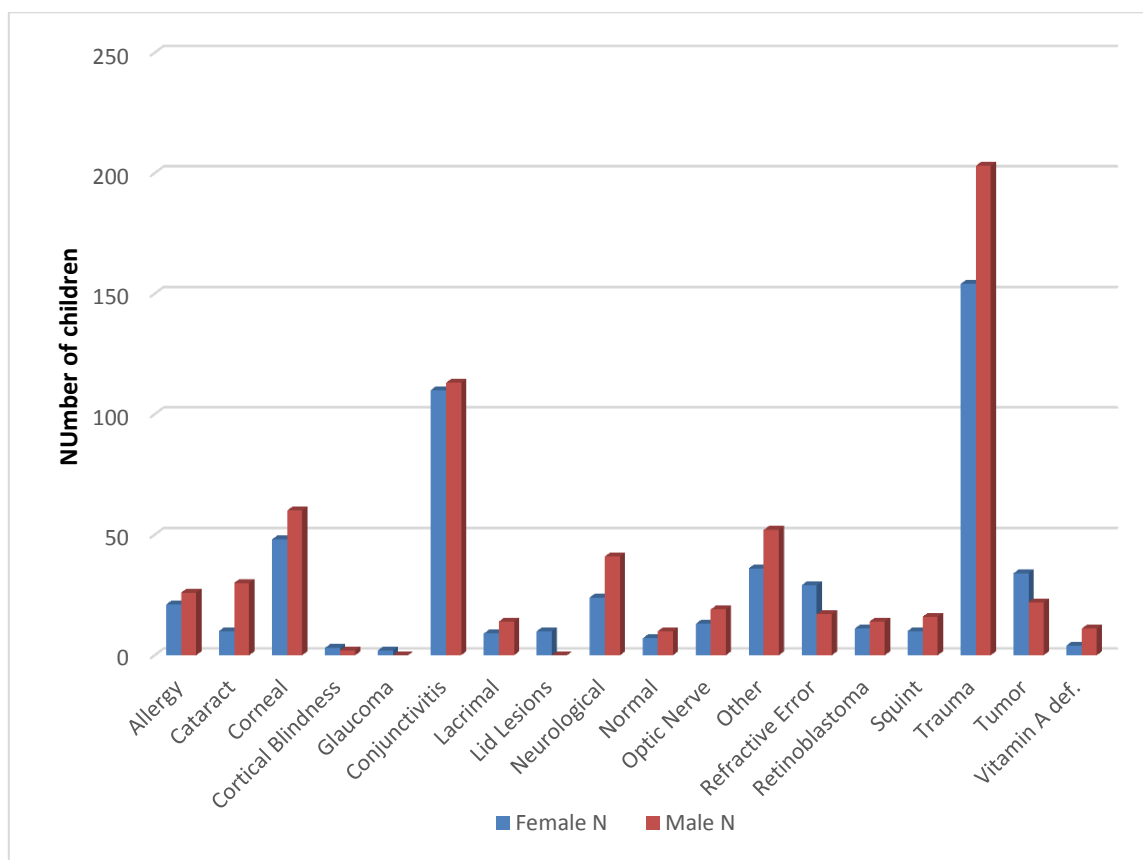
for children living with low vision to develop amblyopia. Additionally, the high maternal mortality rate (230-500 per 100000 live births) (WHO, 2013), (Mola & Kirby, 2013) compounds all the barriers mentioned above, due to the additional vulnerabilities experienced when child are left without a mother in a weak health system. Other conditions seen among the children with low vision and blindness were uveitis, optic atrophy and trauma. Some of the uveitis might be attributed to exposure to tuberculosis. For those children not seen timeously or for whom blindness and vision impairment cannot be prevented, provisions need to be made in the health system to link clinical services with other services such as special needs education to provide opportunity to access appropriate educational institutions.

#### *4.1.8 Disease pattern*

Trauma, conjunctivitis and corneal ulcers contributed to 21.6%, 18.9% and 9% (Figure 4) respectively, of the conditions seen among at Port Moresby General Hospital.

This is different to what was found in a study in Karachi, where squint, bacterial conjunctivitis and vernal catarrh were the top three conditions observed (Mahdi, Munami, Shaikh, Awan, & Wahab, 2005), while in Ethiopia (Demissie & Demissie, 2014), allergic conjunctivitis bacterial conjunctivitis and trauma were the most common (in that order). In Ghana, allergic and bacterial conjunctivitis followed by refractive error, were the most common ocular disorders among children (Merepa, et al., 2017). Knowledge of the disease pattern that presents in PNG is important in order to prioritise eye health education material available, defining the referral pathways, as well as planning appropriately for human resources and supplies.

Figure 4: Diagnosis categories (Port Moresby)



## 4.2 Age profile of select diagnoses

Select diagnoses are presented in Table 10, and discussed below.

Table 10: Age characteristics for select diagnosis

Characteristic	N	Female N (%)	Male N (%)	p-value
Assessment of Retinoblastoma cases:	25	11	14	
Mean Age (SD)		5.86 (4.5)	6.02 (2.4)	0.906
Lime Assessment:	93	48	45	
Mean Age (SD)		5.54 (4.4)	4.51 (4.0)	0.246
Vitamin A Assessment:	16	4	12	
Mean Age (SD)		6.25 (6.2)	6.05 (5.0)	0.949
Cataract	40	10	30	
Mean Age (SD)		4.25(2.7)	7.55(4.6)	0.040

#### *4.2.1 Retinoblastoma*

Strategic interdisciplinary partnerships are essential in order to address the global inequities in retinoblastoma survival disparities, as survival reaches 97% in resource-rich countries, but are as low as 30% in some resource-limited nations, where 92% of the burden lies (Hill J, et al., 2016). The low survival rate in developing countries survival rate is attributed to multiple factors associated with low resources (Hill J, et al., 2016). Partnerships between departments in developed countries and low resource countries can mitigate some of the limitations to improved survival rates. Absolute numbers of retinoblastomas are not large, but the impact on individual families from the high case fatality rate is immense. In Table 7, our findings show that there was a mean age in years at diagnosis of 5.87 (SD4.5) for girls and 6.02 (SD 2.4) for boys respectively. This is higher than in Kenya (Nyamori, Kimani, Njuguna, & Dimaras, 2012), where mean age at diagnosis was 36 months and 27 month while in Taiwan mean age for unilateral cases was 27.1 months; and in bilateral cases, 15.6 months (Kao, Su, & Lin, 2002). Studies in the United States (Abramson, et al., 2003), Taiwan (Kao, Su, & Lin, 2002), and Honduras (Leander, et al., 2007) all revealed leucokoria as the first presenting sign in the majority of cases. This sign could be included in eye health promotion messages considered for dissemination in PNG, where late presentation is a big problem, as shown in this study. Early diagnosis is critical for survival, given that retinoblastoma remains intraocular and curable for 3–6 months after the first sign of leucokoria (Dimaras, et al., 2012)

#### *4.2.2 Lime Injury*

Lime remains an important specific cause of trauma among the young age group (Tables 7 and 8) in PNG, more than a decade after it was first highlighted (Verma, Verma, Jacob, & Demok, 1997). Although lime is found in many parts of the world, injury attributed to it is mostly as a result of occupational hazards (Eslani, Baradaran-Rafii, Movahedan, & Djalilian, 2014) (Deleepkumar, Preetha, Raju, & Rini, 2018). In the published literature, chemical burns in children are attributed to household products such as toilet bowl cleaners, drain cleaners, detergents, and bleaches (Yin, 2017), (Das, et al., 2014), but in PNG it mostly occurs as a result of accidents in the widely practiced habit of chewing betel nut (Verma, Verma, Jacob, & Demok, 1997) combined with mustard fruit and lime powder. The low price (Swanson D. , 2014) at which chewers get a euphoric feeling and form of relaxation makes it attractive. Unfortunately, when the lime accidentally gets into the eyes of babies, chemical injury results in extensive damage to the ocular



conjunctiva, cornea, and limbus stem cells. Early intervention may save vision (Singh, Tyagi, Kumar, Gupta, & Sharma, 2013), as supported by clinical and occupational medicine studies (Schrage, et al., 2000). Without intervention, damage to the ocular surface may result into scarring and permanent visual loss. Results from the current study reveals that late presentation is also a problem with lime injury, as out of the 93 children presenting with lime burns only 33 (35%) arrived for treatment within the first week of injury. The community needs to be aware that apart from discomfort following injury, residual particles need to be removed to halt further damage to the ocular surface. For many of these children, specific intervention was obtained after significant damage to the eye had already occurred. Management of severe ocular chemical injuries typically requires a long period of treatment for restoration of visual acuity. In ocular trauma in the paediatric age group, there is an additional risk of the development of amblyopia (Vajpayee, Shekhar, Sharma, & Jhanji, 2014). This is due to the affected eye being subjected to reduced vision for a long time.

Prevention of lime burns is a challenge due to its association with the trade of betel nut, which is 'big business' in PNG (Sharp, 2016). As a mild indigenous stimulant, it is considered the 'green gold of the grassroots', and supports a flourishing informal economy (Sharp, 2016) with no direct taxation on its proceeds. However, there are increased risks of oral cancer associated with the use of betel nut, prevalent in PNG and a number of Asian countries (IARC Working Group, 2012). Due to the oral cancer risks, there have been attempts by government to regulate consumption and marketing of betel nut. However, the potential danger to the eyes from the associated lime product is not well articulated publically, and only the oral cancer health hazard is mentioned in the current discussion (IARC Working Group, 2012). The current discussion about the deleterious effects of chewing betel nut provides a platform that can be considered for a systemic approach to reduce lime injury to eyes in children. As an adjunct to current efforts, the immediate intervention could be one of sensitizing the betel nut vendors about the potential hazard of lime to the eyes and enlisting their participation in information dissemination to their customers, either by giving out flyers or displaying posters on their premises with eye health information. The vendors would probably be more amenable to this in the current climate when their business is under much public health scrutiny.

#### *4.2.3 Vitamin A deficiency (VAD)*

There were 16 children (Table 9) who presented with features of VAD. A closer look at their addresses showed no evidence of clustering. Their mean age was about 6 years with no significant difference in age between male and female. These may be the survivors of VAD as more severe forms of vitamin A are associated with high mortality rate among infants (National Departments., 2016). The fact some children presented with symptoms of VAD is suggestive of possibly a bigger nutritional problem in PNG. Data from previous studies revealed that 21.2%, 27.5% and 28.1% per cent of children aged 0 to <6 months, 6-<24 months, and 24 to 60 months respectively, were underweight (National Statistical office, 2017). Another hospital based study in PNG found that VAD in the male and female children with normal plasma C - reactive protein was 14% and 8%, respectively (Temple, Kaira, Vince, Kevau, & Willie, 2011). Even though this cohort was derived from a population of sick children, detection of deficiency in the presence of a normal c-reactive protein should concern the health system. Follow up field studies among apparently normal children are needed for prevalence and monitoring the vitamin A status of the community.

Infants in PNG are introduced to solid food at a much earlier stage and this is attributed to low rates of exclusive breast feeding during the first 6 months of life. The exclusive breastfeeding rate was 56% in 2006 (National Statistical office, 2006). The recommended practice of exclusive breastfeeding for the first 6 months of life and continued breastfeeding through the second year of life (Hou, Xiaohui, 2016) should be made known to the mothers during antenatal periods. This will benefit the children with a reliable source of vitamin A. A recent field study in Madang found no evidence of clinical VAD among the children. However, subclinical VAD with concurrent malnourishment occurred at a level of mild to moderate public health importance, which warrants further attention (Jeganathan & Verma, 2017). Currently vitamin A is given through immunisation clinics. However, more health promotion efforts are needed since many children do not present to well-baby clinics, and not all the scheduled immunisations are administered, which reduces the uptake of vitamin A supplementation (National Department of Health, 2016). And yet globally VAD is the leading cause of preventable paediatric blindness and also contributes to the mortality risk of infections and episodes of diarrhoea (FAO, 2014). Estimates from 2012 (James P, Petry, Tanumihardjo, Rogers, & McLean, 2017) showed that vitamin A supplementation coverage in PNG is 15%, while a 2005 Vitamin A survey with national representation revealed 15.7% VAD, categorized as moderate in severity (Department of Health of Papua New Guinea, 2005).

It is worthwhile considering VAD from a broader health systems perspective, due to the broader goals of increasing immunisation coverage and raising awareness in the community about the importance of good nutrition and adherence to current recommended interventions. To prevent visual impairment resulting from VAD, a multipronged effort is required, as the solution lies in addressing cultural practices, agriculture and a broader strengthening of the health system.

#### 4.2.4 Trauma

The difference in frequency of trauma (Table 11) between girls and boys was not statistically significant (p-value=0.264), which contrasts with a prior study by Ko (Ko, 2016) which indicated a predominance in adult males. Lime as a specific cause of trauma is discussed elsewhere; however other causes of trauma will be discussed here.

*Table 11: Trauma causes and time prior to presenting post injury (n=360)*

<b>Characteristic</b>	<b>Females 157(43.60)</b>	<b>Males 203(56.40)</b>	<b>P- value</b>
<b>Cause of trauma</b>			
Blunt injuries	10(38.46)	16(61.54)	0.264
Burns	0(0.00)	3(100.00)	
Chemical	2(66.67)	1(33.33)	
Cuts	11(42.31)	15(57.69)	
Domestic animals	3(50.00)	3(50.00)	
Foreign bodies	15(57.69)	11(42.31)	
Lime	50(52.08)	46(47.92)	
Not recorded	40(39.60)	61(60.40)	
Pricks	24(34.78)	45(65.22)	
<b>Time of presentation after any trauma</b>			
<1 week	57(40.43)	84(59.57)	0.182
>1 week	48(51.06)	46(48.94)	
No record	46(39.66)	70(60.34)	
Others	2(50.00)	2(50.00)	

The cause of trauma was missing on 101 participants cards out of 314 with a broad diagnosis of trauma. There was no consistent record of how the listed causes of injury occurred, however a few of the details include blunt injuries which were mostly caused by projectiles from catapults or stone throwing by children while playing .Catapults a common crude household weapon for stone projectiles are used for leisure hunting of birds by young children, especially boys. A search for

systematic documentation of injuries from catapults in PNG revealed no prior references, although studies by Ko (Ko, 2016) and Verma (Verma, Verma, Jacob, & Demok, 1997) indicated that some of the stone injuries were attributed to catapults. Stick injuries were sometimes accidental while children are playing. With a few occurring during the process of corporal punishment. Cuts appeared to be accidental when children were unattended and they were self-inflicted or received from another child. Some of the pricks were from safety pins and pencils.

Pecks from free-range chicken accounted for some of the injuries by domestic animals while foreign bodies were from dust and flying insects. Most of the burns to the eyes were extensions from burns on the face caused by a child falling on a saucepan with hot porridge or hot water, or a splash from hot cooking oil when a parent was frying.

The male to female ratio in trauma presentations of approximately 1:1 in this study are quite different from what Dasgupta (Dasgupta, Mukherjee, Ladi, Gandhi, & Ladi, 1990) reported, where the male to female ratio was 5.28:1 and 4:1 in an earlier study in Israel (Rapoport, et al., 1990). After extensive review of the literature Silveria (Silveria, 2007) found that globally, while all children are at risk of injury, males aged 5 to 9 years had the highest incidence. Ocular injuries are the most common cause of acquired uni-ocular blindness in children (Kaur & Agrawal, 2005). A 1:1 ratio girl to boys is an unusual finding in trauma among children. This may be due to the free interaction in Papua New Guinean society that young girls and boys have in the early years of life thereby being exposing them to similar risks for domestic accidents. Male and female babies of adults who chew betel nut are exposed to the same risk to lime injury while on the adult's lap. However further investigation is needed to get a deeper understanding of why, unlike elsewhere, girls appear to experience similar rates of eye injuries, when compared to boys.

It is recommended that parents or care givers purchase toys that are age appropriate, and ensure that they do not have sharp or projecting aspects that may cause children's eye injuries, (Hoskin, Philip, Yardley, & Mackey, 2016). In PNG the immediate focus should be on preventing lime burns and closer supervision of children while playing. Most of the cases of trauma registered were due to lime burns, followed closely by stick injuries. Additionally many children don't have access to safe toys and yet play is an important and spontaneous part of childhood. However this is a broader issue that needs to be addressed in PNG through socio-economic development.

Other aspects to bear in mind about children include the daring manner of play, and anatomic features such as a more prominent and less protected eyeball, (Harrison & Telander, 2002). Soylu et al (Soylu, Demircan, Yalaz, & Işigüzel, 1998) recommend educative and legislative measures such as informing the parents, teachers and children about common causative factors and potential hazards of perforating ocular injuries, and restricting the availability of dangerous items to children. Children cannot express their needs or advocate for their rights hence the responsibility is that of adults actively get involved in the safety issues faced by children (Griffen, 2006).

A study in Chaoshan Region China (Cao, Li, & Zhang, 2012) showed that a presentation interval of 24 hours or longer after injury results into a significant difference in the final visual acuity, when compared to those who arrived in the emergency room within 24 hours. This is supported by the findings of Agarwal et al from Central India (Agrawal, Rao, Naigaonkar, Ou, & Desai, 2011). Public health education including awareness on the part of parents to the importance of prompt intervention is needed.

Loss of vision also results in significant the economic loss, which Wittenborn et al (Wittenborn, et al., 2013) argue amounts to \$5.3 billion, based on severe visual impairment of children less than 18 years. In the PNG context this needs investigation so it can be quantified and the result used for advocacy for strengthening the health system.

#### *4.2.5 Refractive error*

Untreated refractive error accounted for 18.6% (n=16) of the low vision and blind children among our participants. Refractive error in this study group probably under represents the magnitude of the problem since most children presenting with other lesions in the eyes did not undergo refraction. Field studies are needed to establish the prevalence of refractive error in PNG and to make an informed plan of how to address the unmet need. This is crucial because of the variability in refractive error prevalence and pattern in studies conducted across the world for example prevalence rates of 11.2% in the Darfur region of South Sudan (Alrasheed, Naidoo, & Clarke-Farr, 2016), 6.3% in Ethiopia (Mehari & Yimer, 2013) and 4.5% in Saudi Arabia (Al-Rowaily, 2010) were reported. Uncorrected refractive may cause a child to underperform at school, and impact present and future accomplishments for the child (Naidoo & Jaggernath, 2012).

#### 4.2.6 Cataracts

There were 10 children (Table 12) who presented with cataracts and faced the risk of a life of blindness (WHO definition) if not operated. Vision in the better eye among children with cataract is reported in Table 13.

*Table 12: Cataract*

<b>Diagnosis</b>	<b>Female n (%)</b>	<b>Male n (%)</b>	<b>p-value</b>
Congenital cataract	9 (90.0)	26 (86.7)	0.783
Traumatic cataract	1 (10.0)	4 (13.3)	
Total	10 (100.0)	30 (13.3)	

Some of the children n=3 with cataracts (Table 13) were put under observation, as cataract surgery would have been less beneficial than leaving the children with the ability to accommodate, as minor cataracts are sometimes best left alone if they are not causing significant visual impairment There was no significant difference in the course action between girls and boys (p-value=0.446).

*Table 13: Vision in the eye with better vision and management plan among cataract participants (by sex)*

<b>Vision and management</b>	<b>Female</b>	<b>Male</b>	<b>p-value</b>
<b>Visual acuity</b>			
Normal	2(20.00)	12(40.00)	0.494
Mild	0(0.00)	2(6.67)	
Moderate	1(10.00)	1(3.33)	
Profound	0(0.00)	1(3.33)	
Near Blind	1(10.00)	6(20.00)	
Blind	1(10.00)	1(3.33)	
<b>Management</b>			
Observe	1(10.00)	2(6.67)	0.446
Medication	1(10.00)	1(3.33)	
Referral	0(0.00)	1(3.33)	
Surgical	5(50.00)	23(76.67)	
No record	2(20.00)	1(3.33)	
Lost to follow up	1(10.00)	2(6.67)	

Despite intervention, amblyopia remained a potential problem because of late presentation. Late presentation featured in a study in East Africa by Mwende et al (Mwende, Bronsard, Masha, Bowman, & Geneau, 2005) which revealed that bilateralism seemed not to influence how soon the children present. In our study,

closer scrutiny showed that 3 participants had spent 5-8 years prior to seeking medical attention, possibly a reflection of information gaps and unavailability of intervention services. Eye health promotion messages are required, that encourage seeking medical advice as soon as parents or guardians notice any behaviour in the child suggestive of reduced vision.

There was significant difference in the presenting mean age, as girls presented with cataracts at mean age 4.25 years (SD 2.7) while boys presented at a mean age 7.55 years (SD4.25)  $p$ -value=0.04. This is different from the findings in Tanzania which revealed that half as many girls as boys received cataract surgery and those girls tended to be brought for surgery later than boys (Bronard & Shirima, 2009). More studies are needed to understand whether there is some differential treatment for children based on gender. Despite the late presentation of children with cataracts, treating them may still improve their ability to perform activities of daily living and may lighten the burden on their local community (Tomkins, Ben-Zion, Moore, & Helveston, 2011). A study at Aravind eye hospital in India showed that indeed patients regardless of gender, literacy, and education level can have a significantly improved quality of life with the assistance of low vision services and low vision aids (Do, et al., 2014). Considering that visual deprivation in both eyes slows the cognitive development of the child (Dale & Sonksen, 2002), the earlier vision is restored the better for the child's development. The strategy of case finding, which is particularly beneficial for identifying girls with vision impairment, is needed so that all children with congenital cataract can access treatment early (WHO, 2007b).

Several studies (Patel, Tajunisah, Gilbert, & Subrayan, 2011) (Muhit, 2004) indicate that fear of surgery, lack of awareness and knowledge, inappropriate counselling, financial difficulty, large families, and poor parental commitment are all barriers to early detection and successful treatment outcomes. In PNG a 'one stop' tertiary centre with a complete paediatric team is yet to be established. An appropriate tertiary centre in PNG should have a paediatric ophthalmologist, an optometrist, an orthoptists, a paediatric anaesthetist, a counsellor, paediatric nurses and a community based rehabilitation personnel. This is consistent with the aspirations of VISION2020 and IAPB to make training of specialized paediatric eye teams an essential component of 'blindness in children' programs (VISION 2020 and IAPB, 2007). Amblyopia attributed to; late presentation, scarce optometry services, uncoordinated amblyopia management and incoherent follow up after surgery characterizes the experiences of many children after treatment for congenital cataract. If vision impairment holds a child back later in life, even by a small margin, the overall costs are magnified by the large numbers of years 'lived

with vision impairment'. The opportunities 'lost' are immense, especially if you consider that some may have become renowned artists, pilots, astronauts, of brain surgeons, in the absence of preventable blindness (William, 2014). But even in the case of timely surgery, follow up is essential for addressing the changing refractive state of the eye, and risk of glaucoma developing long after the surgery has been performed. The recurring features of missing data ought to be of concern, as good records are crucial for systematic follow up of the children. A survey conducted in Botswana highlighted the importance of improved eye care systems combined with improved public awareness as being integral to the successful implementation of any programme (Nallasamy, et al., 2011). Any discussions of congenital cataract should lead to more discussions of human resources for eye health in PNG and the need for modifications of the health system, so that it is more able to respond to the needs of some vulnerable sections of society like children.

The improvement of refractive services in general requires a critical mass of well-trained optometrists in the public sector so that children who have had congenital cataract surgery can access on-going refraction services. And to effectively address the congenital cataract problem and other refractive problems among children, we need to invoke objective 2 of the global action plan (VISION 2020, 2018). This objective encourages the development and implementation of integrated national eye health policies, plans and programmes that align universal eye health with action for strengthening health systems to improve health outcomes.

