HISTORIES OF ANTIBIOTICS

A one health account of the arrival of antimicrobial drugs to Zimbabwe, Malawi and Uganda

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This report would not have been possible without the collaboration and advice of many professionals. First, we would like to thank the staff of Malawi National Archives and, especially, McDonald Baluti, for his availability to help this research during these challenging times. The support from Jeff Waage, Jo Lines, and all the LSHTM Agriculture and Infectious Disease Group was also invaluable – as well as from colleagues in the Anthropology of AMR team at LSHTM. We also are very grateful to John Manton, Stuart Anderson and Martin Gorsky from the LSHTM History Centre as well as Claas Kirchhelle from University College Dublin and the Oxford Martin School, Oxford University, for their insightful advice regarding historical sources and methodologies.

This project was funded through the Improving Human Health project at LSHTM, a collaboration with the International Livestock Research Institute, as part of the Agriculture for Nutritional and Health (A4NH) Programme of the Consultative Group on International Agricultural Research (CGIAR), a global consortium of donors and research centres for agricultural development. The overall aim of this short project is to uncover some of the socio-historical roots of antibiotic use in both humans and non-humans outside of the European and American histories that are now well understood. We provide an historical account of the arrival and generalisation of use of antibiotics in three Eastern African countries: Zimbabwe, Malawi and Uganda. Drawing upon historical and ethnographic data, we describe when, how and in what context antibiotics arrived in these countries, providing an account of their early uses – both human and non-human. This project follows antibiotics as commodities, investigating how they were inserted within broader markets and the channels through which they were introduced in the African continent.

The project pursues four distinct but interrelated objectives. First, to establish when and which antibiotics were first introduced in each country of focus. We find that this was not so different from Europe: the earliest mentions of antibiotics in Africa date from the mid-1940s, and refer to the same antibiotics that were being discovered and used in the rest of the world. Second, to investigate the context in which antibiotics arrived. We describe this as a set of already-functioning healthcare and veterinary systems, which were established by the colonial governments and missionary organisations throughout the first decades of the twentieth century. Third, to gain insight into the supply chains through which antibiotics were procured and distributed in each country. This was primarily through pharmaceutical companies from the UK and the US, which saw the market opportunities that drugs (and particularly antibiotics) offered in the colonised African territories. Finally, our fourth objective is to explore the actors behind the introduction of antibiotics, and the interests motivating them. We identify these as colonial governments, medical practitioners (private, colonial officers and missionaries) and pharmaceutical companies, who variously worked to ease the healthcare burden, and improve productivity and profit.

Understanding the arrival and further spread of antibiotics in the focus countries can provide important insights about their current use. These findings show how antibiotics and biomedicine came to be associated together. Considering the interests that brought and kept antibiotics in African settings reveals how antibiotics have come to exist in the intersection between health, political agendas, economic interests, cultural identities and international relations. We intend this report to contribute to the development of initiatives to tackle AMR under a One Health framework, expanding the scope to include a diachronic perspective on the health of humans, animals and the environment.

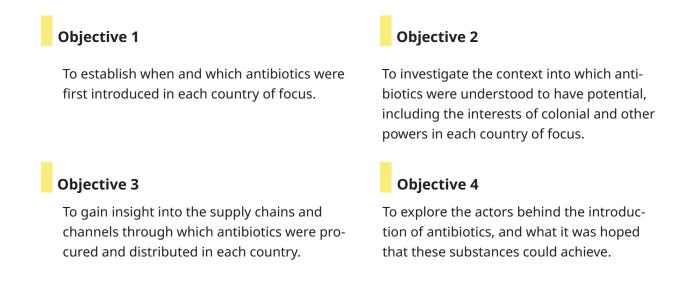
In a time when Antimicrobial Resistance (AMR) is more worrying than ever, and when we are grappling with how best to reduce our reliance on antibiotic medicines, looking at the past can offer insights into alternative paths into the future. The historical development and significance of antibiotics has been reflected in various excellent works that highlight the social, political and cultural embeddedness of these drugs, both in human and non-human spheres (Bud, 2007; Kirchhelle, 2020; Santesmases, 2018). So far, the focus of these historical accounts and analyses has been mostly directed to the presence of antibiotics in Europe and the United States, only mentioning tangentially their existence in the rest of the world. Concerns about rising antibiotic use in low and middle income countries has led to increased interest in the scale and trajectories of antibiotics outside of Europe and the US. As yet, there remain numerous gaps in our understanding of antibiotics in recent history, especially in Africa. Exploring this history may provide a path beyond fatalistic stories about self-medication, irrational use and abuse by African people, and instead understand at the contexts and conditions in which antibiotics have been embedded in particular locations.

