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### Infection prevention and control and antibiotic stewardship

*Two sides of the same coin in the prevention of antimicrobial resistance*

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## **Chapter 10**

### **Summary, Samenvatting, Acknowledgements, Author Portfolio & Resume**

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## **SUMMARY**

### **Infection prevention and control and antibiotic stewardship: two sides of the same coin in the prevention of antimicrobial resistance**

Infection prevention and control (IPC) and antibiotic stewardship (ABS) are two major interventions that have been promoted to reduce antimicrobial resistance. Little is known on the state of IPC and ABS in the Kenyan context, which is a representation of many low and middle-income countries. Functional Water sanitation and hygiene (WASH) structures in hospitals are crucial for the success of IPC in hospitals. This work aimed to assess hospitals Infection Prevention and Control (IPC) and Antibiotic Stewardship (ABS) capacity as part of tracking and tackling efforts to limit antimicrobial resistance in Kenya. The specific aims were;

1. To develop a survey tool that can be applied at the national or sub-national level to monitor WASH and IPC performance in hospitals.
2. To evaluate the WASH and IPC arrangements in Kenyan county hospitals and explore how these may vary within a single public health system.
3. To evaluate the opportunities and challenges for IPC and WASH implementation in Kenya, in the COVID-19 pandemic.
4. To evaluate antibiotic stewardship arrangements in Kenyan hospitals to guide action at the regional and national level.
5. To examine patterns of antibiotic use and guideline availability across hospitals and medical specialities in Kenyan public hospitals.
6. To make a case for further development and use of treatment guidelines in improving antibiotic usage in hospitals in low and middle-income countries.

7. To examine the feasibility of creating an inpatient data platform to support the regular assessment of appropriate and correct treatment in Kenyan hospitals, taking inpatient neonatal units as an example.

The focus on the first part of this work was Infection prevention and control, encompassing Water sanitation and hygiene.

In chapter 2, this work presents the process of modifying the Water Sanitation and Hygiene Facility Improvement Tool (WASH- FIT) into a Water Sanitation and Hygiene facility survey tool (WASH-FAST) at ward and facility level, including assigning responsibility for action. This process enabled for assessment of 34 WASH indicators at ward level and 65 WASH indicators at facility level in level 4 and 5 public hospitals with performance scores attached to each indicator. Additionally, three levels of accountability (county government, hospital management and IPC committees) are identified by the WASH-FAST through a process that involved different stakeholders. The stakeholders included the Ministry of Health representatives, hospital infection prevention and control managers, faculty from the universities and nursing schools and representatives from non-governmental organisations dealing with IPC and WASH.

In Chapter 3, a mixed-methods approach which included cross-sectional surveys and in-depth interviews, was used to assess WASH in 14 public hospitals with 116 wards. The surveys revealed varying levels of performance within hospital wards and across the hospitals. The overall hospital performance ranged between 47 and 71% with IPC and WASH being a low-status activity in most of the hospitals. In-depth interviews with hospital managers, health officials from the county governments and frontline health workers were used to understand the reasons behind these variations. The main findings from these interviews were the existing differences in the built environment,

differences in availability and use of resources within hospitals to improve WASH and variations in the effort the leadership puts into improving WASH. Other new insights included the role of outsourcing of cleaning services by the hospitals to external service providers and how this has helped hospitals focus on their core mandate of care provision.

In chapter 4, I present how the IPC structures have been affected by the emergence of COVID-19. Using phone interviews, I carried out 11 interviews with key hospital leaders in the study hospitals. The pandemic exposed gaps in the hospitals IPC capacity, including the broken-down hand hygiene and waste management structures. This caused growing fear and anxiety among the health care providers who felt exposed to contracting the disease. Conversely, it led to the IPC committees stepping up and taking up leadership roles to offer training to clinicians on IPC, including the use of personal protective equipment. Additionally, in a commentary, I highlight the role played by the infection and prevention committees in the leadership and accountability for IPC in the hospitals.

This chapter concludes with a policy brief providing an overview and recommendations from the WASH/IPC work in Kenya.