### **4.3 Goroka General Hospital**

#### *4.3.1 Introduction*

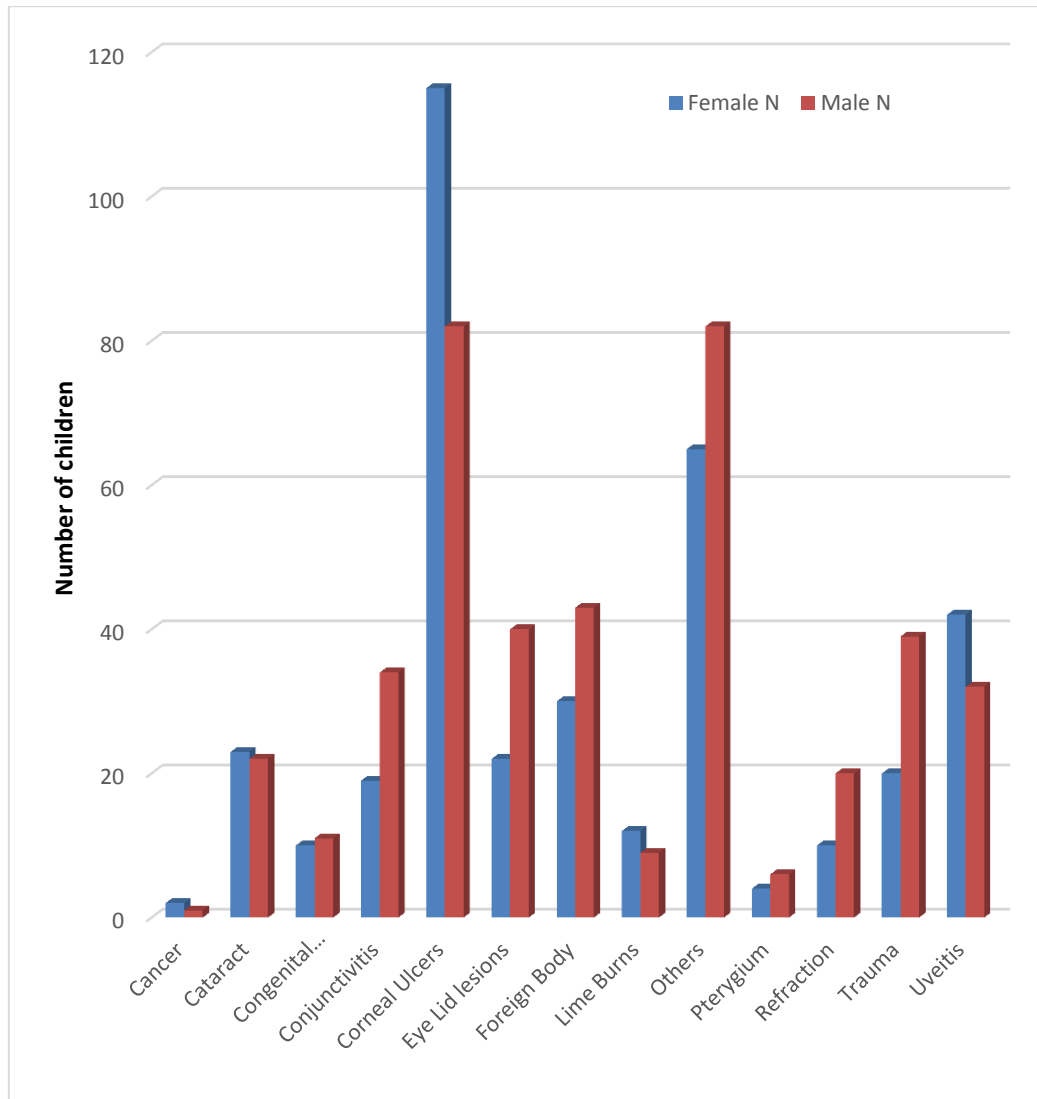
At Goroka Hospital, patients are given an exercise book known as a 'health book' when they initially register at the hospital. The health book for children has details of immunization schedules, and the patients are required take this book with them whenever they seek medical attention. Clinical findings, laboratory investigations, procedures and prescriptions are all recorded in this book. While this is useful in providing relevant 'patient history' information to clinicians on subsequent visits, the hospital does not retain sufficient clinical details about patients. This study therefore had less clinical and demographic data available for the children that were seen at Goroka Hospital between January 2015 and December 2017.



#### 4.3.2 Results and discussion for Goroka Hospital

The data presented here, attempts to make the most out of what was available and highlights some of the areas that need strengthening in the health system, such as the health and management information system. We were able to obtain and analyse diagnoses for 2017 (Figure 5).

Figure 5: Diagnosis categories (Goroka)



Out of 18,087 eye patients seen between January 2015 and December 2017, 2,551 (14.1%) were children between 0 and 18 years of age. This rate is 10% higher than the proportion of children seen in Port Moresby. This may be due to location of Goroka being at an intersection of two major highways making it more

accessible to a bigger population and possibly having referrals from a bigger catchment area.

Analysis of diagnoses for 2017 (Figure 5) revealed that corneal ulcer was the most frequently seen eye morbidity accounting for 197 (24%) morbidity, followed by uveitis n=74 (9.3%) and foreign bodies n=73 (9.2%). This differs from Port Moresby, where trauma, conjunctivitis and corneal ulcers accounted for 21.6%, 18.9% and 9% of diagnoses respectively. It is possible the more rural environment predisposes children to trauma from vegetative matter more frequently resulting in more corneal ulcers. On the other hand, the higher consumption of betel nut in the coastal region (Port Moresby) compared to the highland region (Goroka) might explain why lime injury is much higher in Port Moresby than Goroka. Goroka is along the highway that links a number of towns in the northern part of the country. This is likely to result in a greater catchment area for referrals from other health units of more serious conditions, like corneal ulcers.

The high number of uveitis cases calls for closer attention with respect to aetiology and follow up. Uveitis is often associated with complications that result in visual loss. Engelhard et al argue that while non-juvenile idiopathic arthritis paediatric uveitis can be difficult to diagnose and manage due to the number of uveitis aetiologies present in childhood, many cases may be due to trauma and respond to conservative interventions (Engelhard, Bajwa, & Reddy, 2015). Careful history might reveal that some of the cases of uveitis seen in Goroka might have been caused or associated with recent or previous trauma. But because tuberculosis is rampant in PNG (Department of Health, 2011) children presenting with uveitis need to be evaluated for possible tuberculosis infection. This is additional evidence for the need to have a well-functioning health system so that multidisciplinary approaches to patient care can be implemented without difficulty.

#### 4.3.3 Limitations of the study

This was a hospital based study and not a population based study. Population based studies are acknowledged as being more appropriate than that of hospital based for reasons of representativeness. However they are more difficult and more expensive to conduct. Much of the global data on child eye health is derived from institutions, such as hospitals or schools. While institution based studies may not provide definitive information about the prevalence of vision impairment in children in the community, it is indicative of need and is useful as a starting point for planning.

Data was obtained from chart reviews and depended upon availability of accurate medical records (Hess, 2004). Since information on the charts was recorded without anticipation of this study, there was variability in the way the notes were recorded within the individual study sites and between the two study sites. This affected the quality of data obtained. Missing data on the medical chart affected the quality of the information obtained. In Goroka, the lack of patient clinical notes deprived the study of good comparisons between urban and rural eye morbidity patterns. This finding revealed a weakness in the current health information management system and changes will be recommended.

Quantitative analysis was reliant on the routine data already collected and did not allow measuring associations with other important variables (e.g. parents' education, occupation, or the size of family where the children live). However chart reviews remain important in defining unmet medical need and quantifying healthcare resource use. Additionally they contribute to filling information gaps in countries where suitable sources of secondary data are insufficient (Payne & Stein, 2013).

#### **4.4 Results: Interviews with service providers**

The qualitative analysis addressed objectives 2 and 3 of the study:

Objective 2: To establish and describe how pediatric eye health services are being delivered and integrated in the general health system, using health system building blocks as an analytical framework.

Objective 3: To explore strengths and weaknesses of the existing system from the perspective of service providers and service users

##### *4.4.1 Characteristics of the service providers interviewed*

There were an equal number of males and female participants, (Table 14) as well as diverse designations from the health system. There were 7 participants from Port Moresby General Hospital, and 5 from Goroka Hospital. The job titles of those interviewed were: chief executive officer, acute care manager, surgical ward manager, clinical coordinator, director medical services, eye clinic manager, hospital pharmacist, post-natal nurse manager, maternity manager, senior medical officer, and special care /nursery manager. The mean age of the participants was 49.9 years (SD 7.66).

*Table 14: Study participants (qualitative analysis)*

<b>Participants (n=12)</b>	<b>n</b>	<b>%</b>
<b>Site</b>		
Goroka	5	41.7
Port Moresby	7	58.3
<b>Gender (n=12)</b>		
Female	6	50.0
Male	6	50.0
<b>Designation</b>		
Surgical Ward Manager	1	8.3
Acute Care Manager	1	8.3
CEO	1	8.3
Clinical Coordinator	1	8.3
Director of Medical Services	1	8.3
Eye Clinic Manager	2	16.7
Hospital Pharmacist	1	8.3
Post Natal Nurse Manager	1	8.3
Maternity Manager	1	8.3
Senior Medical Officer	1	8.3
Special Care/ Nursery Manager	1	8.3

#### *4.4.2 Access to paediatric eye services*

The majority of participants (70%) pointed out that paediatric eye services do not exist as such, but children with eye problems will usually go to the paediatric outpatients department. Some children go to the emergency unit at the hospital from where they are referred to the eye clinic. The participants explained that occasionally some children are taken directly to the eye clinic.

#### *4.4.3 Human resources for eye health*

The following cadres were not known to 10 out of the 12 participants: 'paediatric ophthalmologist', 'paediatric anaesthesiologist', 'orthoptist' or 'optical technician'. Participant PSP2 confirmed such personnel are not available. All participants were aware of availability of social workers in the hospital. Similar findings were obtained in subsequent interviews with two national departments of health staff who said that they were not familiar with 'paediatric ophthalmologists', 'paediatric anaesthesiologists', 'orthoptists' or 'optical technicians'.

#### 4.4.4 Referral and Support

With regard to linkages from the hospital to other organizations that deal with disability, the majority said the social workers in the hospital are responsible for this component of patient care, and that they would know where to channel patients with permanent disability whether it's visual or other forms of disability.

Participants PSP4 commented:

*“What I see, there is no clear referral system for children with disability”. This was corroborated by the response from DH1 and DH2 from department of health.*

Participant PSP5, added:

*“I have heard of Cheshire home as a provider of services for the disabled”.*

#### 4.4.5 Leadership in paediatric eye health

Most participants said the planning for paediatric eye health is within the domain of whoever is in charge of eye services in the hospital and that in this case, the responsibility rests with the heads of the eye units. Participants PSP4 and PSP6 added that the thought that the chief ophthalmologist is responsible, since:

*“He is in charge of eye health issues in the country”.*

However participants SP2 and SP4 stated

*“From my observation there is nobody. It is just a general eye care”.*

#### 4.4.6 Service delivery

Apart from the interviewees working at the eye clinic, the majority of the other participants who work elsewhere in the hospital were not aware of the details of any services offered at the eye clinic. They knew there were eye services but more than 60% could not confirm whether paediatric eye services existed. PSP1 said:

*“We have an eye clinic where patients with eye problems go and some are operated but details of what services are offered I don't know”.*

This suggests that there are low awareness levels about child eye health even among health workers.

#### *4.4.7 Community eye work*

Most of the participants were not aware of any community eye work done by their respective hospitals. Participants working at the eye clinics indicated that community eye work activities are only intermittent, and have decreased in frequency in recent years. This was attributed to reduced funding from development partners who used to provide most of the funds. However the participants were able to confirm that there were no direct costs to patients for accessing eye services. Participants DH1 and DH2 from the department of health said:

*“We have a feeling eye care needs to do more to be visible. Resources can be availed for community eye work if this is known in advance and budgeted for”.*

The researcher sees this as goodwill from policy makers, and a document that articulates a child eye health strategy is likely to be received favourably.

#### *4.4.8 Spectacle supply*

All the participants were aware about spectacle outlets in the optical shops in town, and development partners like Callan services and PNG eye care. In their opinion they thought that patients who need glasses can obtain them from these outlets. However, the cost was said to be higher, in the commercial optical shops in town.

#### *4.4.9 Hospital data management*

All the participants were able to describe how data is collected in the hospital, but some explanations varied significantly even between staff of the same hospital. Just over half of them were able to name personnel who handle data for the hospital. Based on the responses it was apparent that the health information management system functions is not clear to some of the managers in the hospitals.

Half of the participants said that most of the data is not analysed, apart from immunisation. They revealed that this is possible because supplies for vaccines are linked to data that accounts for vaccines previously supplied. In addition the expanded programme for immunisation was embraced by government as a priority

for meeting targets for immunization coverage. The researcher noticed that a motivation for collecting data is important to the people who are collecting it. In this case fresh supplies of vaccine are based on returns from the previous supplies. They all said that they do not get feedback for any of the other data collected in the hospital. For instance, SP3 said:

*“It is collected summarised and sent to the department of health”*

The staff may not demand it, but feedback on data collected seemed to be important to them. They also confirmed there is not much about eye health in the data that is collected.

#### *4.4.10 Budgeting*

Half of the participants were able to describe the budgeting process at the hospital. However, the majority did not think that data collected influences the budgeting process. SP1 said;

*“The money allocated to the hospital is decided upon from above and how it is apportioned here at the hospital is by the chief executive officer”.*

Asked about the composition of the budget committee, most expressed that it is top administration which means the chief executive officer and a few senior people in the hospital. If the health system is going to address needs of paediatric eye care, there needs to be a more participatory mechanism for budgeting, so the vulnerable segments of society can have a share in the allocated resources.

#### *4.4.11 Procurement*

Most participants interviewed were not clear about how procurement is performed. But it was reported that at individual department level they make requisitions and get the supplies from the pharmacy. When asked about some supplies for paediatric eye health, the response was that these are not on the regular procurement list of the hospital. On this particular issue SP2 indicated that if a list of such supplies is availed to them and justification is provided for their procurement there is provision to incorporate new requests.

*“Most of the specialized items for eye are not in the hospital catalogue. When we are given the list of items and quantities required we (pharmacy) put a cover letter and submit it to the*

*national department of health indicating that these are specialized consumables that are not on the usual catalogue for the ordering process. In most cases we are granted permission to source the item/s from alternative sources”.*

#### *4.4.12 Policy documents*

Nearly all the participants were aware that there are policy documents. Examples of policy documents mentioned include; Infection Control policy, Medication Management policy, Disaster and Fire policy. However, the majority were not able to explain how these documents can be accessed. Some participants with nursing backgrounds indicated that they got some policy documents specific to the nursing profession at the time of graduation. An example from SP4:

*“I don’t know of any policy documents which can be obtained by staff.”*

When the researcher requested to see some of the documents, in most instances a search in the drawers/shelves by the participants did not yield any relevant documents.

#### *4.4.13 Common child eye conditions*

When asked about what they consider to be the common eye conditions affecting children, the majority of participants mentioned trauma to the eyes followed by conjunctivitis, which is concordant with the overall picture from the quantitative results.

Only PSP4 and SP3 answered in the affirmative to knowing a child with severe visual impairment.

#### *4.4.14 Factors affecting access to paediatric eye care*

When asked about what they thought were the important factors affecting access to paediatric eye care the following factors emerged as the most important as identified by the participants.

- Low awareness in the community about childhood eye problems,
- Inadequate personnel that can handle children’s eye problems,
- Some families with no regular income have financial constraints to travel,
- Parents’ unwillingness to spend a lot on children, and



- Distances involved in getting to places where the services can be obtained.

Another aspect mentioned by participant PSP2 was:

*“Our current set up is such that children have to come to our eye clinics with a referral note from the nearest clinic. And when they present at the hospital they have to go through another appointment system.”*

This was echoed by all the service providers interviewed.

## **4.5 Discussion: Interview with service providers**

### *4.5.1 Introduction*

Health systems are complex entities with multiple aspects, making performance very difficult to summarize, through a single measure. Smith et al argue (Smith, Mossialos, & Papanicolas, 2008) that performance measurement seeks to monitor, evaluate and communicate the extent to which various aspects of the health system meet their key objectives. In this case, we were interested in knowing how the health system in PNG, using Port Moresby and Goroka hospitals as case studies, makes provision for child eye health. The result underlines the importance of finding opportunities to review the performance of the health system. This study has shown that there is no specific mention of this aspect of health care in the current health delivery system in PNG. Expecting that it will somehow be covered without appropriate articulation, leads to the omission and absence of vital eye health services for children. In the United States, it is recommended that all neonates, infants, and children, have their eyes screened by a paediatrician or other primary care clinician before discharge from the neonatal nursery, and during all subsequent routine health supervision visits (The American Academy Of Pediatrics, 2008). But in PNG while child birth in a hospital presents an opportunity for initial eye screening by the attending doctor, the national average indicates that only 37% of births are supervised at a health facility (Department of Health, 2014). In addition, screening of the red reflex is not yet a routine practice. The absence of an implementation policy means that almost all children in PNG leave health facilities after birth without being checked for a red reflex .While the current undergraduate medical curriculum includes skills in ophthalmoscopy, doctors already in the field would need some refresher training on how to do the initial eye screening and documentation in neonates.

In the short term, health units with eye departments may be able to discharge mothers with consultation requests to have eye screening performed in the eye clinic.

#### *4.5.2 Human Resource for Eye Health*

It may be true to say that as much as the health workforce truly represents the critical pathway for achieving universal health coverage, making provision for child eye health in PNG remains a big challenge considering, shortages, misdistribution and performance challenges are all prevalent (Jimba, et al., 2010). According to the national eye care plan (Department of Health, 2010) there are about 60 nurses or eye care workers providing various levels of eye care. The number of practicing ophthalmologists remains at 14 with small numbers graduating at intervals. The minimum target currently for the national eye plan is to have at least one ophthalmologist per province, and but only three provinces currently have fulltime ophthalmologists. Therefore there is need to be innovative and address child eye health now and in the future. Some proposed approaches are discussed in Chapter 5.

#### *4.5.3 Hospital data management, budgeting, procurement and policy documents*

It was observed that data collected in the hospital, with the exception of that on immunization, is not analysed regularly to inform decisions on resource and bed allocation in hospital. And yet we know that the information obtained through indicators such as these, helps to avoid the impulsive decisions which are often objectively unfounded (Bodina, Pavan, & Castaldi, 2017). Knowledge of the eye health status is the first step in identifying health events, prevention of disease, and improving health behaviours (Hashemi, Moghaddasi, Asad, & Farahi, 2018).

In resource allocation formulae, it is important that information systems are dynamic and able to generate relevant data (Pearson, 2002). More needs to be done in data management, so that the needs of different potential users of the health system, like children with eye problems can be addressed. Molyneux et al (Barasa, Molyneux, English, & Cleary, 2015) noted that personal relationships and mutual benefit, lobbying, level of ambition and bargaining ability of departmental heads, and political interests among actors were key in decision making especially in developing countries. Presenting data on the state of child eye health to influential stakeholders may attract support and improving access for children to eye care. A study in Zambia by Bozzani et al identified lack of routine monitoring as being a root cause of underperformance in the eye health system (Bozzani, Kou,

Blanchet, & Schmidt, 2014). Therefore good data management contributes towards the monitoring of health systems and can identify areas for strengthening and those that need to be sustained.

However, according to some service providers, current financial allocation to the hospitals doesn't seem to be influenced by data collected from the hospital. But whatever is received is apportioned internally based on felt priorities guided by budgets of previous years. This needs to change so that sound policy setting and planning is based on evidence (Jimba, et al., 2010). This study avails some new information that may guide policy on child eye health.

With the exception of the pharmacist, other hospital managers were not very clear about the hospital procurement system. They acknowledged however, that some supplies that may be needed for treating children with eye problems were not available. But it should be of interest to the planners of child eye health to know that there is a mechanism for acquisition of some of the items not on the regular catalogue. Improving supply chain and procurement processes requires identifying the limiting factors and addressing them. The health workforce needs to be engaged in providing context specific interventions and innovations (Millington & Bhardwaj, 2017). More needs to be done to increase participation of more staff in the hospital in the procurement process through in-house seminars on procurement. In addition the managers need to rank priorities in the allocation of resources, and follow up judiciously to ensure the resulting use is for the intended purpose.

#### *4.5.4 Policy*

All the managers interviewed were aware of the existence of policy documents such as treatment guidelines and professional guidelines, however these could not be located at the time of the interview. This might be indicative that the staffs are not using them or they were borrowed without documentation. The health system needs to have a mechanism of continuing medical education that includes refreshing people's knowledge about policies and guidelines. Such activities can be used for introducing the health work force to new information that promotes efficiency or new operating procedures to address the changing pattern of health challenges. There is flexibility and Barbazzaa et al suggests various training sessions spanning from a few days to weeks or months, at varied intervals (Barbazzaa, Margrieta, Kluge, & Tello, 2015). Ensuring there are opportunities to improve skills is an important motivator to the work force and child eye health may come as new knowledge to many health workers

#### *4.5.5 Issues affecting access*

The responses from the participants were highly suggestive that there is no specific service for child eye health. Low awareness among service providers was pointed out as one of the factors affecting access to child eye services. Efforts to raise awareness about child eye health in PNG may need to consider using some success stories of children that have benefited from eye care interventions.

Health materials linked to ordinary patients or doctors evoke stronger response, than when linked to celebrities (Fishman, Greenberg, Bagga, Casarett, & Propert, 2017). There is a partnership between UNICEF PNG and the Department of Health to reach out to communities with information about immunization (UNICEF, 2018). These channels of dissemination for immunization information can potentially be used for eye health information dissemination. As it is the same target population, instead of sending different teams for every health concern, fewer teams need to be equipped with multi-health information packages that include child eye health. This should go a long way in reducing costs and reaching more people in a country with a predominantly rural scattered population and difficult terrain (Hou, 2015). Distribution of the services at a local level is needed to reduce the demands on travel, but things to the fore the challenge of strong referral pathways and clear policies, both of which need to be strengthened in the current health system. The responses from participants seemed to suggest that no systematic timely referral of children that need rehabilitation services is taking place. This may be putting a big burden to the caregivers, by leaving them to figure out what to do themselves. Whereas low cost spectacles may be available in some centres that are run by charity organisations, such centres are not widely distributed in the country. The private commercial outlets are more common but provide spectacles at a higher cost. This may the uptake of spectacles for correcting refractive error.

### **4.6 Results: Strengths and weaknesses of the existing system**

The section will explore objective 3, which was to focus on the perspectives of service beneficiaries, their views and experiences of the system and suggestions as to how it services be improved.

#### *4.6.1 Demographics of service users (care givers)*

The results presented below are derived from consecutive participants who brought children aged 0 to 18 years inclusive to either Port Moresby General Hospital or Goroka Hospital between 1<sup>st</sup> October 2017 and 30<sup>th</sup> November 2017.

The majority of the participants were women (80%) (Table 15). More than 80% attended school for at least one year. Those who had not ever attended school comprised 17.5% of the study population.

Most of the service user participants came to hospital by public motor vehicles (PMV) (Table 15). A few of them used boats for part of the journey, while some others came by plane from their home provinces to access eye services for their children. One participant, GKA 9, had to use a boat, plane and PMV to reach the hospital. The service user participants comprised a wide range of occupations but the majority was fulltime house wives and market vendors (Table 15).