Historians have indicated the entanglement of antibiotics with biomedicine as part of the imperial project. Biomedicine is understood to have been considered a necessary replacement for traditional African healing practices, as well as offering a philanthropic contribution to the Empire's civilising mission (Digby & Sweet, 2002; Iliffe, 1998; Vaughan, 1991). The potency of biomedicine is understood to have been achieved in part because of the effectiveness of antibiotics in treating infectious diseases. This is understood to have contributed to the consolidation of colonial healthcare systems and, more generally, to the adoption of biomedical procedures as a paradigm. However, scholars also intimated that antibiotics enabled a different form of biomedicine to travel; that the arrival of antibiotics formed as a convenient – if unintentional – replacement for the often expensive and sophisticated set of resources, knowledge and processes that constituted biomedicine in the West. For example, Bud relates that "the power, mass production, and relative cheapness of penicillin had made the drug itself much easier to import across the world than the entire structure of Western medicine, or even the doctor or Western-style pharmacist" (2007:158). Therefore, not only can antibiotics be understood to have reinforced the biomedical apparatus but in so doing they replaced some of it, generating a form of medicine that, while ostensibly the same, was somehow different from that practised in the West.

However, beyond this interesting but patchy picture of the history of antibiotics, and their relations to colonial powers, there remains a gap in our understanding of when, how and why these medicines were initially used in African countries. Uncovering further the histories of antibiotics in particular settings means better understanding the necessity of antibiotics for biomedicine, the extent to which they are entangled with social concepts such as the 'modern' society, the 'meshwork' of political and economic ideologies in which antibiotics have been inserted and have potentially co-produced.

The present day focus on a One Health framework for AMR has now become self-evident, but historically the use of antibiotics in humans and animals has been studied separately. Non-human use of antibiotics in agriculture is greater, even today, than human health-related use. Agricultural use has been directly connected with demands for increased productivity of both livestock and crops. The use in livestock increased globally during and after the Second World War. For colonial settings, this was a period of scarcity and rationing, with economic pressure on the colonies even higher than before. Investigating the role that antibiotics played in the post-war economic recovery (during the late 40s and 50s) is crucial for filling out the picture of antibiotic use in Africa. Studying the uptake and scale up of antibiotics from a historical perspective contributes further dimensions to the One Health framework, allowing us to understand the diachronic interrelation of human, animal and environmental health under particular political, economic and social regimes.

This project focuses on the arrival and generalisation of the use of antibiotics in African settings. This project aims to provide a nuanced account of when, how and why antibiotics arrived in three different locations: Zimbabwe, Malawi and Uganda. The research and the report have been organised around four objectives:



The study countries were selected to align with ongoing ethnographic research in each country as part of two LSHTM AMR Centre projects: the Antimicrobials In Society (AMIS) and Febrile Illness Etiology in a Broad Range of Endemicities (FIEBRE).

Looking at these three places comparatively allows an appreciation of the differences and similarities of their colonial architectures, and how these were reflected in the visions and agendas behind each healthcare system. Thus, it is possible to link the particular ways in which healthcare was delivered and the colonial interests for each specific territory. Investigating these particularities is a way of bringing additional nuance to the already-existing stories of colonialism.

This project presents exploratory work that considers an overlooked part of the history of medicine. Drawing upon archival and historical data, it is an attempt to produce a rigorous account of the circumstances surrounding antibiotic arrival in African settings, including the different actors involved in this arrival and the interconnectedness created by these drugs. Ultimately, this research provides insight into how antibiotics arrived and stayed in Africa, aiming to contribute to the development of actions to tackle the problem of AMR under a One Health framework.

This project has been informed by an anthropological approach to history, following the methods of archival ethnography and, to a lesser extent, oral history. To this end, its sources have included data gathered from archival research, literature reviews of existing historical accounts and oral interviews with key informants across countries of interest.

The research process for this project began by assessing the material available. In this case, the boundary was set in the timeframe from the 40s to the 60s, covering the early decades of the discovery and spread of most antibiotics currently known. After this, the next step was to collate archives to trace relationships and, after a process of coding, establish thematic nodes to compare them. The process of coding ensured the thorough revision of the materials, allowing us to find common points and divergences, and, therefore, to re-construct the processes that took place and so narrate the story in a rigorous way.