The second part of the thesis focussed on antibiotic use and stewardship in Kenya public hospitals.

Chapter 5 presents the findings from the assessment of the antibiotic stewardship arrangements. Using a combination surveys and in-depth interviews, the antibiotic stewardship capacities were assessed from a set of 17 indicators with aggregate scores assigned to each indicator. From these surveys, only one hospital in the survey had a functional antibiotic stewardship programme in place. We noted the lack of funds for stewardship activities and lack of antibiotic use guidelines in the hospitals with aggregate scores of 25 and

28% respectively. Five key themes were highlighted from the interviews. These were leadership for ABS, accountability and expert support, supplies of drugs, mechanisms for monitoring and reporting, and the policies and practices for ABS.

Chapter 6 presents findings from data collected on antibiotic use and guideline availability in the study hospitals. Data on antibiotic use was collected from 3590 hospitalised patients in the 14 hospitals using a point prevalence survey. From the data, cephalosporins and penicillins were the most frequent prescriptions. There was limited laboratory use with only two of the hospitalised patients having bacteriological cultures to inform the antibiotic therapy. From the survey, in only 53% of the patients was the treatment deemed appropriate based on the predefined criteria. Treatment guidelines were only available in the paediatric and neonatal units. The availability of these treatment guidelines increased the odds of appropriate treatment Odds Ratio 6.44[95% CI 4.81-8.64].

The final part presents some practical solutions to improve antibiotic use and stewardship in public hospitals.

Chapter 7 of the thesis demonstrates the role played by treatment guidelines in improving diagnosis and treatment. In this section, I use data and findings from the antibiotic point prevalence survey to highlight how availability of guidelines improves treatment appropriateness and why treatment guidelines need to be extended beyond the paediatric and neonatal units. Here I present some insights into why policymakers and governments should urgently focus the guideline development process on the most common diseases. I use the example of the development of the Kenya basic protocols to present a successful guideline development process in Kenya.

Chapter 8 demonstrates how to improve the use of antibiotics, using an inexpensive electronic data collection tool and a routine neonatal admission form. Using routine admission data collected from a neonatal unit in a clinical information network, this work demonstrates how the review of these routine data using cycles of audit and feedback improved dosing accuracy of gentamicin improved overtime for those under 2 kg from 60% to 83% over three years.

## SAMENVATTING

### **Infectiepreventie en -bestrijding en antibioticabeheer: twee kanten van dezelfde medaille bij de preventie van antimicrobiële resistentie**

Infectiepreventie en -bestrijding (IPC) en *antibiotic stewardship* (ABS) zijn twee belangrijke interventies om antimicrobiële resistentie te verminderen. Er is weinig bekend over de stand van zaken van IPC en ABS in de Keniaanse context, die beschouwd kan worden als representatief voor veel lage- en middeninkomenslanden. Schoon water, sanitaire voorzieningen en hygiene (WASH) zijn cruciaal voor het succes van IPC in ziekenhuizen. Het onderzoek in dit proefschrift heeft tot doel om de status van IPC, ABS en WASH in ziekenhuizen in Kenia te beschrijven en te analyseren, ten behoeve van het voorkómen en terugdringen van antimicrobiële resistentie. De specifieke doelstellingen van het onderzoek waren als volgt.

1. Het ontwikkelen van een methode om WASH en IPC in ziekenhuizen te monitoren die op nationaal of sub-nationaal niveau kan worden toegepast.
2. Het evalueren van de organisatie van WASH- en IPC in Keniaanse provinciale ziekenhuizen en de variatie hierin binnen één enkel volksgezondheidssysteem.
3. Het beschrijven van de kansen en uitdagingen voor de implementatie van IPC en WASH in de COVID-19-pandemie.
4. Het evalueren van ABS activiteiten in Keniaanse ziekenhuizen om maatregelen op regionaal en nationaal niveau te sturen.
5. Het meten van antibioticagebruik en beschikbaarheid van richtlijnen voor antibioticagebruik in Keniaanse ziekenhuizen.
6. Zich sterk maken voor de verdere ontwikkeling en toepassing van behandelrichtlijnen voor het verbeteren van antibioticagebruik in ziekenhuizen in lage- en middeninkomenslanden.