*Table 15: Service users (n=40)*

	<b>N (%)</b>
<b>Region of study</b>	
Port Moresby	18(45)
Goroka	22(55)
<b>Gender</b>	
Male	8(20)
Female	32(80)
<b>Level of education</b>	
1 – 8 years	22(55)
9 – 12 years	11(27.5)
None	7(17.5)
<b>Mode of transport</b>	
Dingy and PMV	1(2.5)
PMV	37(92.5)
PMV, Plane and Dingy	1(2.5)
Plane	1(2.5)
<b>Occupation</b>	
Pastor	1 (2.5)
Plumber	1 (2.5)
Police woman	1 (2.5)
Cleaner	2 (5.0)
Fulltime housewife	13 (32.5)
Market vendor	12 (30.0)
Morgue attendant	1(2.5)
Nurse	1(2.5)
Office work	4 (10.0)
Student	1 (2.5)
Subsistence farming	3 (7.5)

#### 4.6.2 Awareness about eye services

Most of the participants were already aware they would find eye care services in a big hospital, but about half of them came to these particular hospitals as a result of referrals from other health units. Participant GKA14 explained:

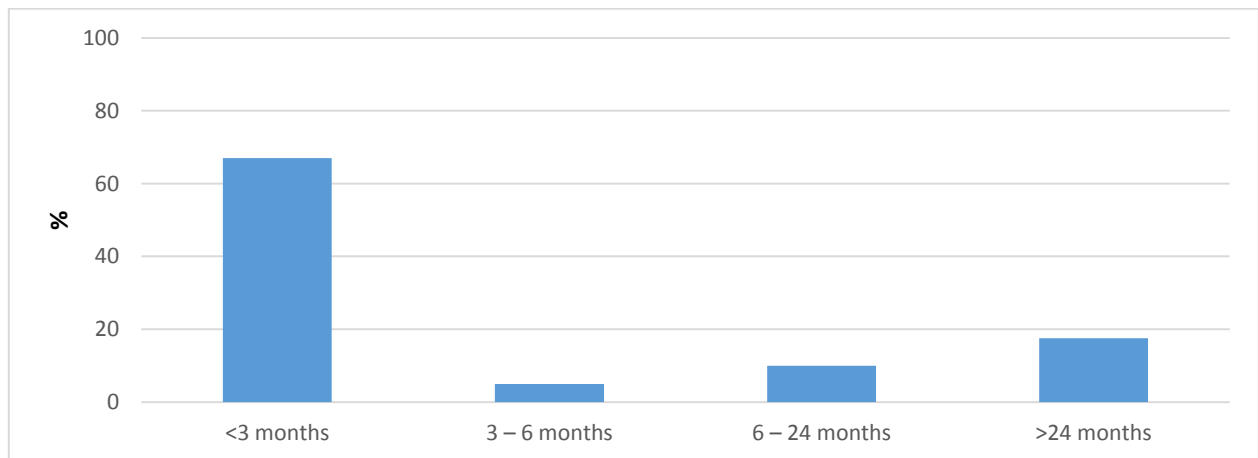
*“The teacher noticed that my child was not reading well on the chalk board so he wrote a letter for us which we took to a nearby clinic from where we got information about this hospital.”*

#### 4.6.3 Duration of symptoms prior to coming to the hospital

Most of the participants reported having taken the children to their closest health unit within the first few days of onset of symptoms (Figure 6). Most of the delay to getting definitive treatment was because they had been put on some form of treatment and only after failure to improve did they then get referred. Participant GKA1 narrated:

*“My child poked herself in the eye, and then I took her to a nearby health centre. The child was put on treatment for two weeks without improvement then got referred. Now that I am here I have high hopes.”*

Figure 6: Duration prior to presentation at hospital clinic

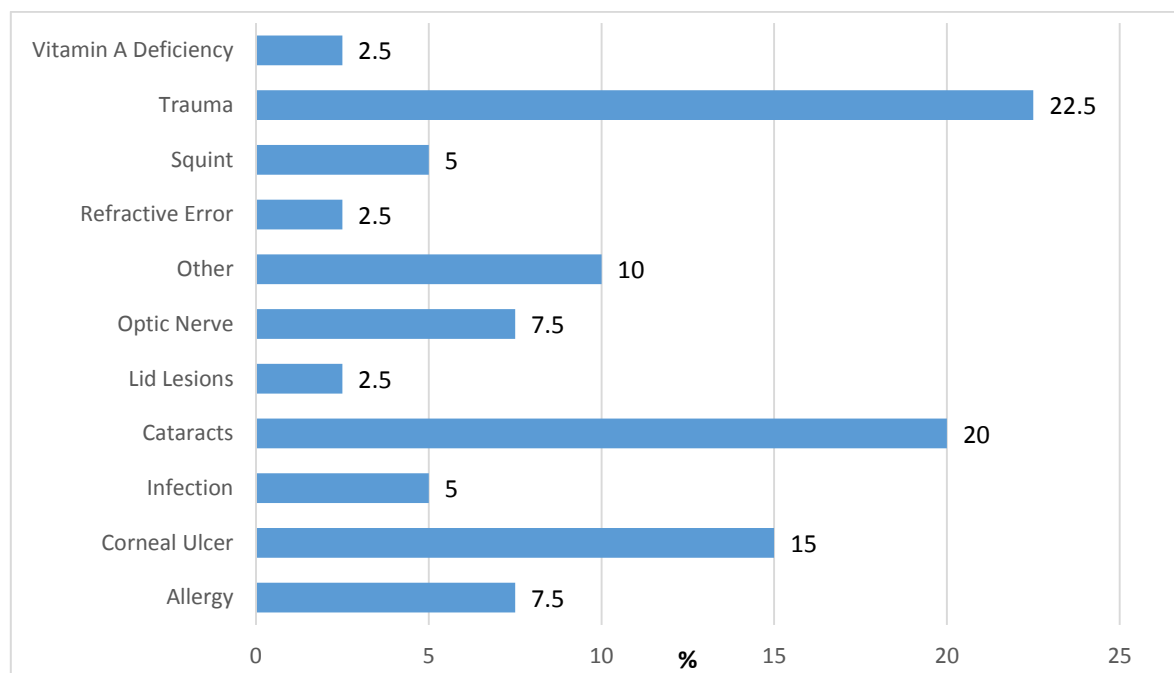


#### 4.6.4 Information about the children the service users brought

The gender of the children brought for care by the participants was similar, with 45% female, and 55% male. Trauma accounted for (22%), cataracts (20%) and

corneal ulcer (15%) (Figure 7). But even in this small study group there was a wide spectrum of eye conditions including allergy, conjunctivitis, VAD and optic nerve hypoplasia.

Figure 7: Diagnosis categories of children



#### 4.6.5 Services users experiences with services received

Although majority of services users said they were satisfied with the service received, some had concerns that they felt need attention. For instance, the following statement by participant GKA 2 was reflected in similar sentiments by PSU11 and PSU20.

*“It was my first time here and was excited but the waiting time to get to be seen is too long. And I noticed some people who came after me were seen before me. There seems to be no real order followed in seeing us.”*

Some expressed difficulty finding the eye clinic within the hospital and feel they lost a lot of time just looking for the right place to go. For example, participant PSU 5 said:

*“There should be clear labels that can guide patients”.*

This was their first visit and with a referral, they went straight to the eye clinic but were sent to the emergency department only to be sent back to the eye clinic.

The participant GKA 6 said in frustration:

*“I wish there was one place to have all these problems sorted. I have been to three places today trying to get my child treated. Is it not possible to have the blood drawn from the eye clinic or children’s clinic”?*

The participant had been to the children’s outpatient then referred to the eye clinic then sent to the laboratory for some blood investigations. These services are in different parts of the hospital and at each place there is some waiting.

Another participant (PSU 9) said:

*“I want a cure for my child to what keeps bringing me here.”*

The child brought by this participant suffers from allergy but this had not previously been explained adequately for her to understand. Her expectation was for an intervention that would cure or stop the allergy.

#### *4.6.6 Eye health posters*

We were interested in finding out if the participants had ever seen eye health posters in their nearest health center or any public place. The majority of them said they had not seen any poster with eye health information in the health centers close to where they live, or in other public places. Participants who had seen some eye health posters saw them in diverse places including some AID posts, at Port Moresby General Hospital, and at the youth with a mission ship and health centers.

#### *4.6.7 Primary Eye care work*

We tried to find out if participants were aware if there was any primary eye care taking place in their communities. The majority of the participants were not aware of any such services. Some knew of churches offering reading glasses at a very low cost, without an eye examination. Some stated that they had heard something about eyes during mobilization for a surgical outreach in their location.



## 4.7 Discussion: Caregivers

### 4.7.1 Gender of caregivers

Our results show that 80% of the caregivers bringing children to eye care services at the hospitals were women. Women bringing children to hospital is an extension of traditional family roles, whereby they/ ensure all family members remain in good health, eat enough and physical protection of the off springs.

If women were adequately equipped with knowledge of which foods to give children to prevent VAD they are likely to do so willingly, just as they are likely to avoid providing food to children that causes diarrhea. The proportion of female caregivers in this study confirms the central role of women in health that Goodwin et al expound in their paper ( Goodwin, Garrett, & Galal, 2005). For women who have an additional vocation of selling in the market or some other employment every single day is a long day.

### 4.7.2 Education

Most of the care givers (82.5%) interviewed had attended school and were literate. The national average of literacy is about 60% (The World Bank Group, 2016) while in our study the caregiver literacy rate was 82.5%. Various studies (Ihaji, Gerald, & Ogwuche, 2014), (Ford, et al., 2009) have demonstrated how education positively influences health seeking behavior. It is therefore possible that there could be more children in the community that are not brought to hospital because of the low overall literacy rate and the higher rate in this cohort might be attributed to self-selection, since the more educated members of the community tend to have a better health seeking behavior.

### 4.7.3 Accessing eye services

*“The eye clinic is difficult to find”*

*“Waiting time is too long”*

The above statements given by participants should be viewed in the light of the inverse relationship between patient satisfaction and waiting time that has been demonstrated by some studies (AIMutairi, 2016) (Helbig, Helbig, Kahla-Witzsch, & May, 2009). A study by Pillay et al in Malaysia revealed that on average, patients wait two hours from registration to getting the prescription slip but the contact time with medical personnel is only about 15 minutes. (Pillay, et al., 2011). The health

system in PNG needs to be responsive to the tortuous course clients undertake to get to the hospital and then the time it takes to receive service once they are in hospital. There is consensus that a well-designed healthcare service management system should not have patients wait lengthy times for appointments and consultations (Sun, et al., 2017). Some changes to the health system to reduce waiting times need to be considered. Many of the participants were market vendors and fulltime housewives (Table 15) both of which roles exert a high demand on their time. It is important that they are attended to promptly to enable them to return to their chores at home and in the market.

In this study, a majority of the clients arrived by public transport, which only operates during the day. A more user friendly registration and booking system and transparent management of queues is needed at the hospitals to avoid corruption and nepotism, which was a concern raised by some service users (GKA1, PSU11 and PSU20).

Regular evaluation of patient flow will allow for the identification problems and make helpful changes. This can be done by one person, but it is often better to do it as team (Pons, 2012). A study by Ugarte, (Ugarte, 2015) showed that involvement of a multidisciplinary team (one consultant, junior doctors, staff nurses, technicians, and receptionist), as well as patients and relatives was essential to understand the main delays in the clinic and the impact on the quality of services. Therefore the feedback from the participants in the current study is important in making adjustments to reduce waiting time in the eye clinics in PNG.

#### *4.7.3 Referral patterns*

It was observed that care givers initially went to paediatric clinics and other general clinics for any child ailments. Therefore while the paediatricians play an important role in managing eye conditions, awareness of the location of eye services in the community is vital so that primary care can accessed directly when needed. But further studies are also needed to better understand health seeking behaviours in PNG in order to make the health system more responsive to the health needs of the community.

Display of eye health promotion materials in children's clinics, maternity wards, antenatal clinics and general outpatient clinics is a way of enhancing the role of the health system in preventing and reducing vision impairment among children. A closer working relationship between eye health and other health services within individual health units and between health units broadens the audience for eye

health information dissemination. This also demands clear treatment and referral protocols so that the treatment at the primary level complements what the ophthalmologists will do in the referral site. Some of the delays in children getting definitive interventions were attributed to inadequate guidance and capacity at other health units to determine cases that need immediate referral to a tertiary unit.

Additionally there is need for clear communication and health education. This enables caregivers to make informed and smart decisions about their children and to manage their expectations in the context of the disease condition affecting their child. Current models for paediatric eye care for example in India (Praveen, et al., 2004) are heavily tilted towards tertiary care and school screening programs. Tertiary-care models are effective when there is increased awareness among parents or other caretakers of children to recognise ocular abnormalities and bring children in for eye care. However, this approach is reliant on the general awareness levels of eye care problems of children among caregivers. In PNG there is not enough data to inform current awareness level of caregivers about eye health in children. The recent RAAB (Lee, Burnett, Wabulembo, Garap, & Keys, 2019) revealed that a cross section of society was not aware that cataract can be treated. Knowledge about child eye health may be even less, since to date no specific programme is actively promoting it. A model that seeks to raise awareness about child eye health in the community so that more child eye health screening is performed is essential. However it is even more critical for caregivers to seek medical attention immediately, should they notice any redness of the eyes. But the health system also needs to make the necessary adjustments to make access easier. Currently intervention places in PNG are far apart and in some instances require taking a domestic flight or boat ride to access.

With respect to child eye health the decision maker at family level is different from the affected individual. Raising awareness about the United Nations Convention on the Rights of the Child (CRC), particularly Article 3, this states:

*“All actions concerning the child shall take full account of his or her best interests. The State shall provide the child with adequate care when parents, or others charged with parental responsibility, fail to do so”*

(Children's Rights and Business Principles, 2013).

The rights of children should be brought into context in a culturally sensitive manner. There is also a local legal framework to ensure that the CRC tenets are upheld.

*“If a matter before a Village Court involves a child; the Court is to act in the best interest of the child”*

(OHCHR-UNOG, 2016).

Advocacy for promotion of child eye health partnerships with agencies and the community should occur to address vision impairment as a child rights issue. Especially as vision impairment and age-related eye diseases affect economic and educational opportunities, reduces quality of life, and increase the risk of death (Bourne, et al., 2017).

Children of school going age can play a positive role if eye health promotion information is simplified for them. They can in turn be asked to take the same information to their caregivers, resulting into a multiplier effect in dissemination of knowledge into the community. School eye health programmes, when integrated into broader school health education and backed up by eye and child health services, can reach a large number of children and their families (Yasmin, Minto, & Chan, 2015). A study in Tanzania showed that indeed children have the potential to effectively share eye health messages and conduct simple vision screening for their families and peers (Chan, Naidoo, Minto, & Mashayo, 2017). In this regard there is a gap that can be filled by the health system working together with the education sector. The impact of severe vision impairment is even greater among children who live in an environment of less developed infrastructure and less social support services for people living with disability such as PNG. The health system strengthening approach remains crucial for mitigating the negative impact of severe vision impairment and blindness by ensuring that no child loses their vision from preventable and treatable causes. Should there be children with irreversible severe visual impairment picked up the health system, clear mechanisms for accessing rehabilitation and education services should be put in place.

#### *4.7.4 Limitations of the study*

The qualitative components of this study may not be generalizable to the wider population, as it was based on non-probability sampling of participants. However it is a reflection of the views of those who manage to access services. It must be acknowledged though that the views of those that do not access services and their experiences in trying to access services, is a major gap in this study.

The case study sites were not chosen randomly and findings from these two sites may not be representative of the rest of the country. With regards to the service

users we might have missed some objectivity in the responses because we were part of the team treating the children of the participants.

Some service providers could have been less explicit as this depends on how secure they felt about our efforts at concealment of their identity; however this is a feeling that is difficult to quantify.

#### **4.8 Document reviews**

The following are key areas of relevance to child eye health from some of the main documents that guide eye health in PNG.

1. Curriculum for the post graduate training of ophthalmologists at the University Of Papua New Guinea School Of Medicine (RANZCO AND UPNG, 2017) makes provision for the issues of child eye health: Below are some excerpts- Trainees should be able to:
  - a) “Diagnose and treat cataract, including performance of surgery, pre-operative surgical planning and post-operative follow-up with an emphasis on treatment of amblyopia and detection of post-operative complications such as glaucoma.
  - b) Recognise and know how to treat the apparently blind infant.
  - c) Work empathetically with the patient, parents or carers and, where appropriate, other eye care workers, and the extended family or community to help ensure good treatment outcomes.
  - d) Perform surgery for congenital cataracts, understanding the need for early surgery to prevent amblyopia.
  - e) Should be able to manage the human resource and logistics of Prevention of Blindness programs”.
2. The National Eye Care plan 2013-2016 (Prevention of blindness Committee PNG, 2013) is being revised. Below are some excerpts:

“Treatment for congenital cataract, VAD and trauma, particularly lime burns will be assisted by health promotion initiatives. Low Vision - additional teaching and appropriate low vision aids will need to be integrated into the existing training courses and the spectacles supplies. This will also require additional courses for eye care professionals. Some low vision work is currently being conducted by NGOs, however a more comprehensive low vision plan should be developed, so that services are integrated within current systems and people across PNG can access these specialist services”.

The researcher proposed to the review committee to include a statement on the specific human resource requirements for comprehensive child eye health and the need for a child eye health strategy.

3. The National Health plan 2011-2020 (Government of Papua New Guinea, 2010) has some excerpts that can be invoked by a comprehensive child eye health strategy. They include the following key result areas (KRA):  
KRA 1: Improve Service Delivery. This KRA can be a basis for addressing some of the findings from this study such as the lack of a cohesive plan for child eye health.

KRA 2: Strengthen Partnerships and Coordination with Stakeholders.

Child eye health requires an inter-disciplinary and multi-sectorial approach as recommended in the literature (Malik, Mafwiri, & Gilbert, 2018).

KRA 3: Strengthen Health Systems

The current study has identified some gaps in the current health system that directly affect child eye health for example the current health information management system which is not inclusive enough to capture important data on child eye health.

KRA 4: Improve Child Survival. The current body of literature shows links between blindness and child survival (Gilbert & Foster, 2001).

## **CHAPTER 5: CHILD EYE HEALTH STRATEGY**

### **5.1 Introduction**

Objective 4 of this study which is to formulate a pediatric eye health strategy. Results from the interviews indicate that there is no coherent strategy for child eye health at the moment. In this chapter, the researcher proposes some ways in which child eye health can be embedded in the policies of the health system in PNG in a more explicit manner to attract resources and action. While the strategy will endeavor to align with Vision 2020 “The Right to sight” Global initiative, the main focus will be:

1. Eye health issues that emerged from the study results and innovative ways to address them,
2. Highlights of existing policies that can benefit a child eye health strategy,
3. Components of existing policies that explicitly reference on child eye health,
4. Health system support interventions critical to comprehensive child eye health

### **5.2 Aim and objectives of the child eye health strategy**

To establish a sustainable integrated child eye health program through a health system strengthening approach.

Specific objectives of the child eye health strategy are to advocate for:

1. A child eye health policy.
2. Documentation for children with eye conditions
3. Two tertiary centers for pediatric ophthalmology in the next 3 years
4. Establishment of a mobile team to address the current un-operated congenital cataracts
5. Integration of child eye health promotion in the existing health promotion packages
6. A baseline survey for childhood vision impairment in the next year.

### **5.3 Child eye health strategy: Objectives 1 and 2**

Objectives 1 and 2: To advocate for a child eye health policy and to standardize documentation of children with eye conditions

The National Eye Care Plan for PNG 2011-2016 did not attain sufficient official recognition by the department of health. That plan is being revised to produce a

2018-2023 National Eye Plan. The plan needs to advocate for a fulltime position for an eye focal health person in the department of health, or modify the job description of an existing position to drive the agenda of eye health in the country.

A summary of the findings of this study will be shared with members of the prevention of blindness committee to inform the content of the next National Eye Plan. A section in the next plan may need to be devoted to child eye health, in order to guide policy on child eye health. This document will stipulate how the current health information system could be modified to capture child eye health information in a more comprehensive manner. In addition this document could outline how that data would be managed, including feed back to the sources and sharing with those responsible for planning at all levels within the health system.

#### *5.3.1 Indicators (Objectives 1 and 2)*

1. National Eye Plan adopted by the department of health with a section articulating the strategy for child eye health and dissemination to programme implementers,
2. A new position for a focal person in the department of health or a modified job description to provide leadership for eye health with a budget line item for inclusive eye health, and
3. A revised health information management system that includes important child eye health conditions, with a provision for analysis and feedback, in order to influence planning in health institutions.

### **5.4 Child eye health strategy: Objective 3**

Objective 3: Advocate for 2 tertiary centres for child eye health in the next 3 years

This objective seeks to address some of the current barriers revealed by the study, such as a shortage of pediatric eye care professionals, lack of equipment, and long distances travelled by children to get to service centers. The initial two pediatric ophthalmology tertiary centers will need to take into account the overall accessibility constraints that exist because of the difficult terrain. The author proposes Mt Hagen in the highlands, as it is accessible by roads, and could serve a big population, and Port Moresby where the National Referral Hospital is.

Additional recommendations are to train some health workers and non-health workers at all levels to promote early detection of common eye conditions in children and improve effectiveness of the referral system. The health workers may include pediatricians, midwives, and immunizers, gate keepers at hospitals,



emergency department teams and established traditional healers, with the training tailored for the anticipated tasks for each cadre. Also, introduce courses for cadres that are currently not available like optometrists, low vision therapists, orthoptists and optical technicians and lobby for establishment of their positions in the public service structure.

Equipment needs assessments are required and a budget identified to purchase items that are unavailable but essential to the management of childhood eye conditions. Finally, the establishment of formal linkages between health institutions and low vision rehabilitation centers where children with severe visual impairment and blindness can be supported with life skills, special needs education and vocational training is recommended.

#### *5.4.1 Indicators (Objective 3)*

1. List of pediatric eye care professionals trained,
2. Structures established where positions are currently absent in the public service,
3. Two tertiary centers set up with equipment and the necessary human resource, and
4. A manual with protocols for management of childhood eye conditions.

### **5.5 Child eye health strategy: Objective 4**

Objective 4: Advocate for establishment of a mobile team to address the current backlog of un-operated congenital cataracts

Because there are already many children in the community with un-operated cataracts there is an urgent need to set up an interim mobile team that can go to strategically located provincial hospitals to assess and operate on these children. Prior to each visit, plans for follow up should be discussed and documented. The team members initially may not be from the same hospital as no one hospital has personnel with all the competencies required, but a mechanism of bringing them together for specific activities can be designed.

#### *5.5.1 Indicators (Objective 4)*

1. List of identified trained people for the mobile team
2. Number of children with congenital cataracts identified and operated in one year,
3. Activity plan with identified resources to support the activities, and

4. Reports including number of visits, places visited and number of children evaluated and those operated upon.

## **5.6 Child eye health strategy: Objective 5**

Objective 5: Advocate for integration of child eye health promotion in the existing health promotion packages

This objective seeks to address some of the findings from this study such as lack of awareness among caregivers about preventive measures, intervention options, and places to find services.

This study revealed that the child eye health agenda is not well articulated and therefore no specific provisions are made by health institutions. The result is that even the available interventional facilities are not being optimally used. Lobbying for integration of child eye health in the training programmes of all cadres of health workers should be pursued.

Messages about the potential dangers of lime to the eyes need to be developed and disseminated. Betel nut vendors can be recruited in this campaign through one day seminars and pictures of lime burns in the eyes be shown to them. Fliers with a message “Warning!! Lime is dangerous to the eyes. Keep lime out of reach of children” and avoid using lime while carrying a baby on your lap”. Each flier with a picture of a normal eye and one with a corneal opacity may be given to vendors for free distribution to their clients.