7. Onderzoeken van de haalbaarheid van een elektronisch dataplatform voor de evaluatie van zorg voor intramurale patiënten in Keniaanse ziekenhuizen, met als casus de afdeling neonatologie.

Het eerste deel van dit proefschrift richt zich op Infectiepreventie en WASH.

Hoofdstuk 2 beschrijft de aanpassing van de Water Sanitation and Hygiene Facility Improvement Tool (WASH-FIT) naar een Water Sanitation and Hygiene Facility Improvement Tool (WASH-FAST) dat toegepast wordt op afdeling- en instellingsniveau, inclusief het toewijzen van verantwoordelijkheden. Deze aanpassing omvat 34 WASH-indicatoren op afdelingsniveau en 65 WASH-indicatoren op instellingsniveau ten behoeve van openbare ziekenhuizen (niveau 4 en 5), met indicatoren waaraan prestatiescores zijn gekoppeld. WASH-FAST omvat ook drie niveaus van verantwoording, die gezamenlijk zijn opgesteld met diverse belanghebbenden onder wie vertegenwoordigers van het Ministerie van Volksgezondheid, managers verantwoordelijk voor ziekenhuisinfectiepreventie en -bestrijding, vertegenwoordigers van kennisinstellingen en vertegenwoordigers van niet-gouvernementele organisaties die zich bezighouden met IPC en WASH.

Hoofdstuk 3 beschrijft een studie, gebruik makend van een enquête en diepte-interviews, waarin WASH status werd beoordeeld in 14 openbare ziekenhuizen met 116 afdelingen. Uit de onderzoeken kwam variatie in WASH prestatieniveaus naar voren tussen ziekenhuisafdelingen en tussen ziekenhuizen. De algehele scores van de ziekenhuizen varieerden tussen 47% en 71% van de maximale score, waarbij IPC en WASH in de meeste ziekenhuizen activiteiten met een lage status bleken te zijn. Diepte-interviews met ziekenhuismanagers, gezondheidsfunctionarissen van de provinciale regeringen en eerstelijnsgezondheidswerkers werden gebruikt om deze variaties te begrijpen. De belangrijkste bevindingen waren de verschillen in de

bouwstaat van de ziekenhuizen, verschillen tussen ziekenhuizen in beschikbaarheid en gebruik van middelen om WASH te verbeteren en verschillen in aansturing en leiderschap om WASH te verbeteren. Daarnaast bleek dat de uitbesteding van schoonmaakdiensten aan externe dienstverleners de ziekenhuizen beter in staat stelde hun kernopdracht van zorgverlening uit te voeren.

In hoofdstuk 4 presenteer ik hoe de opkomst van COVID-19 van invloed is op de IPC-structuren. Uit telefonische interviews met belangrijke leiders in de ziekenhuizen die aan het eerdere onderzoek hebben deelgenomen blijkt dat de pandemie hiaten in de IPC-capaciteit van de ziekenhuizen bloot legt, waaronder gebrek aan handhygiëne en afvalbeheer. Deze hiaten veroorzaakten een groeiende angst op het oplopen van de ziekte bij de zorgverleners die zich blootgesteld voelden. Omgekeerd leidde het ertoe dat de IPC-comités meer en meer het initiatief namen om klinici op IPC te trainen, inclusief het gebruik van persoonlijke beschermingsmiddelen. Daarnaast belicht ik in een commentaar de rol die de infectiepreventiecommissies spelen bij de leiding en verantwoording van IPC in de ziekenhuizen.

Dit hoofdstuk wordt afgesloten met een beleidsnota die is gepresenteerd aan het Ministerie van Volksgezondheid en andere belanghebbenden, met een overzicht van en aanbevelingen voortkomend uit het WASH / IPC-werk in Kenia. Het tweede deel van het proefschrift is gericht op antibioticagebruik en ABS in openbare ziekenhuizen in Kenia.