There is a wide network of village health volunteers, with some already trained to conduct safe deliveries and identify mothers for referral (O’Keefe, Davis, Yakuna, Gemert, & Morgan, 2011). This was shown to reduce maternal mortality in places where they are currently active. These volunteers may be provided with eye health promotion materials and information about location of eye services to which they can refer children with eye conditions. They may be sensitized to the possibility of ophthalmia neonatorum and ensure such children receive treatment in a timely manner. About two thirds (Fleming, 2015) of women in Rural PNG deliver their babies outside established health facilities. Working with health care providers outside the formal sector, who live among the target population and have the respect of the people they serve, may bring some benefits.

Other important target audiences include schools where vision screening can be performed by teachers (Kaur, et al., 2016). The screening may be at the time of enrollment and at annual intervals thereafter. Health promotion information given to

the children is likely to reach their caregivers as well as younger siblings not yet at school.

#### *5.6.1 Indicators (Objective 5)*

1. Child eye health included in the training documents of all health workers,
2. Number of teachers trained in eye screening each year,
3. Number of children screened per year,
4. Number of health workers sensitized per year,
5. Number and distribution of village health volunteers, betel nut vendors, and immunizers sensitized per year,
6. Availability of eye health promotion materials in languages understood by the community displayed in public places, schools and betel nut vending places.

### **5.7 Child eye health strategy: Objective 6**

Objective 6: Advocate for Conduct a baseline survey for childhood vision impairment in the next one year.

There is a strong link between information used to plan and used to monitor against the plan (Courtright, et al., Using evidence for VISION 2020 “district” planning; Situational analysis, 2009). We need to have baseline data on child eye health by conducting population based surveys and surveys in schools. This will help in advocacy for resources, and in evidence based planning. The results from such surveys can be used to formulate indicators against which interventions will be evaluated.

#### *5.7.1 Indicators (Objective 6)*

1. Survey conducted and report written.
2. Report adopted by the department of health.

### **5.8 Summary of child eye health strategy recommendations**

The following strategy encapsulates the issues discussed previously and summarizes the key steps that need to be taken. To date PNG has never had a child eye health strategy, which has led to a non-focused approach to the provision of eye care for this vulnerable age group. The indicators identified provide a good basis for monitoring and evaluation, a major challenge in a health system such as PNG. However setting out to achieve these changes requires an overhauled health management information system, in order to capture important data relating to

child eye, alongside service delivery. In addition, the child eye health strategy envisages that good governance principles would be upheld to make current institutions more effective. This strategy seeks to align itself with the ideals of government efforts to provide equal opportunities to all citizens including those in rural areas where the majority of Papua New Guineans live. The strategy will provide clarity, cohesiveness and certainty to both government and development partners who require such predictability for committing resources to identified priority areas.

*Table 19 Log frame for Child Eye Health Strategy*

<b>OBJECTIVES</b>	<b>ACTIVITIES</b>	<b>PROCESS INDICATOR</b>	<b>EXPECTED OUTCOME</b>
To advocate for a child eye health policy in the revised national eye health plan	Share results of this study with prevention of blindness committee and stakeholders	Inclusion of child eye health policy in the next 5 year national eye plan	1. Child eye health policy for PNG 2. Manual with guidelines for implementation of the child eye health policy
To advocate for establishment of 2 tertiary child eye health centres in three years	Have this idea on PBL agenda Identify two centres Identify human resource for training Identify institutions for the different competences	1. Discussed and passed 2. Detailed implementation plan 3. Budget allocated for development 4. Admission of trainees to respective institutions	Two tertiary centres established with appropriate human resource and equipment for paediatric ophthalmology and optometry
To have a short term emergency intervention service for un-operated paediatric cataracts within 1 year	1. Identify human resource for the various competences of a paediatric ophthalmology team 2. Have them linked for purposes of the mobile team and get clearance from their employers	1. Implementation plan in place 2. Budget /resources allocated 3. Team mobilized.	More children with congenital cataracts identified and operated Younger children identified and operated.
To integrate child eye health promotion in existing health promotion programs/activities	1. Envision stakeholders in eye health promotion. 2. Generate and avail child eye health promotion materials	1. Implementation plan available and shared 2. Persons/stakeholders to conduct child eye health promotion activities identified and commitment secured	1. Community awareness levels improved 2. Eye health promotion materials displayed in strategic locations
To conduct a population based baseline survey for child eye health	1. Proposal for survey written and shared with stakeholders 2. National protocols for conducting a survey done 3. Resources for the survey identified	1. Stakeholders approval obtained 2. Approvals from the research regulatory authorities 3. Budget availed 4. Survey teams and survey places in place 5. Survey conducted	Baseline survey report written and disseminated

### *5.8.1 Critical assumptions*

1. The national prevention of blindness committee will be persuaded by the findings from this study that child eye health policy and strategic plan are essential.
2. There will be resources available to implement the different components in the strategic plan
3. The community will respond positively to the messages and the structure that emanates from this child eye health strategy.

### *5.8.2 Threats*

1. Continuing budget cuts for the health sector.
2. Difficulty in creating new positions in the public sector.

## **CHAPTER 6: SUMMARY, FUTURE RESEARCH AND CONCLUSION**

This hospital based study was the first and largest analysis of childhood eye morbidity conducted in PNG. At Port Moresby General Hospital we were able to show that trauma is the most common cause of eye morbidity, with a presentation that differed to similar studies in the literature. Additionally unlike all study reports where trauma in boys significantly exceeds that in girls, we had a boy to girl ratio of 1:1. Lime burn, which happens accidentally when adults are mixing lime with betel nut, emerged as a single most common cause of eye injury in this study population. This is different to what has been reported in the literature, where trauma in children is mostly caused by physical rather than chemical injury and where lime burns in the eye mostly occur in adults as an occupational hazard in industry and construction. Conjunctivitis and corneal ulcer were the second and third most common cause of eye morbidities, after trauma. Based on the WHO definition of blindness 7.4 % (n=51) of the children were blind mostly from optic nerve disorders and un-operated cataracts.

The disease pattern at Goroka Hospital a more rural setting was different with more corneal ulcers followed by foreign bodies and uveitis respectively. The findings at Goroka demonstrated that the practice of patients retaining their important clinical records, without a duplicate copy or backup at the hospital deprives the health system of the opportunity to accurately derive trends of morbidity from chart reviews.

The study did not find systemic mechanisms in the health systems that cater for child eye health or its integration. Service providers highlighted some strengths and weaknesses in key areas of the health system in relation to child eye health

### **6.1 Strengths**

- There is a referral system in place for different levels of care in which management of child eye diseases can be integrated
- There are health facilities widely distributed in the country in which appropriate staffing to manage child eye conditions can be deployed
- The immunisation programme is effective and already contributing to child eye health and could be used for eye health promotion

### **6.1 Weaknesses**

- There is no clear leadership and guidance with respect to child eye health.

- Some cadres for child eye health like optometrists, orthoptists are not in the current civil service structure and eye health personnel, in general, are few
- Some items required for child eye conditions are not in the regular hospital catalogues

This study revealed gaps in the health information management systems with no clear systems in place for monitoring prevalence and causes of childhood eye morbidity, yet reliable information on which to base decisions and policies is crucial. Variations were found in patient data handling between the two study sites which makes comparative analysis difficult and loss of valuable information.

Care givers were unanimous in having been well attended to but expressed the following concerns:

- Eye clinics in the hospitals where the study was conducted are difficult to access.
- The waiting time before seeing a doctor is too long
- Distances to the health units are too long for most of them.

Our analysis of their responses showed that there is very little information about child eye health available to the community in form of posters, resulting in low awareness of child eye conditions, or knowledge of where to find or obtain services.

## **6.2 Policies**

Review of some important documents revealed that there is currently no specific policy on child eye health in PNG.

## **6.3 Human Resource**

The current human resource gaps have meant that more children are losing vision from preventable or treatable causes. This study suggests that innovative approaches to enable the current health system to optimally use the available human resource, while training more, are required.

Paediatric clinics in hospitals as well as other general health clinics are already serving as primary eye care intervention sites. Capacity building for staff working there to be able to identify, treat and refer children with eye problems may be worth considering.

Service users expressed concern about the long waiting time before accessing services at the clinic, which calls for review of the processes and procedures involved in patients' access in order to make it more efficient. Some of these reviews can be outsourced for more objectivity, but clients and staff at the hospital would need to be engaged.

#### **6.4 Future Research and Next steps**

Development of a policy document is needed that can be used for advocacy and to guide child eye health.

Generate population based epidemiology data even in specific regions to cross validate the data from hospitals that are used to plan child eye health programs. Population based studies on child eye health are needed to establish the profile of vision impairment in the community, schools or annexes for the blind and visually impaired using the WHO standard form (WHO, 2006).

Baseline studies of awareness levels of child eye health and subsequent follow up studies to evaluate impact of interventions.

Pilot studies to determine the effectiveness of immunisers, traditional birth attendants and hospital antenatal services in screening for common child eye diseases.

Further studies on lime (what is its true chemical composition) are needed in order to aid local simple quick treatment to prevent severe damage to the eyes.

Review of the health management information system data collection tools to ensure that all information that is important for planning, including that of children's eye health, is collected, analysed and feedback given to planners and those who collect it.

Review of the human resource for health data in PNG, since addressing child eye health may entail task shifting for early identification of congenital cataracts and treatment of common eye infections as well as establishment of clear referral pathways.

There is need to develop and disseminate eye health education materials that are relevant to PNG.



## **6.5 Conclusion**

The findings presented in this thesis demonstrate the value of assessing how the health system is responding to the health needs of vulnerable groups like children. While children are vulnerable by virtue of their age, their vulnerability increases when they have severe vision impairment or when completely blind. Attainment of SDGs will remain elusive in PNG without strengthening the health system. The cumulative economic benefits of preventing a child from losing their vision should catapult child eye health to the list of priority areas for government attention and intervention. Engagement of the community served by the health system and multi-sectorial collaboration in PNG will go a long way in ensuring that enhancing the profile of child eye health remains an active and dynamic agenda.

## REFERENCES

- Abramson, D. H., Beaverson, K., Sangani, P., Vora, R. A., Lee, T. C., Hochberg, H. M., . . . Ranjithan, M. (2003, Dec). Screening for retinoblastoma: presenting signs as prognosticators of patient and ocular survival. *Pediatrics*, *112*, 1248-55.
- Ackland, P. (2012, 08). The accomplishments of the global initiative VISION 2020: The Right to Sight and the focus for the next 8 years of the campaign. *Indian Journal Of Ophthalmology*, *60*, 380-386.
- Adhikar, S., & Shrestha, U. (2011, July- December). Validation of performance of certified Medical assistants in preschool vision screening Examination. *Nepal Journal of ophthalmology*, *3*(6), 128-133.
- Adhikari, S., Shrestha, M., Adhikar, K., Maharjan, N., & Shrestha, U. D. (2015, 05 28). Causes of visual impairment and blindness in children in three ecological regions of Nepal: Nepal Pediatric Ocular Diseases Study. *Clinical Ophthalmology*, *2015*(9), 1543—1547.
- Adolescents in Uganda:Sexual and Reproductive Health. (2005). *Research In Brief*(2), pp. 1-4.
- Aeesha, N. J., Milka, M., & Clare, G. (2017). Integrating primary eye care into global child health policies. *Archives of Diseases in Childhood*, 1-5.
- Agrawal, R., Rao, G., Naigaonkar, R., Ou, X., & Desai, S. (2011). Prognostic factors for vision outcome after surgical repair of open globe injuries. *Indian Journal of ophthalmology*, *59*(6), 465-470.
- Aipit, S., Aipit, J., & Laman, M. (2014, October 1). Malnutrition: a neglected but leading cause of child deaths in Papua New Guinea. *Lancet Global health*, *2*(10).
- Akambi, F., Afolabi, K., & Aremu, A. (2016). Individual Risk Factors Contributing to the Prevalence of Teenage Pregnancy among Teenagers at Naguru Teenage Centre Kampala, Uganda. *Primary Health Care: Open Access*, *6*(4), 2-5.
- AlMutairi, M. A. (2016, December). Parents' satisfaction with pediatric dental care provided by dental college, Riyadh. *Journal of international preventive and community dentistry*, *6*(6), 542-548.
- Alrasheed, S. H., Naidoo, K. S., & Clarke-Farr, P. C. (2016, October). Prevalence of visual impairment and refractive error in school-aged children in South Darfur State of Sudan. *African Vision and eye health*, *75*(1), p. a355.

- Al-Rowaily, M. A. (2010, April–June). Prevalence of refractive errors among pre-school children at King Abdulaziz Medical City, Riyadh, Saudi Arabia. *Saudi Journal of Ophthalmology*, 24(2), pp. 45-48.
- Anagha, M., & Ken, K. N. (2015). Pediatric cataract: challenges and future directions. *Clinical Ophthalmology*, 9, 77-90.
- Anchal, L., & Kavita, D. (2015, July-September). Organizational Communication and Management, Effectiveness: An analytical Study, at Various Managerial Levels. *International Journal of Management & Business Studies*, 5(3), 2231-2463.
- Anja, L., & Markus, J. K. (2011, March). Pathogenesis, diagnosis and management of hyperkalemia. *Pediatric Nephrology*, 26(3), 377-384.
- Ann, H., & Lois, E. S. (2013, October 26). Retinopathy of prematurity. *The Lancet*, 382(9902), 1445-1457.
- Babalola, O. E. (2011). Ocular onchocerciasis: current management and future prospects. *Clinical ophthalmology*, 5, 1479–1491.
- Baliwongerani, K., Chen, K., & Kisebeyi, P. (1989, October). Going to Kampala. (Charles, Ed.) 2(6), 1098-1100.
- Banayot, R. G. (2016, 04 05). *A retrospective analysis of eye conditions among children attending St. John Eye Hospital, Hebron, Palestine*. Retrieved 05 01, 2018, from Biomed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4822304/>
- Barasa, E. W., Molyneux, S., English, M., & Cleary, S. (2015, April 1). Setting healthcare priorities in hospitals: a review of empirical studies. *Health Policy and Planning*, 30(3), 386–396.
- Barbazzaa, E., Margrieta, L., Kluge, H., & Tello, J. (2015, 12). Health workforce governance: Processes, tools and actors towards a competent workforce for integrated health services delivery. *Health Policy*, 119(12), 1645-1654.
- Bartholomew, K. L., Guy S, P., Gerjo, K., Nell H, G., & Maria E, F. (2011). Delphi Technique. In K. L. Bartholomew, P. Guy S, K. Gerjo, G. Nell H, & F. Maria E, *Planning Health Promotion Programs. An Intervention Approach* (3rd ed., p. 220). Hoboken, New Jersey, U.S.A: Joss-Bass.
- Bartlett, S., Dominic, H., Simon, B., & Haddad, D. (2019, January). Elimination through collaboration; Success factors through a global consortium. *International Health*, 11(1), pp. 24-29. Retrieved August 2018, from [https://www.researchgate.net/publication/326958582\\_Elimination\\_through\\_collaboration](https://www.researchgate.net/publication/326958582_Elimination_through_collaboration)

- Blencowe, H., Lawn, E. J., Vasquez, T., Alistair, F., & Gilbert, C. (2013, December). Preterm-associated visual impairment and estimates of retinopathy of prematurity at regional and global levels for 2010. *Paediatric Research*, 34-49.
- Bodina, A., Pavan, A., & Castaldi, S. (2017, June). Resource allocation criteria in a hospital. *Journal of preventive medicine*, 58(2), E184–E189.
- Bourne, R., Flaxman, S., Braithwaite, T., Cicinelli, M. V., Das, A., Jonas, J., . . . Tahhan, N. (2017, September). Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. *The Lancet Global health*, 5(9), pp. e888-e897.
- Bozzani, F. M., Kou, G. U., Blanchet, K., & Schmidt, E. (2014). Health systems analysis of eye care services in Zambia: evaluating progress towards VISION 2020 goals. *14(94)*, 1-19.
- Bronsard, A., & Shirima, S. (2009, June). Cataract surgery: ensuring equal access for boys and girls. *Community eye health Journal*, 22(70), 28-29.
- Burnett, A., Mitasha, Y., Prakash, P., Thomas, N., Fricke, T. R., Yvonne, H., & Jambí, G. (2015). Perceptions of Eye Health and Eye Health Services among Adults Attending Outreach Eye Care Clinics in Papua New Guinea. *Ophthalmic Epidemiology*, 22(6), 361-369.
- Burton, M. J. (2009, Dec). Corneal blindness Prevention, treatment and rehabilitation. *Community Eye Health*, 22(71), 33-35.
- Cama, A. T., Sikivou, T., & Keefe, J. E. (2010). Childhood Visual Impairment in Fiji. *Archives of Ophthalmology*, 128(5), 608-612.
- Cao, H., Li, L., & Zhang, M. (2012, October). Epidemiology of Patients Hospitalized for Ocular Trauma in the Chaoshan Region of China, 2001–2010. *PLOS One*, 7(10), e48377.
- Chadha, R. K., & Subramanian, A. (2011). The effect of visual impairment on quality of life of children aged 3–16 years. *British Medical Journal of Ophthalmology*, 95(5), 642-645.
- Chan, V. F., Naidoo, K. S., Minto, H., & Mashayo, E. (2017, November 23). *Improving eye health using a child-to-child approach in Bariadi, Tanzania*. Retrieved October 4, 2018, from African Vision and Eye Health: [https://www.researchgate.net/publication/321249572\\_Improving\\_eye\\_health\\_using\\_a\\_child-to-child\\_approach\\_in\\_Bariadi\\_Tanzania](https://www.researchgate.net/publication/321249572_Improving_eye_health_using_a_child-to-child_approach_in_Bariadi_Tanzania)

- Children's Rights and Business Principles. (2013). *Summary Of The Convention On The Rights Of The Child*. Retrieved Sept 17, 2018, from Children's rights and business principles: <http://childrenandbusiness.org/the-principles/summary-of-the-convention-on-the-rights-of-the-child/>
- Chunharas, S., & Davies, S. C. (2016). Learnership in health systems: a new agenda for interactive leadership. *Health Systmes & Reform*, 2(3), 176-178. Retrieved July 14, 2019, from <https://www.tandfonline.com/doi/pdf/10.1080/23288604.2016.1222794?needAccess=true>
- CIA. (2016-2017). *East Asia/SouthEast Asia :: Papua New Guinea*. Retrieved June 27, 2019, from The World Fact Book: <https://www.cia.gov/library/publications/the-world-factbook/geos/pp.html>
- CIA World Factbook. (2018, 01). *Papua New Guinea Maternal Mortality rate*. Retrieved 04 14, 2018, from Index Mundi updated: [www.indexmundi.com/papua\\_new\\_guinea/maternal\\_mortality\\_rate.html](http://www.indexmundi.com/papua_new_guinea/maternal_mortality_rate.html)
- Colenbrander, A. (2002, 04). *Visual Standards, Aspects and ranges of Vision loss with emphasis on population surveys*. Retrieved 04 29, 2018, from International Council of ophthalmology: <http://www.icoph.org/downloads/visualstandardsreport.pdf>
- Collins, G. B., McAllister, M. S., & Adury, K. (2010, August). *Drug Abuse and Addiction*. Retrieved August 22, 2017, from Cleveland clinic Centre for Continuing Education: <http://www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/psychiatry-psychology/drug-abuse-and-addiction/>
- Commonwealth network. (2018). *Gouvernement*. Retrieved November 02, 2018, from Nexus Commonwealth network: [http://www.commonwealthofnations.org/sectors-papua\\_new\\_guinea/government/](http://www.commonwealthofnations.org/sectors-papua_new_guinea/government/)
- Countrymeters. (2019, June 27). *Papua New Guinea Population*. Retrieved June 27, 2019, from Countrymeters: [http://countrymeters.info/en/Papua\\_New\\_Guinea#facts](http://countrymeters.info/en/Papua_New_Guinea#facts)
- Courtright, P. (2012). Childhood cataract in sub-Saharan Africa. *Saudi Journal of Ophthalmology*, 26(1), 3-6.
- Courtright, P., Mathenge, C., Limburg, H., Lewallen, S., Wahab, A., Aghajanian, J., . . . Oye, J. (2009, November). *Using evidence for VISION 2020 "district" planning. Situational analysis*. Retrieved May 10, 2018, from ICEH and

London School of Hygiene and Tropical Medicine:  
<http://iceh.lshtm.ac.uk/files/2014/04/situationanalysis.pdf>

- Cumberland, P. M., Pathai, S., & Rahi, J. S. (2010, November). Prevalence of Eye Disease in Early Childhood and Associated Factors. *Ophthalmology*, 117(11), 2184-2190.
- Dale, N., & Sonksen, P. (2002). Developmental outcome, including setback, in young children with severe visual impairment. *Developmental medicine and child neurology*, 44(9), 613-622.
- Dalia, M. K., Sayed, A. T., & Gehan, A. A. (2017, May 9). Experience of dysmenorrhea among a group of physical therapy students from Cairo University:an exploratory study. *Journal of Pain Research*, 1079-1085.
- Dandona, R., & Dandona, L. (2003). Corneal blindness in a southern Indian population: need for health promotion strategies. *Br J Ophthalmol*, 87(2), 133-141.
- Das, S., Kabir, F., Das, J., Hannan, A. A., Chowdhury, W., Anwa, S. M., & Mothey, R. (2014, January). Pattern of Chemical Ocular Injury: A Clinical Study. *Chattagram Maa-O-Shishu Hospital Medical College Journal*, 13(1).
- Dasgupta, A. (2014, October 14). *Tok Pisin: Papua New Guinean Creole*. Retrieved June 27, 2019, from Cultural trip: <https://theculturetrip.com/pacific/papua-new-guinea/articles/tok-pisin-papua-new-guinean-creole/>
- Dasgupta, S., Mukherjee, R., Ladi, D., Gandhi, V., & Ladi, B. (1990). Pediatric ocular trauma--a clinical presentation. *Journal of post graduate medicine*, 36(1), 20-22.
- Dawodu, O. M. (2011). How to Improve Outcome of Paediatric Cataract Surgery in Nigeria. *Nigerian Journal of Ophthalmology* , 19(1), 1-5.
- Dawson, P., Pradhan, Y., Houston, R., Karki, S., Poude, D., & Hodgins, S. (2008, May). From research to national expansion: 20 years' experience of community-based management of childhood pneumonia in Nepal. 86(5), pp. 339-343.
- Deleepkumar, K. V., Preetha, F., Raju, K. V., & Rini, R. (2018, February). *Clinical Characteristics And Visual Outcome Of Ocular Chemical Injuries*. Retrieved June 29, 2019, from ResearchGate: [https://www.researchgate.net/publication/324086170\\_CLINICAL\\_CHARACTERISTICS\\_AND\\_VISUAL\\_OUTCOME\\_OF\\_OCULAR\\_CHEMICAL\\_INJURIES](https://www.researchgate.net/publication/324086170_CLINICAL_CHARACTERISTICS_AND_VISUAL_OUTCOME_OF_OCULAR_CHEMICAL_INJURIES)

- Demissie, B. S., & Demissie, E. S. (2014, 01). Patterns of Eye Diseases in Children Visiting a Tertiary Teaching Hospital: South-western Ethiopia. *Ethiopian Journal of Health Science*, 24(1), 69-74.
- Dennis, A. (2018, June). Reducing Maternal Mortality in Papua New Guinea: Contextualizing Access to Safe Surgery and Anesthesia. *Obstetric Anesthesia Digest*, 38(2), pp. 97-98.
- Department of Education. (2016). *National Education Plan 2015-2019*. Retrieved 04 14, 2018, from Department of Education: [http://www.education.gov.pg/documents/NEP\\_2015-2019\\_DoE.pdf](http://www.education.gov.pg/documents/NEP_2015-2019_DoE.pdf)
- Department of Health. (2010, June). *Papua New Guinea National health plan 2011-2020*. Retrieved July 06, 2019, from WHO West Pacific Region: [http://www.wpro.who.int/health\\_services/papua\\_new\\_guinea\\_nationalhealthplan.pdf](http://www.wpro.who.int/health_services/papua_new_guinea_nationalhealthplan.pdf)
- Department of Health. (2011). *National Tuberculosis Management Protocol*. Retrieved October 11, 2018, from Australian Doctors International: <http://www.adi.org.au/wp-content/uploads/2016/11/National-Tuberculosis-Management-Protocol-PNG-2011.pdf>
- Department of Health. (2014). *Health Sector Assessment*. Retrieved July 03, 2019, from Asiana Development Bank: <https://www.adb.org/sites/default/files/linked-documents/CAPE-PNG-7-Health-Sector-Assessment.pdf>
- Department of Health of Papua New Guinea. (2005). *National Nutrition Survey Papua New Guinea, 2005*. Retrieved November 02, 2018, from Global Health data Exchange: <http://ghdx.healthdata.org/record/papua-new-guinea-national-nutrition-survey-2005>
- Department of Health Papua New Guinea. (2010, 06). *National Health Plan 2011–2020 Volume 1 Policies and Strategies*. Retrieved 04 14, 2018, from WHO Western Pacific: [http://www.wpro.who.int/countries/png/PNGNHP\\_Part1.pdf](http://www.wpro.who.int/countries/png/PNGNHP_Part1.pdf)
- Department of Health PNG. (2010). *Transforming Health Systems. National Health Plan 2011-2020*. Retrieved December 4, 2016, from WPRO-WHO: [http://www.wpro.who.int/countries/png/PNGNHP\\_Part1.pdf](http://www.wpro.who.int/countries/png/PNGNHP_Part1.pdf)
- Department of National Planning and Monitoring. (2010). *Papua New Guinea Development Strategic Plan 2010-2030*. Retrieved November 01, 2018, from Department of health: Papua New Guinea Development Strategic Plan 2010-2030

- Department of Treasury. (2017). *Mid Year Economic And Fiscal Outlook*. Retrieved June 27, 2019, from [https://www.treasury.gov.pg/html/national\\_budget/files/2013/budget\\_documents/Related%20Budget%20Documents/2017%20Mid%20Year%20Economic%20and%20Fiscal%20Outlook%20Report.pdf](https://www.treasury.gov.pg/html/national_budget/files/2013/budget_documents/Related%20Budget%20Documents/2017%20Mid%20Year%20Economic%20and%20Fiscal%20Outlook%20Report.pdf)
- Dimaras, H., Kimani, K., Dimba, E. A., Gronsdahl, P., White, A., Chan, H. S., & Gallie, B. L. (2012, April 14). Retinoblastoma. *The Lancet*, 349(9824), 1436-46.
- Do, A. T., Krishanmurthy, I., Ramasamy, D., Kalidasan, S., Balakrishnan, V., & Chang, R. T. (2014, December). Effectiveness of low vision services in improving patient quality of life at Aravind Eye Hospital. *Indian Journal of ophthalmology*, 62(12), 1125–1131.
- Earl, S. F. (2003, August 18). C-Reactive Protein Concentration and Cardiovascular Disease Risk Factors in Children Findings From the National Health and Nutrition Examination Survey 1999–2000. *AHA Journal*.
- Eballe, O., Ebana, M., Koki, G., Mounè, N., Teutu, C., Ellong, A., & Bella, A. (2011, September 09). Prevalence and causes of blindness at a tertiary hospital in Douala, Cameroon. *Clinical Ophthalmology*, 2011(5), 1325—1331.
- Engelhard, S., Bajwa, A., & Reddy, A. (2015, April). Causes of uveitis in children without juvenile idiopathic arthritis. *Clinical Ophthalmology*, 9, 1121—1128.
- Eslani, M., Baradaran-Rafii, A., Movahedan, A., & Djalilian, A. R. (2014, July 1). *The Ocular Surface Chemical Burns*. Retrieved Sept 15, 2018, from Hindawi: <http://dx.doi.org/10.1155/2014/196827>
- ESOMAR. (2009). *ESOMAR World Research Codes & Guidelines*. Retrieved December 4, 2016, from Interviewing Children and Young People: [https://www.esomar.org/uploads/public/knowledge-and-standards/codes-and-guidelines/ESOMAR\\_Codes-and-Guidelines\\_Interviewing-Children-and-Young-People.pdf](https://www.esomar.org/uploads/public/knowledge-and-standards/codes-and-guidelines/ESOMAR_Codes-and-Guidelines_Interviewing-Children-and-Young-People.pdf)
- Faal, H. B. (2012). Millennium development goals and eye health. *Indian Journal Of Ophthalmology*, 60(5), 411-415.
- FAO. (2014, June). *Papua New Guinea - Food and Nutrition Security Profiles*. Retrieved October 9, 2018, from Food and Agricultural Organization of the UN: [http://www.fao.org/fileadmin/templates/rap/files/nutrition\\_profiles/DI\\_Profile\\_-\\_Papua\\_New\\_Guinea\\_280714.pdf](http://www.fao.org/fileadmin/templates/rap/files/nutrition_profiles/DI_Profile_-_Papua_New_Guinea_280714.pdf)



- Fierson, W. M. (2018, December). Screening examination of premature infants for retinopathy of prematurity. *Pediatrics*, 142(6), 189-195.
- Fishman, J., Greenberg, P., Bagga, M. B., Casarett, D., & Propert, K. (2017, October 19). Health materials linked to celebrities or religious figures were consistently less likely to be selected than those linked to ordinary patients, or doctors. *American Journal of Health Promotion*, 932-938.
- Fleming, L. (2015, April 1). *A safer start to life – how Village Birth Attendants are saving lives in Papua New Guinea*. Retrieved May 10, 2018, from Relief Web international: <https://reliefweb.int/report/papua-new-guinea/safer-start-life-how-village-birth-attendants-are-saving-lives-papua-new>
- Ford, C. M., Bayer, A. M., Gilman, R. H., Onifade, D., Acosta, C., Cabrera, L., . . . Evans, C. A. (2009, December). Factors Associated with Delayed Tuberculosis Test-seeking Behavior in the Peruvian Amazon. *American Journal of Tropical Medicine and Hygiene*, 81(6), 1097-1102.
- Foster, A., & Klaus, V. (1995, March). Ophthalmia Neonatorum in Developing Countries. *New England Journal of Medicine*, 600-601.
- Garap, J. N., Praveen, N., Sheeladevi, S., Brian, G., Shamanna, B., & Williams, C. (2006). Blindness and vision impairment in the elderly of Papua New Guinea. *Clinical and Experimental Ophthalmology*, 34(4), 335-341.
- Genna, N. M., Cornelius, M. D., & Donovan, J. E. (2009). Risk Factors for Young Adult Substance Use among Women who were Teenage Mothers. *Addictive Behaviours*, 34(5), 463-470.
- Ghadah, S. A.-S., & Abdullah, M. A. (2018, April-June). Management of traumatic corneal abrasion by a sample of practicing ophthalmologists in Saudi Arabia. *Saudi Journal of Ophthalmology*, 32(2), 105-109.
- Ghahramani, M., & Ghahramani, A. (2007). Epidemiologic Study Of Ophthalmia Neonatorum and Impact Of Prophylaxis On Its Incidence. *Acta Medica Iranica*, 45(5), 361-364.
- Gilbert, C. (2001). New Issues in Childhood blindness. *Community Eye Health*, 14(40).
- Gilbert, C. (2008). Retinopathy of prematurity: A global perspective of the epidemics, population of babies at risk and implications for control. *Early Human Development*, 84(2), 77-82. Retrieved June 27, 2019
- Gilbert, C., & Foster, A. (2001). Childhood blindness in the context of VISION 2020. 79, pp. 227–232.

- Gilbert, C., & Muhit, M. (2012). Eye conditions and blindness in children: Priorities for research, programs, and policy with a focus on childhood cataract. *Indian Journal Of Ophthalmology*, 60(5), 451-455. Retrieved June 25, 2019, from Indian Journal of Ophthalmology: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3491274/>
- Gilbert, C., Anderton, L., Dandona, L., & Foster, A. (1999). Prevalence of visual impairment in children: a review of available data. *Ophthalmic epidemiology*, 6(1), 73-82.
- Gilbert, C., Bowman, R., & Malik, N. A. (2018, February 07). The epidemiology of blindness in children: changing priorities. *Community Eye health*, 30, 74-77.
- Gilbert, C., Canovas, M., Hagan, M., Rao, S., & Forster, A. (1993). Causes of childhood blindness: Results from West Africa, South India and Chile. *Eye*, 7(Part1), 184-188.
- Gilbert, C., Minto, H., Morjaria, P., & Khan, I. (2018). *Standard Guidelines for Comprehensive school eye health programme*. Retrieved 04 15, 2018, from IAPB: <https://www.iapb.org/wp-content/uploads/Standard-Guidelines-for-Comprehensive-School-Eye-Health-Programs.compressed.pdf>
- Gilbert, C., Wood, M., Waddel, K., & Foster, A. (1995, June). Causes of childhood blindness in east Africa: results in 491 pupils attending 17 schools for the blind in Malawi, Kenya and Uganda. *Ophthalmic Epidemiology*, 2(2), 77-84.
- Gilbert, Clare; Foster, Allen. (2001). *Childhood blindness in the context of VISION 2020, The Right to Sight*. Retrieved June 27, 2019, from WHO: [https://www.who.int/bulletin/archives/79\(3\)227.pdf](https://www.who.int/bulletin/archives/79(3)227.pdf)
- Global edge team. (2018). *Papua New Guinea: Government*. Retrieved October 8, 2018, from Global edge: <https://globaledge.msu.edu/countries/papua-new-guinea/government>
- Gogate, P., Deshpande, M., Sudrik, S., Taras, S., Kishore, H., & Gilbert, C. (2007, January). Changing pattern of childhood blindness in Maharashtra, India. 91(1), 8-12.
- Gogate, P., Kishore, H., Dole, K., Shetty, J., Gilbert, C., Ranade, S., . . . Deshpande, S. &. (2009, october). The Pattern of Childhood Blindness in Karnataka, South India. *Ophthalmic Epidemiology*, 16(4), 212-217.
- Goodwin, P. Y., Garrett, D. A., & Galal, O. (2005). Women and Family Health: The Role of Mothers in Promoting Family and Child Health. *International Journal of Global Health and Health Disparities*, 4(1).

- Gordois, A., Cutler, H., L, P., Gordon, K., Allan, C., Winyard, S., . . . Chua, K. (2012). An Estimation of the worldwide economic and health burden of Visual Impairment. *Global Public Health*, 7(5), 465-81.
- Gordon, J., Minassian, D. C., Weale, R. A., & West, S. K. (2012). *The Epidemiology of Eye Disease*. World Scientific Publishing Company.
- Government of Papua New Guinea. (2010, June). *National Health Plan 2011–2020*. Retrieved November 2, 2018, from Government of Papua New Guinea: <http://www.health.gov.pg/pages/healthpolicyM.htm>
- Grierson, M. S., Macdonald, I., Prentice, J., Symon, M., & Mikac, S. (2013, April). *Report of the Parliamentary Delegation to Papua New Guinea*. Retrieved October 29, 2018, from <https://www.aph.gov.au/~media/.../PNG%20Delegation%20Report%20FINAL.pdf>
- Griffen, V. (2006, October). *Gender Relations in Pacific cultures and their impact on the growth and development of children*. Retrieved Sept 2018, from UNICEF: [https://www.unicef.org/eapro/Gender\\_Relations\\_in\\_Pacific\\_cultures.pdf](https://www.unicef.org/eapro/Gender_Relations_in_Pacific_cultures.pdf)
- Guillermo, L. C., Ibrahim, Q., Serife, C., Vikas, K., Zhigu, i. M., Kahak, K., . . . David, H. A. (2010, November 11). *Strategies to manage retinoblastoma in developing countries*. Retrieved from Peadiatrics and cancer: <https://onlinelibrary.wiley.com/doi/full/10.1002/pbc.22843>
- Guttmacher Institute. (2017, February). *Contraception and Unintended Pregnancy in Uganda*. Retrieved 03 15, 2018, from Guttmacher Institute: <https://www.guttmacher.org/fact-sheet/contraception-and-unintended-pregnancy-uganda>
- Gwatkin, D., Detels, R., McEwen, J., Beaglehole, R., & Tanaka, H. (2002). *Oxford textbook of public health (4th Edition)*. New York: Oxford University Press.
- Hannah, F., & Clare, G. (2007). Convincing governments to act: VISION 2020 and the Millennium Development Goals. *Community eye Health*, 20(64), 62-64.
- Harrison, A., & Telander, D. G. (2002, 01 01). Eye Injuries in the Young Athlete: A Case-Based Approach. *Peadiatric Annals*, 31(1), 33-40.
- Hartnett, M. E. (2017, May-June). ADVANCES IN UNDERSTANDING AND MANAGEMENT OF RETINOPATHY OF PREMATURITY. *Survey Ophthalmology*, 62, 257-276.

- Hasan, M., Sumrana, Y., Vingfai, C., & Looi, S. (2015, 03 26). *A Global Pathway to Child Eye Health*. Retrieved 03 17, 2018, from Mivision: <https://www.mivision.com.au/a-global-pathway-to-child-eye-health/>
- Hashemi, N., Moghaddasi, H., Asad, F., & Farahi, A. (2018, July-September). Eye Health Information Systems in Selected Countries. *Journal of Ophthalmic and Vision Research*, 13(3), 333-338.
- Helbig, M., Helbig, S., Kahla-Witzsch, H. A., & May, A. (2009, January 31). Quality management: reduction of waiting time and efficiency enhancement in an ENT-university outpatients' departmen. *BMC Health Services Research*, 9(21). Retrieved 04 28, 2018, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2655294/>
- Helka, U., Ilkka, V., Joel, H., & Markku, P. (1988). Self-evaluations of factors promoting and disturbing sleep: An epidemiological survey in Finland. *Social Science and Medicine*, 26(4), 443-450.
- Hess, D. (2004, November). Retrospective studies and chart reviews. *Respiratory care*, 49(10), 1171-1174. Retrieved from Pubmed.
- Hill J, A., Kimani, K., White, A., Barasa, F., Livingstone, M., Gallie, B., & Dimaras, H. (2016, May 26). Achieving optimal cancer outcomes in East Africa through multidisciplinary partnership: a case study of the Kenyan National Retinoblastoma Strategy group. *Global Health*.
- Hornoch, K. T., Cotter, S. A., Borchert, M., McKean-Cowdin, R., Lin, J., Wen, G., . . . Varma, R. (2013, June). Prevalence and Causes of Visual Impairment in Asian and Non-Hispanic White Preschool Children: Multi-Ethnic Pediatric Eye Disease Study. *Ophthalmology*, 120(6), 1220-1226.
- Hoskin, A. K., Philip, S. S., Yardley, A.-M. E., & Mackey, D. A. (2016, November). Eye Injury Prevention for the Pediatric Population. *Asia-Pacific Journal of Ophthalmology*, 5(3), 202-11.
- Hou, X. (2015, May). *Health, Nutrition and Population Global Practice*. Retrieved September 2018, from The World Bank Group: [https://openknowledge.worldbank.org/bitstream/handle/10986/23497/A0sna\\_pshot0of00d0expenditure0survey.pdf;sequence=1](https://openknowledge.worldbank.org/bitstream/handle/10986/23497/A0sna_pshot0of00d0expenditure0survey.pdf;sequence=1)
- Hou, X. (2015). *Stagnant Stunting Rate Despite Rapid Economic Growth in Papua New Guinea—factors Correlated with Malnutrition among Children under Five*. The World Bank.
- Howes, S., Mako, A. A., Swan, A., Walton, G., Webster, T., & Wiltshire, C. (2014). *A lost decade? Service Delivery and Reforms in Papua New Guinea 2002-*

2012. Retrieved May 13, 2018, from Development Policy Centre:  
[http://devpolicy.org/publications/reports/PEPE/PEPE\\_A\\_lost\\_decade\\_FULL\\_REPORT.pdf](http://devpolicy.org/publications/reports/PEPE/PEPE_A_lost_decade_FULL_REPORT.pdf)
- Hu, D. W.-A. (2017). Development of village doctors in China: financial compensation and health system support. *International Journal for Equity in Health*, 16(1), 9.
- Hubble, J., & Gilbert, C. (2006). Eye health promotion and the prevention of blindness in developing countries: critical issues. *British journal Of Ophthalmology*, 90(3), 279-284.
- Huimin, H., Weiling, Z., Yizhuo, W., Dongsheng, H., Jitong, S., Bin, L., . . . Yan, Z. (2018). *Characterization, treatment and prognosis, of retinoblastoma with central nervous system metastasis*. Retrieved October 7, 2018, from BMC Ophthalmology:  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5914066/pdf/12886\\_2018\\_Article\\_772.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5914066/pdf/12886_2018_Article_772.pdf)
- IAPB. (2017, August 1). *The International Agency*. Retrieved 03 18, 2018, from <https://www.iapb.org/sib-news/child-eye-health-project-kenya-brien-holden-vision-institute/>
- IARC Working Group. (2012). (*IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 100E*). Retrieved July 21, 2019, from <https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100E.pdf>
- ICO. (2011). *Childhood blindness*. Retrieved 11 14, 2018, from International Council of Ophthalmology:  
<http://www.icoph.org/dynamic/attachments/resources/childhood-blindness.pdf>
- Ihaji, E., Gerald, E. U., & Ogwuche, E. H. (2014, October). Educational Level, Sex and Church Affiliation on Health Seeking Behaviour among Parishioners in Makurdi Metropolis of Benue State. *Journal of Educational Policy and Entrepreneurial Research (JEPER)*, 1(2), 311-316.
- International committee for the classification of retinopathy of prematurity. (2005, July). The International classification of prematurity revisited. *Archives of ophthalmology*, 123, 991-999.
- Irava, W., Barker, K., Somanathan, A., & Hou, X. (2015). *A snapshot of health equity in Papua New Guinea*. Retrieved October 7, 2018, from World Bank:  
<http://documents.worldbank.org/curated/en/128471467994623285/pdf/99895-WP-PUBLIC-ADD-SERIES-Box393209B-Health-Equity-PNG.pdf>

- Jagat Ram, A. A. (2014, October). The challenge of childhood cataract blindness. *Indian Journal of Medical Research*, 140(4), 472-4.
- James P, W., Petry, N., Tanumihardjo, S. A., Rogers, L. M., & McLean, E. (2017, 02 24). *Vitamin A Supplementation Programs and Country-Level Evidence of Vitamin A Deficiency*. Retrieved 04 24, 2018, from MDPI: [www.mdpi.com/2072-6643/9/3/190/pdf](http://www.mdpi.com/2072-6643/9/3/190/pdf)
- Jefferies, A. L. (2016). Retinopathy of prematurity: An update on screening and management. *Paediatric Child Health*, 21(2), 101-104.
- Jeganathan, V. ., & Verma, N. (2017, January 06). Vitamin A Deficiency and Malnourishment among Young children in Papua New Guinea. *JSM Ophthalmology*, 5(1), 1047.
- Jimba, M., Cometto, G., Yamamoto, T., Shiao, L., Huicho, L., & Sheikh, M. (2010, November). *Health workforce: the critical pathway to universal health coverage*. Retrieved May 05, 2018, from WHO: <http://pacifichalthsummit.org/downloads/UHC/Health%20workforce%20the%20critical%20pathway%20to%20uhc.PDF>
- Johar, S. R., Savalia, N. K., Vasavada, A. R., & Gupta, P. D. (2004, March). Epidemiology based etiological study of paediatric cataracts in Western India. *Indian Journal Of Medical Sciences*, 58(3), 115-21.
- John P Whitcher; M Srinivasan; Madan P Upadhyay. (2001). Corneal blindness: A global perspective. (79), pp. 214-221.
- Joyce Moriku Kaducu. (2016, october 13). <http://health.go.ug/download/file/fid/1116>. Retrieved August 22, 2017, from Ministry of Health Uganda: <https://www.google.com.pg/search?q=reducing+teenage+pregnancy+in+uganda&oq=reducing+teenage+pregnancy+in+uganda&aqs=chrome..69i57.39842j0j8&sourceid=chrome&ie=UTF-8>
- Jugnoo, S. R., & Noriko, C. (2003, October). Severe visual impairment and blindness in children in the UK. *Lancet*, 362(9393), 1359-1365.
- Kane, Eileen. (1995, December). *Seeing for Yourself-Research Handbook for girl's education in Africa*. Retrieved November 02, 2018, from World Bank: <http://documents.worldbank.org/curated/en/687591468766781113/pdf/multi-page.pdf>
- Kao, L.-Y., Su, W.-W., & Lin, Y.-W. (2002, September -October). Retinoblastoma in Taiwan: survival and clinical characteristics 1978–2000. *Japan Journal of Ophthalmol 2002*; 46: 577–80., 46(5), 577-580.

- Karl, B., Gilbert, C., Lindfield, R., & Crook, S. (2012, April). *Eye Health Systems Assessment: How to connect eye care with the general health system*. Retrieved November 16, 2016, from <http://iceh.lshtm.ac.uk/files/2014/03/Eye-health-systems-assessment.pdf>
- Kaur, A., & Agrawal, A. (2005). Paediatric ocular trauma. *CURRENT SCIENCE*, 89(1).
- Kaur, G., Koshy, J., Thomas, S., Kapoor, H., Zachariah, J. G., & Bedi, S. (2016, April 01). Vision Screening of School Children by Teachers as a Community Based Strategy to Address the Challenges of Childhood Blindness. *Journal Of Clinical and Diagnostic Research*, 10(4).
- Khandekar, R. (2008, December). Visual Disabilities in Children Including Childhood Blindness. *Middle East Journal of Ophthalmology*, 15(3-4).
- Khokhar, S. K., Pillay, G., Dhull, C., Agarwal, E., Mahabir, M., & Aggarwal, P. (2017, December). Pediatric cataract. *Indian Journal of ophthalmology*, 65(12), 1340-1349.
- Kinengyere, P., Samuel, K., Wabulembo, G., John Baptist, K., & Anne, A. (2017, September). Burden, etiology and predictors of visual impairment among children attending. *African Health Sciences*, 17(3).
- Kirby, D. (2007). *Emerging Answers 2007: Research Findings on programs to Reduce Teen Pregnancy and Sexually Transmitted Diseases*. Washington DC.
- Knoema team. (2018). *World Data atlas*. Retrieved November 02, 2018, from Knoema.com: <https://knoema.com/atlas/Papua-New-Guinea/Child-mortality-rate>
- Ko, R. (2016). *Pattern of Ocular trauma in madang General hospital -A 20 month retrospective study (April 2013-December 2014)*. Port Moresby: Unpublished.
- Kringelbach, M. L., Stark, E. A., Alexander, C., Bornstein, H. M., & Stein, A. (2016). On Cuteness: Unlocking the Parental Brain and Beyond. *Trends in Cognitive Sciences*, 20(7), 545–558.
- Kvam, M. H. (2005, January). Experiences of Childhood Sexual Abuse among Visually Impaired Adults in Norway: Prevalence and Characteristics. *Journal of Visual Impairment & Blindness*, 99(1), 1-24.
- Lance, D., & Len, K. (2002, January 01). The History of Fitness. *IDEA Health Fitness Source*.