Hoofdstuk 5 beschrijft de ABS activiteiten in de deelnemende ziekenhuizen aan de hand van een reeks van 17 indicatoren die zijn getoetst met behulp van enquêtes en diepte-interviews. Slechts één ziekenhuis rapporteerde een functioneel ABS programma. Belangrijkste lacunes waren het gebrek aan financiële middelen voor ABS activiteiten en het ontbreken van richtlijnen voor

antibioticagebruik in de ziekenhuizen (totale score van respectievelijk 25% en 28%). In de interviews kwamen vijf hoofdthema's aan bod. Dit waren leiderschap voor ABS, verantwoordingsplicht en deskundige ondersteuning, levering van antibiotica, mechanismen voor monitoring en rapportage, en het beleid en uitvoering van ABS.

Hoofdstuk 6 presenteert bevindingen van het onderzoek naar antibioticagebruik en de beschikbaarheid van richtlijnen in de deelnemende ziekenhuizen. Van 3590 gehospitaliseerde patiënten in de 14 ziekenhuizen werden gegevens over antibioticagebruik verzameld in een puntprevalentie-onderzoek. Cefalosporines en penicillines bleken het meest voorgeschreven te worden. Er werd zeer beperkt gebruik gemaakt van laboratorium diagnostiek, waardoor voor slechts 2 van de gehospitaliseerde patiënten bacteriologische kweken beschikbaar waren op basis waarvan antibiotica konden worden voorgeschreven. Uit de enquête bleek dat bij slechts 53% van de patiënten de behandeling passend werd geacht op basis van de vooraf gedefinieerde criteria. Behandelrichtlijnen waren alleen beschikbaar op de pediatrische en neonatale afdelingen. De beschikbaarheid van deze behandelrichtlijnen verhoogde de kans op een passende behandeling, Odds Ratio 6,44 [95% BI 4,81-8,64].

Het laatste deel van het proefschrift presenteert enkele praktische oplossingen om antibioticagebruik en ABS in openbare ziekenhuizen te verbeteren.

Hoofdstuk 9 van het proefschrift beschrijft de rol die behandelrichtlijnen spelen bij het verbeteren van diagnose en behandeling. Dit is vooral belangrijk in gebieden met beperkte laboratorium- en specialistische ondersteuning. Hier geef ik een aantal inzichten waarom beleidsmakers en overheden het richtlijnontwikkelingsproces dringend moeten richten op de meest voorkomende ziekten. Het voorbeeld van de ontwikkeling van de Keniaanse

basisprotocollen in de neonatologie gebruik ik om het richtlijnontwikkelingsproces in Kenia onder de aandacht te brengen.

Hoofdstuk 8 laat zien hoe het gebruik van antibiotica kan worden verbeterd met behulp van een goedkope elektronische dataplatform en een standaard opnameformulier op de afdeling neonatologie. Dit onderzoek laat zien hoe de beoordeling van routine opnamegegevens met behulp van audit- en feedbackcycli de nauwkeurigheid van de dosering van gentamicine bij neonaten onder de 2 kg verbeterde van 60% tot 83% accuraat in een periode van drie jaar.

## **Acknowledgements**

The success of this PhD journey has been made possible by the excellent support offered to me by several people.

To my promoters and co-promoters, thank you all for reading through numerous drafts and offering valuable and timely feedback to ensure I give the best. Prof Mike English; thank you for your patience and always being open to help and offer direction whenever I needed it. It was a pleasure having you as a promoter. Prof Constance Schultz; I have had the honour of working with you through this PhD, and I enjoyed it. Thank you for always assisting me to frame the right research questions and for the encouraging me to keep going and keep my eye on the goal. Dr Olga Tosas Auguet; thank you for the support through the PhD, your attention to detail came in handy during the project preparation and execution. The thorough manuscript reviews were critical for me to ensure I excel. Thank you, Olga! Dr Jacob Mc Knight, your expertise and encouragement through the PhD is much appreciated. Thank you for always reminding me to take each day at a time and give my best. You taught me to keep my head up even when things were not working as I had planned or hoped. That is a lesson I will carry through life.

To all the co-authors and collaborators on this project, thank you for your time and professional input to produce this work. I believe the findings from this work will go a long way in improving infection prevention and antibiotic stewardship in Kenya and beyond.

Thank you to IDeAL and the KEMRI Wellcome Trust Research Programme for funding my PhD training and offering professional support through training and mentorship. For my colleagues and fellow students at the programme, thank you for always being available to offer your skills whenever I needed assistance.

A special thank you to Paul Mwaniki for teaching and supporting me through the data analysis.

A special mention to my dear wife Nduku Michuki and our wonderful boys Ethan and Ryan for being patient with me and encouraging me to keep going even in the tough times. Thank you Nduku for reading through my work and for ensuring all the commas and full stops were in the right places. Thank you, guys for the love. This is a win for all of us!

To my parents, brothers and sisters, thank you for the prayers and kind words through this PhD journey and the immense support through the years.

Without the support of the skilled health workers and hospital staff who work tirelessly to provide high-quality care in our hospitals, this work would not have been possible. I want to thank you all for the sacrifices you make to serve our citizens.

I would also like to appreciate the defense committee for reviewing and recommending this thesis for defense at the University of Amsterdam.

I may not be able to mention everyone who made this PhD possible; please receive my sincere gratitude for the support.

To God almighty, thank you for life, opportunity, peace and a sound mind.

<b>PhD Portfolio</b>		
PhD student: Jackson Michuki Maina		
Period: May 2018 – October 2020		
PhD supervisors: Prof Constance Schultz, Prof Mike English, Dr Olga Tosas-Auguet, Dr Jacob McKnight		
<b>1. PhD training</b>		
	<b>Year</b>	<b>Workload (Hours)</b>
<b>Courses</b>		
Writing in the sciences online course hosted by the University of Stanford.	2018	80
Communication and consenting in research workshop hosted by the ethics department, KEMRI Wellcome Trust Research Programme. Kilifi, Kenya.	2018	32
Paediatric Advanced Life Support (PALS) offered by the department of paediatrics, Aga Khan university hospital. Nairobi, Kenya.	2018	25
Introduction to qualitative research methods and data analysis by the KEMRI Wellcome Trust data team. Nairobi, Kenya.	2018	32
Statistical analysis in R online training hosted by the data camp group.	2018	100
Implementation science for diseases of online poverty course offered by the WHO Special Programme for Research and Training in Tropical Diseases (TDR).	2018	80

Introduction to global health research online course by the University of Melbourne.	2019	80
Advanced epidemiological analysis at the London School of Hygiene and Tropical Medicine. London, UK.	2019	85
Scientific writing and publication course by the training department at the KEMRI Wellcome Trust Research Programme. Nairobi, Kenya.	2019	16
Clinical leadership and management offered by the Oxford executive coaching group. Nairobi, Kenya.	2019	15
Certificate in project management online course by the University of Washington.	2020	90
<b>Seminars, workshops and masterclasses</b>		
Weekly (4 Hrs/Month) scientific seminars and journal clubs at the KEMRI Wellcome Trust Research Programme. Nairobi, Kenya.	2018-2020	144
KEMRI Wellcome Trust Research Programme, social science group annual workshop. Theme: Power and intersectionality. Nairobi, Kenya.	2019	15
PhD students day convened at the University of Oxford. Oxford, UK.	2018 & 19	16
KEMRI Wellcome Trust Research Programme, PhD students, retreat. Kilifi, Kenya.	2019	25
KEMRI Wellcome Trust Research Programme, staff workshop on disaster management. Nairobi, Kenya.	2019	8