- Lange, S., & Vollmer, S. (2017, January 17). The effect of economic development on population health: a review of the empirical evidence. *British Medical Bulletin*, 121(1), pp. 47-60.
- Leander, C., Fu, L. C., Peña, A., Howard, S. C., Rodriguez-Galindo, C., Judith, A. W., . . . Barrett, H. (2007, Nov). Impact of an education program on late diagnosis of retinoblastoma in Honduras. *Pediatric Blood and Cancer*, 49(6), 817-819.
- Lee, L., Burnett, A., Wabulembo, G., Garap, J., & Keys, D. (2019, May). Rapid assessment of avoidable blindness in Papua New Guinea: a nationwide survey. *British Journal of Ophthalmology*, 103, 338-342. Retrieved November 02, 2018, from Pubmed: <https://www.ncbi.nlm.nih.gov/pubmed/29793925>
- Lenhart, P. D., Courtright, P., Wilson, M. E., Taylor, D. S., Lewallen, S., Ventura, M. C., . . . Tehara, B. (2015, April). Global Challenges in the Management of Congenital Cataract. Proceedings of the International Congenital Cataract Symposium held on March 7, 2014 in New York City, New York. *J.AAPOS*, e1- e8.
- Lewallen, S., & Courtright, P. (1995). Peripheral corneal ulcers associated with use of African traditional eye medicines. *British Journal of Ophthalmology*, 79, 343-346.
- Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J. E., . . . Black, R. E. (2015, January 31). Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. *The Lancet*, 385(9966), 430-440.
- Lloyd I C, A. J. (2007, Oct). Advances in the Management of Congenital and infantile cataract. *Eye*, 21(10), 1301-9.
- Loaiza, E., & Liang, M. (2013). *Adolescent Pregnancy: A review of the evidence*. New York: UNFPA.
- Macintyre, M. (2019, April). *Catastrophic failures in PNG health service delivery*. Retrieved June 28, 2019, from Devpolicy Blog: <http://www.devpolicy.org/catastrophic-failures-in-png-health-service-delivery-20190404/>
- Mahdi, Z., Munami, S., Shaikh, Z. A., Awan, H., & Wahab, S. (2005, July). Pattern of Eye Diseases in Children at Secondary Level Eye Department in Karachi. *Pakistan Journal of ophthalmology*, 22(3).



- Makaka, A., Breen, S., & Binagwaho, A. (2012). Universal health coverage in Rwanda: a report of innovations to increase enrolment in community-based health insurance. *The Lancet*, *S7*, 380.
- Malik, N. A., Mafwiri, M., & Gilbert, C. (2018). Integrating primary eye care into global child health policies. *Archives of Disease in Childhood*, *103*(2), 176-180.
- Mangot, M., Wabulembo, G., Barnabas, R., & Gamini, V. (2019, July). Retinopathy of Prematurity at Port Moresby General Hospital. Not Published.
- Manisha, U., & Anuradha, L. (2019, May). Effect of High Frequency Transcutaneous Electrical Nerve Stimulation on Dermatomal Site Menstrual Pain among Adolescent Girls with Primary Dysmenorrhea. *International Journal of Health Sciences and Research*, *9*(5).
- Mannan, A., Sadeka, C. M., & Shahidulla, M. (2014). Retinopathy of Prematurity (ROP): Current Understanding and Management. *Bangladesh Journal of Child Health*, *38*(3), 142-150.
- Manning, L., Laman, M., Rosanas-Urgell, A., Michon, P., Aipit, S., Bona, C., . . . Davis, T. M. (2012, 12 13). *Severe Anemia in Papua New Guinean Children from a Malaria-Endemic Area: A Case-Control Etiologic Study*. Retrieved 03 13, 2018, from PLoS Neglected Tropical Disease: <http://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0001972>
- Manuel, W. H., Hector, M., Nandao, T., Céline, B., Justin, P., Leo, M., . . . Ivo, M. (2015, October 1). Prevalence of malaria across Papua New Guinea after initial roll-out of insecticide-treated mosquito nets. *A European Journal Of Tropical Medicine and International Health*, *20*(12), 1745-1755. Retrieved May 13, 2018
- Masterson, A. (2019, February). *Polio returns to Papua New Guinea*. Retrieved June 27, 2019, from Cosmos -The Science of everything: <https://cosmosmagazine.com/society/polio-returns-to-papua-new-guinea-1>
- Mbadugha, C., & Patel, D. (2012). Perceptions of Child Caregivers About Factors Influencing Childhood Corneal Blindness in a Rural Community in Southern Nigeria. *Nigerian Journal of Ophthalmology 2012*, *20*(1), 7-13.
- Medsinge, A., & Nischa, K. K. (2015, January). Pediatric cataract: challenges and future directions. *Clinical Ophthalmology*, *9*, 77-90.
- Mehari, Z. A., & Yimer, A. W. (2013, January). Prevalence of refractive errors among schoolchildren in rural central Ethiopia. *Clinical and experimental Optometry*, *96*(1), pp. 65-69.

- Millington, K. A., & Bhardwaj, M. (2017, May 24). *Evidence and experience of procurement in health sector decentralisation*. Retrieved May 04, 2018, from K4D Knowledge Evidence and learning for development: <https://assets.publishing.service.gov.uk/media/59845568e5274a1707000065/108-Evidence-and-experiences-of-other-countries-health-procurement.pdf>
- Mills, Anne; Rasheed, Fawzia; Tollman, Stephen. (2016). Strengthening Health Systems. In D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, . . . P. Musgrove (Eds.), *Disease Control Priorities in Developing Countries* (2 ed., pp. 87-102). New York: Oxford University. Retrieved from WHO.
- Ministry of Education and Sports (MoES). (2013). *Ministry of Education and Sports (MoES) National Strategy for Girls' Education (NSGE) in Uganda 2015-2019*. Retrieved 03 15, 2018, from Uganda -United Nations Girls' Education Initiative: [https://www.google.com.pg/search?q=•+National+strategy+for+girls+education+\(NSGE&oq=•+National+strategy+for+girls+education+\(NSGE&aqs=chrome..69i57.1615j0j7&sourceid=chrome&ie=UTF-8](https://www.google.com.pg/search?q=•+National+strategy+for+girls+education+(NSGE&oq=•+National+strategy+for+girls+education+(NSGE&aqs=chrome..69i57.1615j0j7&sourceid=chrome&ie=UTF-8)
- Ministry of Education and Sports Uganda. (2015). *Education for All 2015 National Review*. Kampala: Ministry of Education and sports.
- Mishra, D., Gulati, M., Bhushan, P., Mohan, N., & Sinha, P. (2017). Prospective Clinical Study to Find out Epidemiology of Xerophthalmia in Children in a Tertiary Care Centre in India. *International Journal of Clinical and Experimental Ophthalmology*, 1, 66-70.
- Mola, G., & Kirby, B. (2013). Discrepancies between national maternal mortality data and international estimates: the experience of Papua New Guinea. *Reproductive Health Matters*, 21(42), 191-202.
- Moody's Analytic Economic Indicators. (2018). *Papua New Guinea - Economic Indicators*. Retrieved 03 13, 2018, from Moody's Analytic Economic Indicators: <https://www.economy.com/papua-new-guinea/indicators#ECONOMY>
- Morone, P., Camacho, C., Kocur, I., & Banatvala, N. (2012). *Investing in eye health:securing the support of decision-makers*. Retrieved October 7, 2018, from Experiences in securing support of decision makers for eye health: <http://www.who.int/blindness/Politicalanalysis.pdf>
- Mothiba, T. M., & Maputle, M. S. (2012, July 11). Factors contributing to teenage pregnancy in the Capricorn district of the Limpopo Province. *Journal of the democratic Nursing organisation of South Africa*, 35(1).

- Muhit, M. A. (2004). Childhood Cataract: Home to Hospital. *Community Eye Health*, 17(50), 19–22.
- Muhwezi, D. K. (2003). *Gender sensitive educational policy and practice, a Uganda case study*. Retrieved 03 15, 2018, from UNESCO:  
<http://unesdoc.unesco.org/images/0014/001467/146783e.pdf>
- Müller, I., Bockarie, M., Alpers, M., & Smith, T. (2003). The epidemiology of malaria in Papua New Guinea. *Trends in Parasitology*, 19(6), 253-259.
- Mwende, J., Bronsard, A., Mosha, M., Bowman, R., & Geneau, R. (2005). Delay in Presentation for Surgery for Congenital and Developmental Cataract in Tanzania. *British Journal of Ophthalmology*, 89(11), 1478-82.
- Naidoo, K. S., & Jaggernath, J. (2012, September 04). Uncorrected refractive errors. *Community Ophthalmology*, 60(5), 432-437.
- Naidoo, K. S., Jaggernath, J., Øverland, L., & Ramson, P. (2014, July). Poverty and Eye health. *Health*, 6(14), 1849-1860.
- Naipait, R. (2012, 02 15). *Marijuana and homebrew use alarming in PNG*. Retrieved from Radio Australia:  
<http://www.radioaustralia.net.au/international/radio/onairhighlights/marijuana-and-homebrew-use-alarming-in-png>
- Nallasamy, S., Anninger, W. V., Quinn, G. E., Kroener, B., Zetola, N. M., & Nkomazana, O. (2011, 10). *Botswana-UPenn Scholarly Publications*. Retrieved 04 11, 2018, from  
[https://repository.upenn.edu/cgi/viewcontent.cgi?referer=https://www.google.com.pg/&httpsredir=1&article=1035&context=botswana\\_schol](https://repository.upenn.edu/cgi/viewcontent.cgi?referer=https://www.google.com.pg/&httpsredir=1&article=1035&context=botswana_schol)
- National Broadcasting Corporation. (2015). *NBC radio*. Retrieved October 29, 2018, from NBC PNG: <https://www.nbcpng.com/nbc-radio>
- National Department of Health. (2012). *Papua New Guinea Health Service Delivery Profile, 2012*. Retrieved October 7, 2018, from WHO-Western Pacific Region:  
[http://www.wpro.who.int/health\\_services/service\\_delivery\\_profile\\_papua\\_new\\_guinea.pdf](http://www.wpro.who.int/health_services/service_delivery_profile_papua_new_guinea.pdf)
- National Department of health. (2013). *Health Sector Human Resource Policy*. Retrieved March 13, 2018, from  
[http://www.health.gov.pg/publications/HRH%20fP\\_IG\\_2014.pdf](http://www.health.gov.pg/publications/HRH%20fP_IG_2014.pdf)
- National Department of Health. (2016). *Papua New Guinea Nutritional policy 2016-2026*. Retrieved October 9, 2018, from Department of health.

- National Departments. (2016). *Papua New Guinea, National Nutritional Policy, 2016-2026*. Retrieved September 16, 2018, from National Department of Health: [http://www.health.gov.pg/publications/PM-SNNP\\_2018.pdf](http://www.health.gov.pg/publications/PM-SNNP_2018.pdf)
- National Executive Council. (2009, December). *Achieving Universal Education for a Better Future Universal Basic Education Plan 2010 - 2019*. Retrieved November 02, 2018, from Global Partnership for education: <https://www.globalpartnership.org/content/papua-new-guinea-universal-basic-education-plan-2010-2019>
- National Statistical office. (2006). *2006 Demographic and Health Survey*. Port Moresby: National Statistical Office.
- National Statistical office. (2006). *Papua New Guinea Demographic and Health Survey*. Retrieved November 02, 2018, from National Statistics Office: <https://www.nso.gov.pg/index.php/projects/demographic-health-survey/48-dhs>
- National Statistical Office. (2011). *Papua New Guinea 2011 National Report*. Port Moresby: National statistical office Port Moresby.
- National Statistical office. (2017, Septemeber). *Papua New Guinea Household income and Expenditure Survey 2009-2010*. Retrieved Novemeeber 02, 2018, from ILO Microdata Repository: <http://www.ilo.org/surveydata/index.php/catalog/1617>
- Niekerk, L. v., Chater, R., Naydenova, E., Lim, J., Chamas, L., Manderson, L., . . . Bonnici, F. (2017). *Social innovation in health case studies and lessons learned from low- and middle-income countries*. Retrieved April 15, 2018, from <http://apps.who.int/iris/bitstream/handle/10665/259187/9789241513098-LR-eng.pdf;jsessionid=082D52CFEF78FB3A22B9EAADA8396E22?sequence=5>
- Ninsiima, R. (2013, 01 15). Beware of drugs; they can ruin your life. *The Observer*. Retrieved from <https://observer.ug/lifestyle/health/23144-beware-of-drugs-they-can-ruin-your-life>
- Nitin, N., Verma, A., Singh, K., & Virendra, M. (2014, Apr-Jun). Management of Paradoxical Response in Pediatric Tubercular Meningitis with Methylprednisolone. *Middle East Africa journal of Ophthalmology*, 21(2).
- Njuguna, M., Msukwa, G., Shilio, B., Tumwesigye, C., Courtright, P., & Lewallen, S. (2009). Causes of severe visual impairment and blindness in children in

- schools for the blind in eastern Africa: changes in the last 14 years. *Ophthalmic Epidemiology*, 16(3), 151-155.
- Ntsoane, & Oduntan. (2010, 11 17). A review of factors influencing the utilization of eye care services. *The South African Optometrist*, 69(4).
- Nursing Ethics*. (2003). Retrieved march 09, 2019, from Medical Dictionary: <https://medical-dictionary.thefreedictionary.com/nursing+ethics>
- Nyamori, J., Kimani, K., Njuguna, M., & Dimaras, H. (2012, Jan). The incidence and distribution of retinoblastoma in Kenya. *Br J Ophthalmol.*, 96(1), 141-3.
- O'Keefe, D., Davis, J., Yakuna, G., Gemert, C. V., & Morgan, C. (2011, Sept-Dec). Formal and informal maternal health care: comparing the service provision of health facilities and village health volunteers in East Sepik Province. *PNG medical Journal*, 54(3-4), 147-153.
- OHCHR-UNOG. (2016, May 6). *Papua New Guinea: Children's Rights References In The Universal Periodic Review*. Retrieved Sept 5, 2018, from Child Rights International Network ( CRIN): <https://www.crin.org/en/library/publications/papua-new-guinea-childrens-rights-references-universal-periodic-review>
- Okoth, C. (2016). Uganda loses sh37b due to adolescent pregnancies. *New Vision*.
- Okoth, C. (2016). *Uganda loses sh37b due to adolescent pregnancies*. Retrieved from [https://www.newvision.co.ug/new\\_vision/news/1437583/delay-pregnancy-rugunda-tells-teen-girls](https://www.newvision.co.ug/new_vision/news/1437583/delay-pregnancy-rugunda-tells-teen-girls)
- Omobolanle, A. A., & Henrietta, N. (2012, December 13). *Pattern of paediatric corneal laceration injuries in the University of port Harcourt teaching hospital, Rivers state, Nigeria*. Retrieved Novemembr 01, 2018, from BMC Res Notes: <https://www.ncbi.nlm.nih.gov/pubmed/23234255>
- Osborne, D., Harden, R., & Hoy, C. (2017, December 6). *Economic Analysis of Papua New Guinea*. Retrieved November 02, 2018, from Lowy Institute: <http:interactives.lowyinstitute.org/publications/PNGin2017/png-in-2017-economics.html>
- P, G., M, D., S, S., S, T., H, K., & C., G. (2007, January). Changing pattern of childhood blindness in Maharashtra, India. *The British Journal of Ophthalmology*, 91(1), 8-12.
- Pacific Media Assistance Scheme. (2013). *Papua New Guinea State of Media and Communication support*. Retrieved November 01, 2018, from [https://www.google.com.pg/search?q=Papua+New+Guinea+State+of+Media+and+Communication+support&rlz=1C1GCEU\\_enPG820PG820&oq=Pap](https://www.google.com.pg/search?q=Papua+New+Guinea+State+of+Media+and+Communication+support&rlz=1C1GCEU_enPG820PG820&oq=Pap)

ua+New+Guinea+State+of+Media+and+Communication+support&aqs=chrome..69i57.1270j0j7&sourceid=chrome&ie=UTF-8

- Padma, B. P., Kuzhupally, V. R., & Minu, P. (2016). Visual Impairment Among Subject With Medically Refractive Corneal Diseases. *Baby Memmorial Hospital Medical Journal*, 3(3), 61-66.
- Pameh, W., Ripa, P., Vince, J., & Mueller, I. (2002, October). Adoption and hospital admission in Port Moresby, Papua New Guinea. *Journal of Tropical Peadiatrics*, 48(5), 264-9.
- Papua New Guinea Department of Education. (2016). *National Education Plan 2015-2019*. Retrieved Novemeber 02, 2018, from Papua New Guinea Department of Education:  
[https://www.education.gov.pg/documents/NEP\\_2015-2019\\_DoE.pdf](https://www.education.gov.pg/documents/NEP_2015-2019_DoE.pdf)
- Patel, D. (2015). Preventing eye injuries. *Community Eye health*, 28(91), 51.
- Patel, D., Tajunisah, I., Gilbert, C., & Subrayan, V. (2011, April). Childhood blindness and severe visual impairment in Malaysia: a nationwide study. *Eye(London)*, 25(5), 436-442.
- Payne, K., & Stein, D. (2013, December 30). *Retrospective chart review studies: an old dog with some new tricks?* Retrieved May 06, 2018, from PharmaPhorum: <https://pharmaphorum.com/views-and-analysis/retrospective-chart-review-studies-an-old-dog-with-some-new-tricks/>
- PD, J. S. (2004). *Epidemiology based etiological study of pediatric cataract in western India*. Indian Journal Of Medical Sciences.
- Pearson, M. (2002). *Allocating public resources for health developing pro-poor approaches*. Retrieved May 04, 2018, from DFID Health Systems Resource Centre:  
[https://assets.publishing.service.gov.uk/media/57a9d719e5274a0f6c000042/19\\_Allocating-public-resources-for-health.pdf](https://assets.publishing.service.gov.uk/media/57a9d719e5274a0f6c000042/19_Allocating-public-resources-for-health.pdf)
- Pena, C. R., Jorge, P. A., & Kara-Junior, N. (2015). Intraocular lenses and clinical treatment in paediatric cataract. *Rev Bras Oftalmol*. 2015; 74 (3): 189-93, 73(3), 189-93.
- Pillay, D., Ghazali, J. R., Manaf, N., Abdullah, A. H., Bakar, A., Salikin, F., . . . Ismai, I. (2011). Hospital waiting time: the forgotten premise of healthcare service delivery? *International Journal of health care quality assurance*, 24(7), 506-22.

- PNG Insight. (2016). *MDG 2: Insight On Universal Primary Education (UPE) Completion In Papua New Guinea*. Retrieved October 8, 2018, from PNG Insight: <https://png-maths.blogspot.com/2016/07/mdg-2-insight-on-universal-primary.html>
- PNG legislation. (2014, July 10). *Independent State of Papua New Guinea Constitution*. Retrieved April 14, 2018, from UNESCO: <http://www.unesco.org/education/edurights/media/docs/600e78096209b63b86f0135f52694b257b4b0c0e.pdf>
- Polis, C. B., Lutalo, T., Wawer, M., Serwadda, D., Kigozi, G., Nalugoda, F., . . . Gray, R. (2009, February). Coerced sexual debut and lifetime abortion attempts among women in Rakai, Uganda. *International Journal of Gynecology and Obstetrics*, *104*(2), 105-109.
- Pollaers, K., Kujan, O., Johnson, N. W., & Farah Camile, S. (2017, July). Oral and oropharyngeal cancer in Oceania: Incidence, mortality, trends and gaps in public databases as presented to the Global Oral Cancer Forum. *Translational Research in Oral Oncology*, *2*, 1-8.
- Pons, J. (2012). Improving patient flow through an eye clinic. *Community Eye Health Journal*, *25*(78), 31-33.
- Population of.Net. (2018, August). *Papua New Guinea population 8524465 (live)*. Retrieved November 2018, from Population of.Net: <https://www.populationof.net/papua-new-guinea/>
- Praveen, K. N., Sheeladevi, S., Tamilselvi, V., Victor, A. C., Vijayalakshmi, & Rahamthullah, L. (2004). Perceptions of Eye Diseases and Eye Care Needs of Children among Parents in Rural South India: The Kariapatti Pediatric Eye Evaluation Project (KEEP). *Community Eye Care*, *52*(2), 163-167.
- Prevention of blindness Committee PNG. (2013, September). National Eye Plan 2013 -2016.
- Prideaux, M., & Beg, A. A. (2008). Exploring Leadership Issues in Papua New Guinea. *Gading Business and Management Journal*, *12*(1), 1-21.
- Pryke, J., & Barke, P. (2017, December 6). *Lowy Institute*. Retrieved 03 13, 2018, from <http://interactives.lowyinstitute.org/publications/PNGin2017/png-in-2017-society-a-bumpy-road-societal-trends-in-papua-new-guinea.html>
- Pryke, J., & Barker, P. (2017, 12 06). *A Bumpy Road: Societal Trends In Papua New Guinea*. Retrieved from Lowy Institute: <http://interactives.lowyinstitute.org/publications/PNGin2017/png-in-2017-society-a-bumpy-road-societal-trends-in-papua-new-guinea.html>

- Qamruddin, M. (2017, 01 04). Assessment of Ocular Conditions among Pediatric Patients. *International Journal of Contemporary Medical Research*, 4(1).
- Quinn, E. G. (2016, May 19). Retinopathy of prematurity blindness worldwide: phenotypes in the third epidemic. *Eye and Brain*, 8, 31-36.
- Quinn, G. E., & Mangot, M. (2016, May 19). Retinopathy of prematurity blindness worldwide: phenotypes in the third epidemic. *Eye Brain*, 8, 31-36.
- Rabindran, & Gedam, D. (2016). Childhood Blindness: Causes & Prevention. *Tropical Journal of Ophthalmology and Otolaryngology*, 1(1). Retrieved 03 20, 2018, from Tropical Journal of Ophthalmology and Otolaryngology: <http://medresearch.in/index.php/JOOO/article/view/1039/1852>
- Rahi S, J., & Dezateux, C. (1999). National cross sectional study of detection of congenital and infantile cataract in the United Kingdom: role of childhood screening and surveillance. The British Congenital Cataract Interest Group. *British Medical Journal*, 1999(318), 362-365.
- Ramai, D., Ryan, E., Shoshana, G., & Tejas, P. (2015). A cross-sectional study of pediatric eye care perceptions in Ghana, Honduras, and India. *Journal of Epidemiology and Global Health*, 5(2), 133-42.
- RANZCO AND UPNG. (2017). UPNG Ophthalmology Curriculum 2017. *Unpublished*. Port Moresby, NCD, Papua New Guinea.
- Rapoport, I., Romem, M., Kinek, M., Koval, R., Teller, J., Belkin, M., . . . Savir, H. (1990). Eye Injuries in Children in Israel -A Nationwide Collaborative Study. *Archives of Ophthalmology*, 108(3), 376-379.
- Riddell, A. (2003). *The introduction of free primary education in sub-Saharan Africa*. Retrieved 03 15, 2018, from UNESCO: <http://unesdoc.unesco.org/images/0014/001469/146914e.pdf>
- Robert, K., Colin, M., David, P., Wabulembo, G., Oliver, S., Drew, K., . . . Anthony W, S. (2016). Population-Based Trachoma Mapping in Six Evaluation Units of Papua New Guinea. *Ophthalmic Epidemiology*, 22-31.
- Roberts, M. J. (2002, October). *Getting Health Reform Right*. Retrieved July 14, 2019, from [http://www.jointlearningnetwork.org/uploads/files/resources/Getting\\_Health\\_Reform\\_Right.pdf](http://www.jointlearningnetwork.org/uploads/files/resources/Getting_Health_Reform_Right.pdf)
- Roberts, M., Hsiao, W., Berman, P., & Reich, M. (2003). *Getting health reform right: a guide to improving performance and equity*. Oxford university press.