<b>Seminar/ Conference Presentations</b>		
Infection Prevention and Control Network annual scientific conference. Oral presentation on Infection prevention and control in Kenyan public hospitals. Nyeri, Kenya.	2018	0.5
Kenya lung conference. oral presentation on respiratory infections in children. Nairobi, Kenya.	2018	0.5
Webinar presentation on Water Sanitation and Hygiene in Kenya hosted by the WHO WASH programme in Geneva, Switzerland.	2018	1
PhD Pre-registration seminar presentation hosted at KEMRI Wellcome Trust Research Programme. Nairobi, Kenya.	2019	1
PhD students day presentation on WASH and antibiotic use in Kenyan hospitals hosted at the University of Oxford. Oxford, UK.	2018 &19	2
Seminar presentation at the KEMRI Wellcome Trust Research Programme, Title: Water Sanitation and Hygiene in Kenya. Nairobi, Kenya.	2019	1
Oral presentation on Infection Prevention and Control in Kenya at the Ministry of Health, quality of care report launch. Nairobi, Kenya	2019	1
Oral presentation to the Ministry of Health Infection Prevention and Control technical working group. Nairobi, Kenya.	2019	3

<p>Oral presentation/ webinar at the WHO quality of care network, Geneva, Switzerland.</p> <p>Webinar link:  <a href="http://www.qualityofcarenetwork.org/webinars/recording-and-materials-webinar-wash-quality-care-kenyan-hospitals">http://www.qualityofcarenetwork.org/webinars/recording-and-materials-webinar-wash-quality-care-kenyan-hospitals</a>.</p>	2020	1
<b>(Inter)national conferences</b>		
<p>Oral presentation and attendance at the crossing boundaries conference at the University of Oxford. Oxford, UK.</p>	2018	15
<p>Attended the Kenya Paediatric Association (KPA) annual scientific conference and facilitated breakout sessions on research in paediatrics. Mombasa, Kenya.</p>	2018	35
<p>Poster presentation African Academy of Science (AAS) international conference. Dakar, Senegal.</p>	2019	25
<p>Risk factors for neonatal sepsis in low resource settings stakeholders technical meeting hosted by the Centers for Disease Control (CDC). Atlanta, USA.</p>	2019	25
<p>KEMRI annual scientific conference was in attendance and gave an oral presentation on Infection Prevention and Control strategies in Kenyan hospitals. Nairobi, Kenya.</p>	2020	25
<b>Others – Policy Engagement</b>		

Member and attendee of the Ministry of Health, Infection Prevention and Control technical working group meetings.	2018 &19	18
Attended a meeting hosted by the Ministry of Health to discuss strategies for sensitization of health workers on antimicrobial resistance. Nairobi, Kenya.	2019	8
<b>2. Teaching</b>	<b>Year</b>	<b>Hours</b>
<b>Lecturing</b> Diploma in Tropical Medicine and Hygiene (DTM&H). London School of Hygiene and Tropical Medicine. (Teaching ETAT+ and Newborn Care Scenarios). Kampala, Uganda.	2017 & 19	40
The University of Nairobi, The Partnership for Health Research Training in Kenya (P-HERT); Systematic review course conducted yearly in March-July. Nairobi, Kenya.	2018 &19	12
Faculty providing training for health care workers on a programme to improve the safe use of oxygen in public hospitals in Kenya under the Clinton Health Access Initiative (CHAI). Nairobi, Kenya.	2019 & 20	122
Teaching University of Nairobi, paediatric residents and faculty on systematic reviews on the weekly journal club. Online teaching series in April 2020.	2020	2

Emergency Triage and Treatment (ETAT+) course faculty. Nairobi, Kenya.	2019	25
Kenya Medical and Dentists Practitioners Council (KMPDC), external examiner (6 Days /Year). Nairobi, Kenya.	2018-2020	50
<b>3. Parameters of Esteem</b>		
		<b>Year</b>
<b>Awards and Prizes</b>		
Appointed into the Kenya Ministry of Health technical working group on Infection Prevention and Control.		2019
Best oral presentation KEMRI annual scientific conference. Nairobi Kenya.		2020
<b>Leadership</b>		
PhD students representative- KEMRI Wellcome Trust Programme. Nairobi, Kenya.		2019
<b>4. Publications</b>		
Kebaya LMN, Kiruja J, Maina M, Kimani S, Kerubo C, McArthur A, et al. Basic newborn resuscitation guidelines for healthcare providers in Maragua District Hospital: a best practice implementation project. JBI database of systematic reviews and implementation reports. 2018;16(7):1564-81.  Maina M, Aluvaala J, Mwaniki P, Tosas-Auguet O, Mutinda C, Maina B, et al. Using a common data platform to facilitate audit and feedback on the quality of hospital care provided to sick newborns in Kenya. BMJ Glob Health. 2018;3(5): e001027.		2018

<p>Morgan MC, Maina B, Waiyego M, Mutinda C, Aluvaala J, Maina M, et al. Pulse oximetry values of neonates admitted for care and receiving routine oxygen therapy at a resource-limited hospital in Kenya. <i>Journal of paediatrics and child health</i>. 2018;54(3):260-6.</p>	
<p>Maina M, Tosas-Auguet O, McKnight J, Zosi M, Kimemia G, Mwaniki P, et al. Extending the use of the World Health Organisations' water sanitation and hygiene assessment tool for surveys in hospitals - from WASH-FIT to WASH-FAST. <i>PLoS One</i>. 2019;14(12): e0226548.</p> <p>Maina M, Tosas-Auguet O, McKnight J, Zosi M, Kimemia G, Mwaniki P, et al. Evaluating the foundations that help avert antimicrobial resistance: Performance of essential water sanitation and hygiene functions in hospitals and requirements for action in Kenya. <i>PLoS One</i>. 2019;14(10): e0222922.</p> <p>McKnight J, Maina M, Zosi M, Kimemia G, Onyango T, Schultsz C, et al. Evaluating hospital performance in antibiotic stewardship to guide action at national and local levels in a lower-middle-income setting. <i>Global health action</i>. 2019;12(sup1):1761657.</p> <p>Roberts DJ, Njuguna HN, Fields B, Fligner CL, Maina J, Zaki SR, Keating MK, et al. Comparison of Minimally Invasive Tissue Sampling with Conventional Autopsy to Detect Pulmonary Pathology Among Respiratory Deaths in a Resource-Limited</p>	<p>2019</p>

<p>Setting. American journal of clinical pathology. 2019;152(1):36-49.</p> <p>Njuguna HN, Zaki SR, Roberts DJ, Fligner CL, Maina J Keating MK, Rogena E, et al. Determining the Cause of Death Among Children Hospitalized with Respiratory Illness in Kenya: Protocol for Pediatric Respiratory Etiology Surveillance Study (PRESS). JMIR Res Protoc [Internet]. 2019 2019/01//; 8(1): [e10854 p.]</p>	
<p>Maina M, Mwaniki P, Odira E, Kiko N, McKnight J, Schultsz C, et al. Antibiotic use in Kenyan public hospitals: Prevalence, appropriateness and link to guideline availability. International Journal of infectious diseases 2020. 99: p. 10-18.</p> <p>Maina M, Tosas-Auguet O, English M, Schultsz C, McKnight J. COVID-19: an opportunity to improve infection prevention and control in LMICs. The Lancet Global Health</p> <p>Maina M, Tosas-Auguet O, English M et al. Infection prevention and control during the COVID-19 pandemic: challenges and opportunities for Kenyan public hospitals [version 1; peer review: 1 approved]. Wellcome Open Res 2020, 5:211 (<a href="https://doi.org/10.12688/wellcomeopenres.16222.1">https://doi.org/10.12688/wellcomeopenres.16222.1</a>)</p>	2020
Other Publications	

<p>Involvement in the delphi process for the World Health Organization "Standards for improving the quality of care for children and young adolescents in health facilities."</p> <p><a href="https://apps.who.int/iris/bitstream/handle/10665/272346/9789241565554-eng.pdf">https://apps.who.int/iris/bitstream/handle/10665/272346/9789241565554-eng.pdf</a></p>	<p>2018</p>
<p>Part of PhD work included in a report by the World Health Organization: Water, sanitation and hygiene in health care facilities: practical steps to achieve universal access.</p> <p><a href="https://apps.who.int/iris/bitstream/handle/10665/311618/9789241515511-eng.pdf">https://apps.who.int/iris/bitstream/handle/10665/311618/9789241515511-eng.pdf</a></p>	<p>2019</p>
<p>Member of the WHO technical working group that is updating the water and sanitation assessment tools for health facilities.</p> <p>2020</p>	