- Royal family. (2015, June). *Papua New Guinea*. Retrieved June 27, 2019, from Royal UK: <https://www.royal.uk/papua-new-guinea>
- Rudan, I., Pate, S., Waters, D., Kerri, W., Campbel, I., Sridhar, D., . . . Young, M. (2016). *Integrated Management of Childhood Illness (IMCI) in the 21st Century; A Review of the Scientific and Programmatic Evidence*. Retrieved June 25, 2019, from UNICEF: [https://www.unicef.org/health/files/UNICEF\\_Review\\_of\\_Evidence\\_Working\\_Paper\\_1\\_FINAL\\_11Oct2016.pdf](https://www.unicef.org/health/files/UNICEF_Review_of_Evidence_Working_Paper_1_FINAL_11Oct2016.pdf)
- Rutaremwya, G. (2013). Factors Associated with Adolescent Pregnancy and Fertility in Uganda: Analysis of 2011 Demographic and Health Survey Data. *Americal Journal of Sociological Research*, 3(2), 30-35.
- Sadia, S., Mohammad, J. S., Ibrar, H., & Tajamul, K. (2008). Refractive errors in children attending out-patient department of ophthalmology, khyber teaching hospital, peshawar. *Pakistan Armed Forces Medical Journal*, 58(4).
- Sahai, M. (2017). Challenges and response to the practices in paediatric referral based on a Case Study from C.G.H.S. Dispensaries in Jaipur, Rajasthan. *The Journal of Community Health Management*, 4(1), 11-17.
- Schilling, J. (2006). On the Pragmatics of Qualitative Assessment Designing the Process for Content Analysis. *European Journal of Psychological Assessment*, 22(1), 28-37. Retrieved from WOMPT.com: <http://www.wompt.com.au/lecturing/materials/schilling2006.pdf>
- Schrage, F. N., Langefeld, S., Zschocke, J., Kuckelkorn, R., Redbrake, C., & Reim, M. (2000, October 6). Eye burns: an emergency and continuing problem. *Burns*, 26(8), pp. 689-699.
- Sharp, T. L. (2016, January 6). *Trade's Value: Relational Transactions in the Papua New Guinea Betel Nut Trade*. Retrieved April 7, 2018, from Wiley Online Library: <https://onlinelibrary.wiley.com/doi/pdf/10.1002/ocea.5116>
- Sharvanan, E. U., Kruthika, K., & Prasad, V. D. (2016, August). Menstrual hygiene practices among adolescent girls residing in tribal and social welfare hostel in Andhra Pradesh: a community based study. *National Journal of Community Medicine*, 7(8), 681-685.
- Sheeladevi, S., Lawrenson, G. J., Fielder A, R., & Suttle, C. M. (2016, September). Global prevalence of childhood cataract: a systematic review. *Eye*, 30(9), 1160–1169.

- Shunmuga, M. s., Sekar, M., & Subburaj, A. (2014, December). Women Empowerment: Role of Education. *International Journal in Management and Social Science*, 2(12), 76-85.
- Siegel, R. S., & Brandon, A. R. (2014, June). Adolescents, Pregnancy, and Mental Health. *Journal Pediatric and Adolescent Gynaecology*, 27(3), pp. 138-150.
- Silveria, S. (2007, May 10). *Peadiatric Ocular Injury, A review of literature*. Retrieved march 27, 2018, from State Wide Ophthalmology Service: [https://www.aci.health.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0016/155023/paediatric\\_ocular\\_injury.pdf](https://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0016/155023/paediatric_ocular_injury.pdf)
- Singh, P., Tyagi, M., Kumar, Y., Gupta, K., & Sharma, P. (2013, May-Aug). Ocular chemical injuries and their management. *Oman journal Of ophthalmology*, 6(2), 83-86.
- Sinha, M. K., Garg, R. K., Anuradha, H. k., Agarwal, A., Singh, M. K., Verma, R., & Shukla, R. (2010, March 15). Vision impairment in tuberculous meningitis: Predictors and prognosis. *Journal of the neurological sciences*, 290(1-2), 27-32.
- Smith, P. C., Mossialos, E., & Papanicolas, I. (2008, June). *Performance measurement for health system improvement:experiences, challenges and prospects*. Retrieved April 07, 2018, from WHO: <http://www.who.int/management/district/performance/PerformanceMeasurementHealthSystemImprovement2.pdf>
- Solomon, S. M., Prince, A. K., Jennifer, A. G., Adrian, S. A., Nana, A. G.-D., Joseph, A.-A., & Daniel, L. (2017). Ocular Conditions Presented to the Eastern Regional Hospital, Ghana: A Retrospective Study. *BAOJ Ophthalmol*, 1(3), 2-7.
- Sommer, A., Taylor, H. R., Thulasiraj, D. R., West, S., Thomas, M. L., Keenan, J. D., . . . Mills, R. P. (2014, May). Challenges of Ophthalmic Care in the Developing World. *JAMA Ophthalmol.*, 132(5), 640-644.
- Soylu, M., Demircan, N., Yalaz, M., & Işigüzel, I. (1998, 03). Etiology of pediatric perforating eye injuries in southern Turkey. *Ophthalmic Epidemiology*, 5(1), 7-12.
- Staff reporter. (2018, September 16). *90 percent of PNG population have access to Mobile Phone services*. Retrieved Sept 16, 2018, from Pngfacts.com: <http://news.pngfacts.com/2017/02/90-percent-of-png-population-have.html>
- StataCorp LP. (2011). *Stata Data-Management Reference Manual Release 12*. Retrieved Novemebr 02, 2018, from Academia Edu:

www.academia.edu/6274331/STATA\_DATA-MANAGEMENT\_REFERENCE\_MANUAL\_RELEASE\_12\_A\_Stata\_Press\_Publication\_StataCorp\_LP\_College\_Station\_Texas

- Stella Neema, N. M. (2004). *Adolescent Sexual and Reproductive Health in Uganda: A Synthesis of Research Evidence*. Retrieved May 23, 2017, from [www.guttmacher.org](http://www.guttmacher.org).
- Stuart, A. (2014). Current ROP Therapies: How Laser and Anti-VEGF Compare. *Eye net Magazine*, 38-43.
- Suelles, M. A., & Shulman, P. J. (2016, May 20). Current screening and treatments in retinopathy of prematurity in the US. *Eye and Brain*(8), 37-43.
- Sun, J., Li, Q., Zhao, P., Zhang, Q., Xu, K., Chen, H., . . . Liu, Y. (2017, 08 22). *Reducing waiting time and raising outpatient satisfaction in a Chinese public tertiary general hospital-an interrupted time series study*. Retrieved 04 28, 2018, from BMC Public Health.: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5568260/#CR4>
- Swanson, C. R., Atun, R., Allan, B., Arvind, B., Campos, F. d., Chunharas, S., . . . Damme, V. . (2015, February 12). Strengthening health systems in low-income countries by enhancing organizational capacities and improving institutions. *Globalization and Health*, 11(5).
- Swanson, D. (2014, 01 31). *Papua New Guinea's battle over betel nut*. Retrieved April 07, 2018, from IRIN: <http://www.irinnews.org/report/99563/papua-new-guinea%E2%80%99s-battle-over-betel-nut>
- Taylor, S. (2009, September 1). Wealth, health and equity: convergence to divergence in late 20th century globalization. *British Medical Bulletin*, 29–48.
- Temming, P., Lohmann, D., Bornfeld, N., Sauerwein, W., Goericke, S. L., & Eggert, A. (2012). *Current Concepts for Diagnosis and Treatment of Retinoblastoma in Germany: Aiming for Safe Tumor Control and Vision Preservation*. Retrieved 10 7, 2018, from Thieme Clinical Pediatrics: [https://eref.thieme.de/ejournals/1439-3824\\_2012\\_06#/10.1055-s-0032-1327563](https://eref.thieme.de/ejournals/1439-3824_2012_06#/10.1055-s-0032-1327563)
- Temple, V. J., Kaira, C., Vince, J. D., Kevau, I. H., & Willie, N. (2011). Vitamin A status of pre-school-age children aged 6 to 59 months in the National Capital District, Papua New Guinea. *Papua New Guinea Medical Journal*, 54(1-2), 4-16.
- The American Academy Of Pediatrics. (2008, December). *American academy of peadiatrics ophthalmology section*. Retrieved April 07, 2018, from American

Academy of Pediatrics News and Journals:

[http://pediatrics.aappublications.org/content/122/6/1401?ijkey=3f95b5ca9301ad8ea3f0fd23db543f42e5aa6315&keytype2=tf\\_ipsecsha](http://pediatrics.aappublications.org/content/122/6/1401?ijkey=3f95b5ca9301ad8ea3f0fd23db543f42e5aa6315&keytype2=tf_ipsecsha)

- The Commonwealth. (2017, May). *A Sustainable Approach to Control Avoidable Blindness and Vision Loss*. Retrieved 03 23, 2018, from <http://thecommonwealth.org/sites/default/files/events/documents/PolicyBrief-ASustainableApproachControlAvoidableBlindnessVisionLoss.pdf>
- The Economist intelligence unit. (2014, February 1). *Papua New Guinea*. Retrieved November 02, 2018, from Economic Intelligence Unit: <http://country.eiu.com/article.aspx?articleid=1901474574&Country=Papua%20New%20Guinea&topic=Summary&subtopic=Political+structure>
- The Heritage Foundation. (2018). *2018 Index of Economic Freedom*. Retrieved November 02, 2018, from [https://www.heritage.org/index/pdf/2018/book/index\\_2018.pdf](https://www.heritage.org/index/pdf/2018/book/index_2018.pdf)
- The World Bank. (2019). *GDP per capita (current US\$) 1960-2018*. Retrieved July 14, 2019, from <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=RW>
- The World Bank Group. (2007a). *Healthy Development, The World Bank Strategy for HNP Results Annex L—April 24, 2007*. Retrieved November 01, 2018, from World Bank: <http://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/281627-1154048816360/AnnexLHNPStrategyWhatisaHealthSystemApril242007.pdf>
- The World Bank Group. (2016, May 12). *Papua New Guinea: Reading for a Better Future*. Retrieved November 06, 2018, from The World Bank: <http://www.worldbank.org/en/results/2016/05/12/papua-new-guinea-reading-for-a-better-future>
- The World Bank Group. (2017, December). *Papua New Guinea Economic update - Reinforcing Resilience December 2017*. Retrieved November 02, 2018, from World Bank: <http://pubdocs.worldbank.org/en/150591512370709162/PNG-Economic-Update-Dec-2017.pdf>
- The World Bank Group. (2017). *The World Bank in Papua New Guinea*. Retrieved 03 10, 2018, from <http://www.worldbank.org/en/country/png/overview>
- The World Bank Group. (2018). *Mortality rate, under-5 (per 1000 live births)*. Retrieved May 13, 2018, from World Bank Data: <https://data.worldbank.org/indicator/SH.DYN.MORT>

- The World Bank Group. (2019, April). *Overview*. Retrieved June 27, 2019, from The World Bank In Papua New Guinea: <https://www.worldbank.org/en/country/png/overview>
- Thylefors, B. (1992). Epidemiological patterns of ocular trauma. *Australian and New Zealand Journal of Ophthalmology*, 20(2), 95-98.
- Tomkins, O., Ben-Zion, I., Moore, D. B., & Helveston, E. E. (2011, October). Outcomes of Pediatric Cataract Surgery at a Tertiary Care Center in Rural Southern Ethiopia. *Archives of ophthalmology*, 129(10), 1293-1297.
- Trading Economics. (2015). *Uganda - Population, ages 13-19, female*. Retrieved may 23, 2017, from <http://www.tradingeconomics.com/uganda/population-ages-13-19-female-wb-data.html>.
- Trading Economics. (2018, August). *Papua New Guinea GDP Annual Growth Rate 1995-2018*. Retrieved November 02, 2018, from Trading Economics: <https://tradingeconomics.com/papua-new-guinea/gdp-growth-annual>
- TSO, I. F., NG, S. M., & CHAN, C. L. (2006, July 19). The development and validation of the Concise outpatient department user satisfaction scale. *International Journal for Quality in Health Care*, 18, 275-280.
- (2017). *Uganda Demographic and Health Survey 2016 Key Indicators Report*. Kampala: Uganda Bureau of Statistics Kampala, Uganda: UBOS, and Rockville, Maryland, USA: UBOS and ICF.
- (March 2017 ). *Uganda Demographic and Health Survey 2016 Key Indicators Report*. Kampala, Uganda: UBOS, and Rockville, Maryland, USA: Uganda Bureau of Statistics.
- Ugarte, M. (2015, 06 19). Waiting time reduction in intravitreal clinics by optimization of appointment scheduling: balancing demand and supply. *BMJ Quality improvements reports*, 4(1).
- UN. (2004, January). *Map Of papua New Guinea*. Retrieved from UN peace keeping mission: <http://www.un.org/Depts/Cartographic/map/profile/papua.pdf>
- UN Inter-agency. (2018). *Levels & Trends in Child Mortality*. Retrieved June 27, 2019, from UNICEF: <https://data.unicef.org/wp-content/uploads/2018/10/Child-Mortality-Report-2018.pdf>
- UNDP. (2016). *Sustainable Development Goals*. Retrieved December 4, 2016, from <http://www.undp.org/content/undp/en/home/sustainable-development-goals.html>

- UNESCO. (2011). *Education Counts*. Retrieved November 02, 2018, from Foresight for development: <http://www.foresightfordevelopment.org/sobipro/55/244-education-counts-towards-the-millennium-development-goals>
- UNFPA. (2013). *Motherhood in childhood-Facing the challenges of adolescent pregnancy*. New York: UNFPA.
- UNICEF. (2013, December 27). *At a glance: Papua New Guinea Statistics*. Retrieved 03 13, 2018, from [https://www.unicef.org/infobycountry/papuang\\_statistics.html](https://www.unicef.org/infobycountry/papuang_statistics.html)
- UNICEF. (2017). *Education*. Retrieved from Papua New Guinea UNICEF: [https://www.unicef.org/png/activities\\_4369.html](https://www.unicef.org/png/activities_4369.html)
- UNICEF. (2017, March 21). *Inclusive Education in Papua New Guinea*. Retrieved June 30, 2019, from UNICEF: <https://www.unicef.org/png/stories/heard-first-time-inclusive-education-papua-new-guinea>
- UNICEF. (2018, June). *UNICEF helps to bring immunization services communities*. Retrieved July 03, 2019, from UNICEF Papua New Guinea: <https://www.unicef.org/png/stories/unicef-helps-bring-immunization-services-communities>
- United Nations. (2018). *About the Sustainable Development Goals*. Retrieved October 8, 2018, from Sustainable Development Goals: <https://www.un.org/sustainabledevelopment/>
- Vajpayee, R. B., Shekhar, H., Sharma, N., & Jhanji, V. (2014, January). Demographic and Clinical Profile of Ocular Chemical Injuries in the Pediatric Age Group. *Ophthalmology*, 121(1), pp. 377-380.
- van Boven, M., & van Lier, A. (2016, October). Global trends in vaccination coverage. *Lancet*, 4(10).
- Van Olmen, J., Marchal, B., Van Damme, W., Kegels, G., & Hill, P. S. (2012). Health systems frameworks in their political context: framing divergent agendas. *BMC Public Health*, 12(1), 774.
- Verma, N., Verma, A., Jacob, G., & Demok, S. (1997, May). Profile of ocular trauma in Papua New Guinea. *Clinical and Experimental ophthalmology*, 25(2), 151-155.
- Vision 2020. (2010, March). *VISION 2020 e resource for eye care management worldwide Vol 6 No 3*. Retrieved 04 15, 2018, from <http://v2020eresource.org/home/newsletter/news032010#5>

- VISION 2020. (2018). *American academy of ophthalmology*. Retrieved 04 13, 2018, from <https://www.aaopt.org/vision-2020>
- VISION 2020 and IAPB. (2007). *A Global Overview of Blindness, Childhood and VISION 2020 The Right to Sight*. Retrieved Sept 13, 2018, from Vision UK: [https://www.visionuk.org.uk/download/archive\\_1/pdf/WSD07%20Report.pdf](https://www.visionuk.org.uk/download/archive_1/pdf/WSD07%20Report.pdf)
- Wabulembo, G. (2013). Pediatric ophthalmology care – A reflection on current status in Uganda. *Journal of Ophthalmology of Eastern Central and Southern Africa*, 3-5.
- Wabulembo, G. (2018, November). Reducing vision impairment in children through health system assessment and strengthening approach in Papua New Guinea. Port Moresby, Papua New Guinea.
- Wabulembo, G., & Demer, J. (2012, September). Long-Term Outcome of Medial Rectus Recession and Pulley Posterior Fixation in Esotropia With High AC/A Ratio. *Strabismus*, 115-120.
- Waddel, K. (1998). Childhood Blindness and Low Vision in Uganda. *Eye*, 12, 184-192.
- Welsh, E. (2002, May). Dealing with Data: Using NVivo in the Qualitative Data Analysis Process. *Forum:Forum For Qualitative Research*, 3. Copyright (c) 2002 Elaine Welsh .
- Whitcher, P. J., Srinivasan, M., & Upadhyay, M. P. (2001). *Corneal blindness: a global perspective*. Retrieved June 26, 2019, from WHO: [https://www.who.int/bulletin/archives/79\(3\)214.pdf](https://www.who.int/bulletin/archives/79(3)214.pdf)
- WHO . (2019). *Papua New Guinea Polio Outbreak Response 2018*. (W. R. Manilla, Producer) Retrieved June 27, 2019, from WHO: <https://www.who.int/papuanewguinea/news/detail/25-03-2019-papua-new-guinea-polio-outbreak-response-report-for-2018-published>
- WHO. (1978). *Declaration of Alma-Ata -International Conference on Primary Health Care, Alma-Ata, USSR, 6-12 September 1978*. Retrieved July 14, 2019, from [https://www.who.int/publications/almaata\\_declaration\\_en.pdf](https://www.who.int/publications/almaata_declaration_en.pdf)
- WHO. (1995). *Global Prevalence of Vitamin A Deficiency(1993) Micronutrient Deficiency Information System Working paper No2*. Retrieved June 27, 2019, from [https://apps.who.int/iris/bitstream/handle/10665/69060/WHO\\_NUT\\_95.3\\_eng.pdf;jsessionid=C875936DEDDC32436F7CCDDC612BD600?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/69060/WHO_NUT_95.3_eng.pdf;jsessionid=C875936DEDDC32436F7CCDDC612BD600?sequence=1)
- WHO. (1999, May). *WHO Guidelines for Epidemic Preparedness and Response to Measles Outbreaks*. Retrieved June 26, 2019, from World Health

Organization-Communicable Disease Surveillance and Response:  
[https://apps.who.int/iris/bitstream/handle/10665/66034/WHO\\_CDS\\_CSR\\_ISR\\_99.1.pdf;jsessionid=872204AD7662F05DA0752CC72C82B224?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/66034/WHO_CDS_CSR_ISR_99.1.pdf;jsessionid=872204AD7662F05DA0752CC72C82B224?sequence=1)

- WHO. (2000). *The World Report :Health Systems:Improving Performance* . Geneva.
- WHO. (2006, May 26). *WHO Childhood blindness form May 26 2006*. Retrieved May 12, 2018, from Community eye health Journal:  
<https://www.cehjournal.org/wp-content/uploads/who-childhood-blindness/WHO-childhood-blindness-form-May-26-2006.pdf>
- WHO. (2007). *Everybody business : strengthening health systems to improve health outcomes : WHO's framework*. Retrieved November 01, 2018, from WHO Geneva:  
[http://apps.who.int/iris/bitstream/handle/10665/43918/9789241596077\\_eng.pdf?sequence=1&isAllowed=y](http://apps.who.int/iris/bitstream/handle/10665/43918/9789241596077_eng.pdf?sequence=1&isAllowed=y)
- WHO. (2007a). *Everybody's business - Strengthening health systems to improve health outcomes*. (Geneva, Switzerland) Retrieved June 25, 2019, from World Health Organization:  
[https://www.who.int/healthsystems/strategy/everybodys\\_business.pdf](https://www.who.int/healthsystems/strategy/everybodys_business.pdf)
- WHO. (2007b). *Global Initiative for the Elimination of Avoidable Blindness : action plan 2006-2011*. Retrieved September 12, 2018, from WHO:  
[http://www.who.int/blindness/Vision2020\\_report.pdf](http://www.who.int/blindness/Vision2020_report.pdf)
- WHO. (2012, November 20). *Combating Tuberculosis in Children*. Retrieved November 02, 2018, from WHO Stop TB Partnership:  
<http://www.who.int/tb/childhoodtbfactsheet.pdf>
- WHO. (2013). *World Statistics 2013*. Retrieved 05 01, 2018, from WHO:  
[http://www.who.int/gho/publications/world\\_health\\_statistics/EN\\_WHS2013\\_Full.pdf](http://www.who.int/gho/publications/world_health_statistics/EN_WHS2013_Full.pdf)
- WHO. (2013a). *Universal Eye health, A global action plan 2014-2019*. Retrieved April 14, 2018, from WHO:  
[http://www.who.int/blindness/AP2014\\_19\\_English.pdf](http://www.who.int/blindness/AP2014_19_English.pdf)
- WHO. (2013a). *Universal Eye Health-A global action plan 2014-2019*. Retrieved June 25, 2019, from [https://www.who.int/blindness/AP2014\\_19\\_English.pdf](https://www.who.int/blindness/AP2014_19_English.pdf)
- WHO. (2014). *Adolescent pregnancy Fact Sheet*. (W. M. Centre, Producer) Retrieved August 20th, 2017, from WHO Adolescent Pregnancy:  
<http://www.who.int/mediacentre/factsheets/fs364/en/>



- WHO. (2014). *Visual Impairment Fact Sheet*. Retrieved November 01, 2018, from <http://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment>
- WHO. (2015). *Eye care service Assessment Tool*. Retrieved 04 07, 2018, from [http://www.who.int/blindness/publications/ECSAT\\_EN.pdf?ua=1](http://www.who.int/blindness/publications/ECSAT_EN.pdf?ua=1)
- WHO. (2015). *PAPUA NEW GUINEA (PNG) Eye care Assessment Report*. WHO.
- WHO. (2015). *Prevention of Blindness and Visual Impairment*. Retrieved April 07, 2018, from [http://www.who.int/blindness/publications/ECSAT\\_EN.pdf?ua=1](http://www.who.int/blindness/publications/ECSAT_EN.pdf?ua=1)
- WHO. (2015). *Reversing a global health workforce crisis*. . Retrieved July 14, 2019, from WHO global Work Force Alliance: [https://www.who.int/workforcealliance/media/news/2015/reversing\\_crisis/en](https://www.who.int/workforcealliance/media/news/2015/reversing_crisis/en)
- WHO. (2016, April Undated). *Mental health: strengthening our response*.
- WHO. (2016). *WHO Extranet Report Papua New Guinea*. Retrieved 03 13, 2018, from [https://extranet.who.int/sree/Reports?op=Replet&name=/WHO\\_HQ\\_Reports/G2/PROD/EXT/TBCountryProfile&ISO2=PG&outtype=html](https://extranet.who.int/sree/Reports?op=Replet&name=/WHO_HQ_Reports/G2/PROD/EXT/TBCountryProfile&ISO2=PG&outtype=html)
- WHO. (2017, May). *Country Cooperation Strategy*. Retrieved October 28, 2018, from World Health Organization: [http://apps.who.int/iris/bitstream/handle/10665/136819/ccsbrief\\_png\\_en.pdf;jsessionid=39E31243ED53A4EC8C47A178B05C2379?sequence=1](http://apps.who.int/iris/bitstream/handle/10665/136819/ccsbrief_png_en.pdf;jsessionid=39E31243ED53A4EC8C47A178B05C2379?sequence=1)
- WHO. (2017, April 11). *Despite overwhelming challenges, Papua New Guinea has made major strides against malaria*. Retrieved Novemebr 02, 2018, from WHO: <http://www.who.int/en/news-room/feature-stories/detail/despite-overwhelming-challenges-papua-new-guinea-has-made-major-strides-against-malaria>
- WHO. (2018). *Health Services Development*. Retrieved 04 14, 2018, from WHO, Western Pacific Region: [http://www.wpro.who.int/health\\_services/health\\_systems\\_framework/en/](http://www.wpro.who.int/health_services/health_systems_framework/en/)
- WHO. (2018). *Maternal Health Fact Sheet*. Retrieved September 10, 2018, from WHO representative office Papua New Guinea: [http://www.wpro.who.int/papuanewguinea/areas/maternal\\_health/maternal\\_health\\_factsheet\\_papuanewguinea/en/](http://www.wpro.who.int/papuanewguinea/areas/maternal_health/maternal_health_factsheet_papuanewguinea/en/)
- WHO. (2018). *Nutrition-Micronutrient deficiencies*. Retrieved October 29, 2018, from WHO nutrition topics: <http://www.who.int/nutrition/topics/vad/en/>

- WHO. (2018). *Prevention of Blindness and Visual Impairment*. Retrieved 04 14, 2018, from WHO:  
<http://www.who.int/blindness/causes/priority/en/index3.html>
- WHO. (2018a, June). *Papua New Guinea confirms poliovirus outbreak, launches response*. Retrieved June 27, 2019, from WHO Western Pacific Region:  
<http://www.wpro.who.int/papuanewguinea/mediacentre/releases/20180725/en/>
- WHO. (2018b). *Key facts*. Retrieved 03 20, 2018, from WHPRO:  
<http://www.wpro.who.int/papuanewguinea/areas/epi/fact-sheet-immunization-papua/en/>
- WHO. (2018c). *Prevention of Blindness and Visual Impairment*. Retrieved 10 7, 2018, from WHO: <http://www.who.int/blindness/partnerships/vision2020/en/>
- WHO. (2019a). *Blindness and vision impairment prevention-Priority eye diseases*. Retrieved June 25, 2019, from World Health Organization:  
<https://www.who.int/blindness/causes/priority/en/index3.htm>
- WHO and the National Department of Health, Papua New Guinea. (2012). *Health Service Delivery Profile Papua New Guinea 2012*. Retrieved November 02, 2018, from WPRO-WHO:  
[http://www.wpro.who.int/health\\_services/service\\_delivery\\_profile\\_papua\\_new\\_guinea.pdf](http://www.wpro.who.int/health_services/service_delivery_profile_papua_new_guinea.pdf)
- WHO and the National Department of Health, Papua New Guinea. (2012). *Health Service Delivery Profile-Papua New Guinea 2012*. Retrieved November 02, 2018, from WPRO-WHO:  
[http://www.wpro.who.int/health\\_services/service\\_delivery\\_profile\\_papua\\_new\\_guinea.pdf](http://www.wpro.who.int/health_services/service_delivery_profile_papua_new_guinea.pdf)
- WHO and UNICEF. (2018). *Papua New Guinea: WHO and UNICEF estimates of immunization coverage: 2017 revision*. Retrieved September 10, 2018, from UNICEF: [https://data.unicef.org/wp-content/uploads/country\\_profiles/Papua%20New%20Guinea/wuenic2017rev-ctry-reports/immunization\\_2018\\_png.pdf](https://data.unicef.org/wp-content/uploads/country_profiles/Papua%20New%20Guinea/wuenic2017rev-ctry-reports/immunization_2018_png.pdf)
- WHO Media Centre. (2015, December). (WHO, Producer, & WHO) Retrieved December 4, 2016, from  
<http://www.who.int/mediacentre/factsheets/fs395/en/>
- WHO, IAPB, VISION2020. (2007). *Global Initiative For The Elimination Of Avoidable Blindness, Action Plan 2006–2011*. Retrieved June 26, 2019, from [http://www.who.int/blindness/Vision2020\\_report.pdf](http://www.who.int/blindness/Vision2020_report.pdf)

- WHO/UNICEF. (2012, June). *WHO/UNICEF JOINT STATEMENT: Integrated Community Case Management(iCCM)An equity-focused strategy to improve access to essential treatment services for children*. Retrieved November 16, 2018, from WHO:  
[http://www.who.int/maternal\\_child\\_adolescent/documents/statement\\_child\\_services\\_access\\_whounicef.pdf](http://www.who.int/maternal_child_adolescent/documents/statement_child_services_access_whounicef.pdf)
- WHO-International agency for Research on cancer. (2012). *IARC Monographs on the evaluation of carcinogenic risks to humans*. Retrieved Sept 11, 2018, from WHO International Agency for research on cancer:  
<https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100E-10.pdf>
- William, E. G. (2014). *Children's Eye Foundation*. Retrieved 04 11, 2018, from  
[http://www.childrenseyefoundation.org/S/wp-content/uploads/2014/06/economic\\_impact\\_of\\_blindness\\_1-7-1.pdf](http://www.childrenseyefoundation.org/S/wp-content/uploads/2014/06/economic_impact_of_blindness_1-7-1.pdf)
- Williams, C. J. (2014). Maternal deaths and their impact on children in Papua New Guinea. *Australian and New Zealand Journal of Public Health* , 38(5).
- Wilson, M. E., Pandey, S. K., & Thakur, J. (2003a, January). Paediatric cataract blindness in the developing world: surgical techniques and intraocular lenses in the new millennium. *British Journal of Ophthalmology*, 87(1), 14-19.
- Wittenborn, J. S., Xinzhi, Z., Charles, W. F., Wesley, L. C., Sundar, S., Alex, R. K., . . . Jinan, B. S. (2013, September). The Economic Burden of Vision Loss and Eye Disorders among the United States Population Younger than 40 Years. *Ophthalmology*, 120(9), 1728–1735.
- (2012). *World Economic Situation and Prospects 2012*. United Nations Organization.  
[http://www.un.org/en/development/desa/policy/wesp/wesp\\_current/2012country\\_class.pdf](http://www.un.org/en/development/desa/policy/wesp/wesp_current/2012country_class.pdf).
- (2015). *World Fertility Patterns 2015*. United Nations.
- Wu, X., Long, E., Lin, H., & Liu, Y. (2016, June). *Prevalence and epidemiological characteristics of congenital cataract: a systematic review and meta-analysis*. Retrieved November 01, 2018, from Scientific Reports:  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4917826/pdf/srep28564.pdf>
- Xu, S., & Hu, D. (2017, Sep 1). Barefoot doctors and the “health care revolution” in rural China: a study centered on Shandong Province. *Endeavour*, 41(3), 136-45.

- Yasmin, S., Minto, H., & Chan, V. F. (2015). School eye health – going beyond refractive errors. *Community Eye Health*, 28(89), 14-15.
- Yin, S. (2017, April). Chemical and Common Burns in Children. *Clinical Pediatrics*, 56(55), pp. 8S - 12S.
- Yorston, D. (2001). Intraocular lens implants in children. *Community Eye health Journal*, 14 (40).
- Zerihun, N., & Mabey, D. (1997, March). Blindness and low vision in Jimma Zone, Ethiopia: results of a population-based survey. *Ophthalmic Epidemiology*, 4(1), 19-26.

## APPENDIX 1 CONSENT FORM FOR SERVICE BENEFICIARIES

Participant number \_\_\_\_\_ Hospital \_\_\_\_\_

You have been invited to participate in a research study conducted by \_\_\_\_\_ which will take place from \_\_\_\_\_ to \_\_\_\_\_.

The purpose of the study is to:

To generate comprehensive information on paediatric eye care needs at the two hospitals in order to formulate a paediatric eye health strategy to reduce visual impairment among children through health system assessment and strengthening.

The benefit of the research will be to gain a better understanding of what is working well in the delivery of eye care to children and what needs to be improved.

Among the methods to achieve the above will be conducting a one on one interview.

Our discussion will be recorded on an audio tape.

You are free to ask me questions during the discussion and after the discussion.

The interview is voluntary and you can withdraw from it at any time.

The information gathered will be used to write a report which will be read by my supervisors and presented as a PhD thesis to the University of Kwa Zulu Natal South Africa. Your identity will remain concealed.

I \_\_\_\_\_ having understood the terms of this consent form agree to participate in the study.

\_\_\_\_\_ Date

Signature

**APPENDIX II CONSENT FORM FOR SERVICE PROVIDERS**

Participant number \_\_\_\_\_ Hospital \_\_\_\_\_

You have been invited to participate in a research study conducted by \_\_\_\_\_ which will take place from \_\_\_\_\_ to \_\_\_\_\_.

The purpose of the study is to:

To generate comprehensive information on paediatric eye care needs at the two hospitals in order to formulate a paediatric eye health strategy to reduce visual impairment among children through health system assessment and strengthening.

The benefit of the research will be to gain a better understanding of what is working well in the delivery of eye care to children and what needs to be improved.

Among the methods to achieve the above will be conducting a one on one interview.

Our discussion will be recorded on an audio tape.

The data obtained will not be used to evaluate your performance.

You are free to ask me questions during the discussion and after the discussion.

The interview is voluntary and you can withdraw from it at any time.

The information gathered will be used to write a report which will be read by my supervisors and presented as a PhD thesis to the University of Kwa Zulu Natal South Africa. Your identity will remain concealed.

I \_\_\_\_\_ having understood the terms of this consent form agree to participate in the study.

\_\_\_\_\_ Date

Signature

## APPENDIX III INTERVIEW GUIDE QUESTIONNAIRE

Service Provider

GENERAL		
Date:	<input type="text"/> - <input type="text"/> - <input type="text"/>	Hospital
Contact No.		Province of origin
DEMOGRAPHICS		
1.	Officers identification number	
2	Title	
3	Qualification	
4	Age in years	<input type="text"/> <input type="text"/> <input type="text"/>
5	Gender	<input type="checkbox"/> Male <span style="margin-left: 150px;"><input type="checkbox"/> Female</span>
	Opening general remarks about eye services at the hospital	How would a child with an eye problem gain access to eye services at this hospital
	<b>HUMAN RESOURCE</b>	<p>6. What is the composition of the HR for Eye Health at your Hospital? Check list:</p> <p style="margin-left: 40px;">1.1 Paediatric Ophthalmologist?</p> <p style="margin-left: 40px;">1.2 General Ophthalmologist?</p> <p style="margin-left: 40px;">1.3 Paediatric Anaesthesiologist?</p> <p style="margin-left: 40px;">1.4 Orthoptists?</p> <p style="margin-left: 40px;">1.5 Low Vision Therapist?</p> <p style="margin-left: 40px;">1.6 Optometrist?</p> <p style="margin-left: 40px;">1.7 Optical Technician?</p>

		1.8 Social Worker?
		6. B How is children with disabilities identified in the hospital linked with any of the organizations for persons with disability? 6.B.2 When children are referred to other organization is there any feedback system for you to know what happened to them
	LEADERSHIP IN PEDIATRIC EYE HEALTH	6. C.1 Who is in charge of planning for paediatric eye health at your institution?  6. C.2 How is the follow up of children with eye problems organized.  6. C.3. How are eye health educational materials obtained?  6.C.4. Who is responsible for procuring and dissemination of educational materials for eye health
SER VICE DELI VER Y	SERVICE DELIVERY	7. Which of these eye services do you offer at your Institution? 7.1 outpatient eye consultations 7.2 Refraction 7.3 Low vision assessment 7.4 Dispensing spectacles 7.3 paediatric cataract surgery 7.3 Paediatric strabismus surgery 7.4 Adult cataract surgery 7.5 Corneal graft 7.6 Chemotherapy 7.7 Radiotherapy



	REPORTING	<p>8. What is the bed capacity of the hospital?</p> <p>8.1 How is the allocation of beds determined?</p> <p>9. Which personnel are responsible for paediatric eye care?</p> <p>10. Which activities does the hospital conduct in the community?</p> <p>10.1 Who does the screening?</p> <p>11. What collaboration is there with the private sector in eye care</p> <p>12. What costs are there to paediatric eye patient in order to obtain eye services?</p> <p>13. If glasses were prescribed how do patients access them?</p> <p>14. Please describe how the reporting system on patients served is executed.</p> <p>15. Are there any specific personnel responsible for analysing the data?</p> <p>16. Do you get some feedback on the data that has been analysed?</p>
	HOSPITAL BUDGET	<p>17. Are you aware as to how the budget of hospital determined? Please provide information for this process.</p>

		<p>18. What role does the patient data collected have during the budgeting process?</p> <p>19. What is the composition of the budget committee?</p> <p>20. How do individual departments get to know what has been included in the budget for them</p> <p>21. How is the budget implemented</p>
	<p><b>SUPPLIES</b></p>	<p>22. Please describe the procurement process</p> <p>23. How does the eye unit interact with the supplies department</p> <p>24. Please let me know if any of the following items are on your procurement list</p> <p>10/0 Nylon <input type="checkbox"/></p> <p>10/0 Vicryl <input type="checkbox"/></p> <p>Intraocular lenses <input type="checkbox"/></p> <p>Viscoelastic materials <input type="checkbox"/></p> <p>Artificial eyes <input type="checkbox"/></p> <p>Patches(eye) <input type="checkbox"/></p>
	<p><b>POLICIES &amp; GUIDELINES</b></p>	<p>25. What policy documents and treatment guidelines are available at the hospital</p> <p>25.1 How do health workers access them for reference?</p> <p>26. What would you consider to be a common eye problem among children</p> <p>26.1 Is there any child with severe visual impairment you know about</p> <p>26.2 Please mention some difficulties such a child faces in accessing the necessary help</p>

Thank You!!

## APPENDIX IV SERVICE USER INTERVIEW QUESTIONNAIRE GUIDE

No.....

GENERAL			
Date:	<input type="text" value=""/> - <input type="text" value=""/> - <input type="text" value=""/>	Hospital	
Contact No.		Province of origin	
DEMOGRAPHICS			
1.	Attendants identification number		
2.	Age in years	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>	
3.	Gender	<input type="checkbox"/> Male <span style="margin-left: 150px;"><input type="checkbox"/> Female</span>	
5.	Which mode of transport did you use	6. What do you do for a living	
7.	How did you choose to come to this particular hospital	8. Prior to coming how long did your child have this problem	9. Please tell me a bit more about the child 9.1. Ages in years <input type="text" value=""/> <input type="text" value=""/> 9.2. Gender <input type="checkbox"/> Male <input type="checkbox"/> Female
10	Please describe your experience in getting a service at this eye clinic	11. Do you know of some children with eye problems among your relatives or in your neighbourhood? 11.1 Do you know if they have sought any medical help 11.2 If they have not what do you think might be the	

		reason or reasons
--	--	-------------------

12.

12.1 have you ever seen any poster that gives some information about eye health?

12.2 Does the hospital closest to your home provide some eye services to the community?

12.3 Do you have difficulty getting permission from your spouse to be away from home as you attend to the child's eye problem?

12.4 Did you have to wait a few days before coming because there was no money immediately available?

12.5 At what level did you finish when you attended school

Thank you

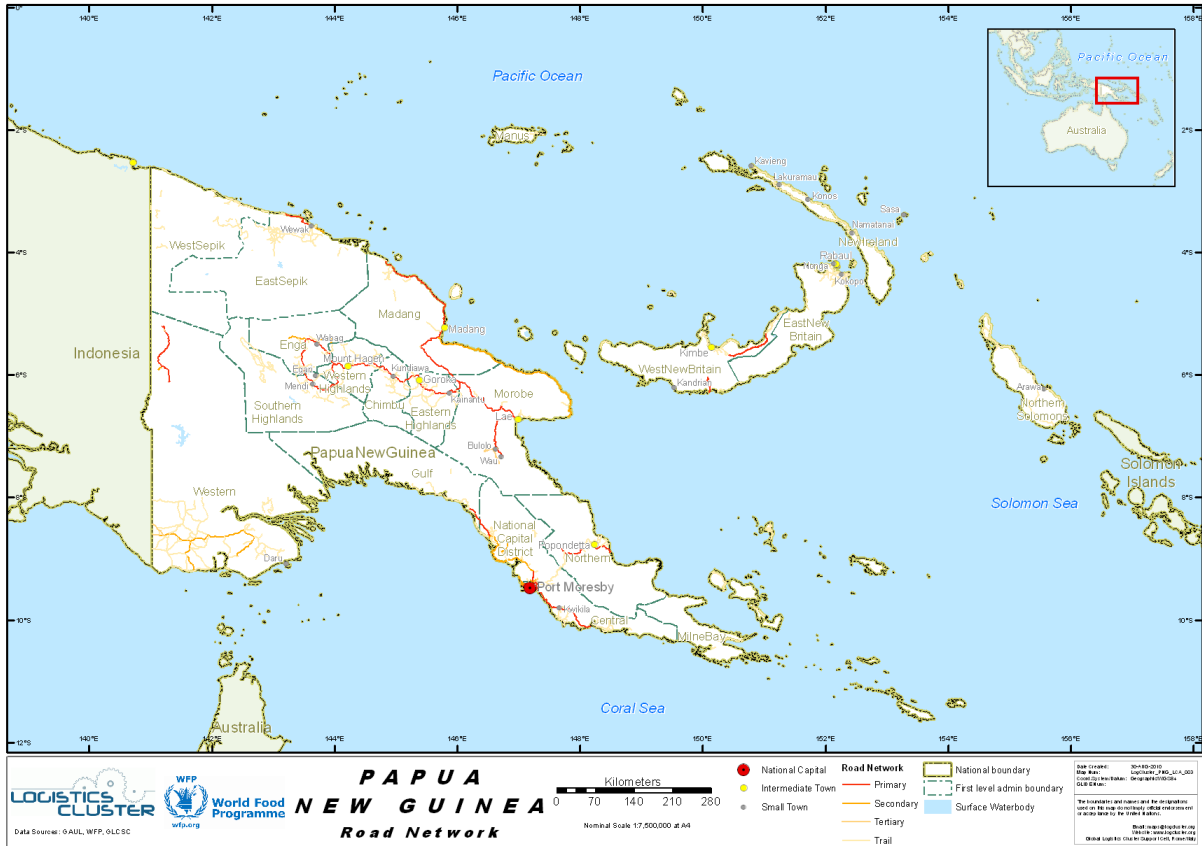
## APPENDIX V PROVINCES OF PAPUA NEW GUINEA



Source:

[https://www.google.com.pg/search?q=Maps+of+the+provinces+of+papua+new+guinea&source=Inms&tbm=isch&sa=X&ved=0ahUKewjZgt6DiZjdAhVHBIqKHUgKBmIQ\\_AUICigB&biw=1280&bih=583#imgrc=gmzqLOExsXw5DM](https://www.google.com.pg/search?q=Maps+of+the+provinces+of+papua+new+guinea&source=Inms&tbm=isch&sa=X&ved=0ahUKewjZgt6DiZjdAhVHBIqKHUgKBmIQ_AUICigB&biw=1280&bih=583#imgrc=gmzqLOExsXw5DM)

## APPENDIX VI ROAD NETWORK IN PAPUA NEW GUINEA



### SOURCE

[https://www.google.com.pg/imgres?imgurl=https://dlca.logcluster.org/download/attachments/853847/logcluster\\_PNG\\_LCA\\_003\\_20100830.png?version%3D1%26modificationDate%3D1381245884000%26api%3Dv2&imgrefurl=http://dlca.logcluster.org/display/DLCA/2.3%2BPapua%2BNew%2BGuinea%2BRoad%2BAssessment&=1241&w=1755&tbnid=MZDOYX3doEMjbM:&q=ROAD+NETWORK+IN+PAPUA+NEW+GUINEA&tbnh=149&tbnw=211&usq=AFrqEzc4BOs7ZHT2hRWUamKVi9\\_CKSWxaw&vet=12ahUKEwjfo9ic5LndAhWLGXwKHbCUD\\_wQ9QEwAHoECAcQBg.i&docid=EaBoBIIIjh50sM&sa=X&ved=2ahUKEwjfo9ic5LndAhWLGXwKHbCUD\\_wQ9QEwAHoECAcQBg](https://www.google.com.pg/imgres?imgurl=https://dlca.logcluster.org/download/attachments/853847/logcluster_PNG_LCA_003_20100830.png?version%3D1%26modificationDate%3D1381245884000%26api%3Dv2&imgrefurl=http://dlca.logcluster.org/display/DLCA/2.3%2BPapua%2BNew%2BGuinea%2BRoad%2BAssessment&=1241&w=1755&tbnid=MZDOYX3doEMjbM:&q=ROAD+NETWORK+IN+PAPUA+NEW+GUINEA&tbnh=149&tbnw=211&usq=AFrqEzc4BOs7ZHT2hRWUamKVi9_CKSWxaw&vet=12ahUKEwjfo9ic5LndAhWLGXwKHbCUD_wQ9QEwAHoECAcQBg.i&docid=EaBoBIIIjh50sM&sa=X&ved=2ahUKEwjfo9ic5LndAhWLGXwKHbCUD_wQ9QEwAHoECAcQBg)

**APPENDIX VII DISTANCE BETWEEN PORT MORESBY AND GOROKA 425KM**



Source

<https://www.google.com.pg/search?q=distance+from+Port+Moresby+to+goroka&aq=chrome..69i57j0l2j69i60j0l2.12138j0j8&sourceid=chrome&ie=UTF-8>

## APPENDIX VIII DEBATE ON BETEL NUT

### Health issue forces government to regulate betel nut, says PM

THE chewing, selling and buying of betel nuts are becoming a real concern for the country, says Prime Minister Peter O'Neill.

O'Neill yesterday tabled in Parliament the Summary Offences (Amendment) Bill 2018 which detailed penalties for those who chew betel nut in public places.

He said under the amendment, offenders would be fined an amount not exceeding K10,000 and/or a jail term not exceeding three years.

"Again it gives a lot of felicity to the magistrates and judges to enforce this," O'Neill said.

He said betel-nut chewing was becoming a major health issue.

He, however, pointed out that "we don't want to infringe on the rights of individuals and traditional practices where people can continue to chew betel nut in a responsible way".

"Sometimes chewing has gone beyond the boundaries of culture and tradition. It has now become a very serious health problem for our country," O'Neill said.

He said according to the World Health Organisation, PNG was among countries with the highest incidence of oral cancer. That is attributed mainly to betel-nut chewing.

"That is why we have a responsibility to protect and promote the health of our people. Some of our people seem not to care but it is our responsibility as the Government to make sure these concerns are publicly addressed and that we continue to regulate this," O'Neill said.

In Port Moresby, the National Capital District Commission imposed a betel-nut ban in 2013 but lifted it in



Parliament has tabled in the Summary Offences (Amendment) Bill 2018 which detailed penalties for those who chew betel-nut in public places. Fine would be less than K10,000 and a jail term not exceeding 3 years.

2017. "During that period, the pavements, streets of our capital city saw a remarkable change in terms of littering associated with betel-nut chewing," O'Neill said.

"Penalty clauses that we are now introducing is just to deter bad prac-

tices. People can chew betel nut in their homes and communities. There is no ban on that.

"People can buy and sell betel nut at designated places in the city. It must be an area that is specifically set up for that.

"But chewing in public is totally banned.

"We have to respect other people and members of our community. Of course health is again a very major issue in terms of the chewing of betel nuts."

Source: A Papua New Guinea Daily: National Thursday September 13, 2018.