# RESUME

## Biodata

Name: Dr Jackson Michuki Maina

Date of Birth: 29<sup>th</sup> July 1982

## Personal Statement

Michuki is committed to professional and academic excellence that enables him to participate in and undertake health research and teaching to improve newborn, child and adolescent health in Kenya.

## Academic Qualifications

<u>Qualification</u>	<u>Institution</u>	<u>Year</u>
PhD Candidate	University of Amsterdam	2018 – Present
Master of Medicine (MMed) in Paediatrics and child health	University of Nairobi	2011-2014
Master of Public Health (MPH)	Moi University/ African Medical Research Foundation (AMREF)	2010-2014
Bachelor of Medicine and Surgery (M.B Ch.B.)	University of Nairobi, September	2002-2007

## Professional Experience

<u>Role</u>	<u>Institution</u>	<u>Year</u>
Research paediatrician/ PhD fellow	KEMRI/Wellcome Trust Research Programme	2014- Present
Consultant paediatrician	Maria Immaculate Hospital/ AAR Healthcare	2014-Present
Honorary consultant paediatrician	Kenyatta National Hospital	2015- 2017
Medical doctor	AAR Healthcare	November 2009-July 2014
Medical officer	Ministry of Health- Embu Level 5 Hospital	January 2009 – October 2009



## **Additional Training**

Instructor Emergency Treatment and Triage plus Admission (ETAT+), March 2015.

Paediatric Advanced Life Support (PALS), February 2018.

Qualitative research methods training KEMRI Wellcome Trust Research Programme. February 2018.

Scientific writing and publication Course KEMRI Wellcome Trust Research Programme February 2018.

Statistical analysis in R online training May 2018.

Introduction to global health research. University of Melbourne (Online 8 weeks course).

Advanced epidemiological analysis, London School of Hygiene and Tropical Medicine 9<sup>th</sup> -20<sup>th</sup> September 2019.

Implementation science training by the World Health Organization 2019 (8 weeks).

University of Washington project management for global health online 11-week course January – March 2020.

## **Teaching Experience**

Part of the faculty that provides teaching on systematic reviews to faculty and postgraduate students at the University of Nairobi school of medicine under The Partnership for Health Research Training in Kenya (P-HERT) (Course conducted yearly in March-July from 2017).

Faculty providing training for health care workers on a programme to improve the safe use of oxygen in public hospitals in Kenya under the Clinton Health Access Initiative (October- November 2019).

Teaching on the London School of Hygiene and tropical medicine East Africa Diploma in Tropical medicine in Uganda course in November since 2017.

Course director on the generic instructors course for the Emergency Triage and Treatment Programme December 2017 – 2019.

Teaching paediatric residents and faculty on systematic reviews on the weekly journal club. April 2020.

### **Research grants awarded**

Initiative to Develop Research Leaders in Africa. Grant award for PhD training amount GBP 100,000 by the Africa Academy of Science. October 2017.

### **Roles and Awards**

Hillman award for outstanding leadership skills (the University of Nairobi, Department of Paediatrics and Child Health 2014.

WHO global consultant on paediatric quality of care 2017.

Member on the national Ministry of Health Infection Prevention and Control technical working group 2018- Present.

Kenya Medical and Dentists Practitioners Council external examiner -2015-Present.

Best oral presentation KEMRI annual scientific conference February 2020.

### **Membership and Affiliations**

Registered medical practitioner and consultant paediatrician by the medical practitioners and dentist's council Kenya.

Member Kenya paediatric association.

Member of the European Society of Paediatric Infectious Diseases (ESPID).

Medical Missions Africa- Volunteer paediatrician.

### **Interests and hobbies**

Music- Guitar playing and sport-recreational runner.