In order to find primary information sources for the present work, an exhaustive search of archival materials was carried out using, among other tools, online search engines and bibliographic references from academic literature. Specifically, online digital archives and physical visits to the British Library provided access to a large number of journals related to the topic of this research. Digital materials often allowed the search of key terms, selected taking into account both the information required and the topic of the journal: for example, pharmaceutical journals offered plenty of information about the composition and properties of antibiotics as substances, while theme-specific journals about agriculture might focus on the practicalities of their use. Likewise, regional or international scopes of these journals would entail different displays of information, allowing us to develop a holistic perspective of antibiotic use overall and compare it to country-specific particularities. Journals were selected for their availability and proximity to the focus of this report, and analysed to cover the widest area possible within the temporal, material and thematic limits of the research. Hard copies of journals were analysed according to the same criteria through a rigorous review of their contents.

Following this, it was necessary to compare other kinds of materials (books, demographic reports etc.), always complemented by bibliographical research regarding the period to which the archives referred. It would have been desirable to carry out fieldwork in existing places and archives, but the COVID-19 pandemic made such travel between countries impossible for the lead author, although our findings were able to dovetail with ongoing ethnographic work by in-country research teams. It was possible to carry out limited interviews through different media, which were pursued with relevant stakeholders in order to gain a better perspective about the use of antibiotics in the focus settings during the focus period, and to contest the authority of archival evidence as the only source of historical data (Stoler, 2002).

The analytical approach of the project has been informed by a postcolonial lens, and a particular focus on the ways antibiotics have become infrastructural in material, affective and political ways (Chandler, 2019). In the process of analysis, interpretation of materials

followed questions such as: who created the material being reviewed? With which objective? And who was it directed to? The analysis then connected these findings with the broader context in which the materials were created (socio-political particularities of the context, history, economy, etc.) and the process that led the material to be analysed (where was it found, what kind of archive was it, etc.). These processes reduced the risk of taking what was written in archival documents as 'objective' and contextless, allowing us to situate materials – as we do when interviewing actors or analysing current policies.

Each of the objectives of this report was explored with particular materials and approaches:

Objective 1. To establish when and which antibiotics were first introduced in each country of focus.

 Hospital records, government annual reports, missionary records, pharmaceutical company records of shipping and invoices.

Objective 2. To investigate the context into which antibiotics were understood to have potential, including the interests of colonial and other powers in each country of focus.

- Historical accounts of the colonial architecture of these locations and, specifically, the colonial health systems.
- Policy briefs, government reports and Development and Welfare plans.
- Academic reviews of colonial economy and its relation to health systems.
- Independent surveys of disease incidence in African settings during the target period.
- International and regional prevention and public-health campaigns (WHO, colonial governments).
- Hospital and missionary records.
- Pharmaceutical, agricultural and medical journals, both international and regional, from the focus countries.

Objective 3. To gain insight into the supply chains and channels through which antibiotics were procured and distributed in each country.

 Hospital records, government annual reports, missionary records, pharmaceutical company records of shipping and invoices.

Objective 4. To explore the actors behind the introduction of antibiotics, and what it was hoped that these substances could achieve.

- Source companies, brand names and release dates for different antibiotics at different periods.
- Trace-backs of suppliers through shipping records, narrative reports, recorded interviews and journal articles about antibiotic potentials in these settings.
- Characterisations of the colonial, missionary and industrial interests and structures in each country.
- Scientific research articles about the non-human, non-therapeutic employment of antibiotics in agriculture.
- Colonial government reports on demands for productivity within the post-WWII period (1940-50).
- The British Empire's Development and Welfare plans.
- Timelines of war, colonial powers, missionaries, independence, development aid and directions.

The findings of the research on these objectives will be addressed in separate sections. Therefore, throughout the analysis, as reflected in this report, there was a commitment to be aware of the potential for antibiotics to emerge as an entanglement between biomedicine and the concept of 'modernity'. We have aimed to consider to what extent the development of the pharmaceutical industry is an important factor for the consolidation of colonial healthcare systems and, more generally, for the adoption of biomedicine as a global paradigm.

This report draws on both primary and secondary sources, as summarised in Figure 1. All materials are listed in the bibliography. Among the primary sources, archival materials – both online and in hard copy – stand out in providing first-hand information about how antibiotics were understood, thought about and represented throughout the period covered by this research. The nature of these archival materials is varied, as it is possible to find personal documents (such as memoirs or private letters), official and corporate documents (such as reports, official correspondence or adverts) and academic documents, often closely linked to the governmental sphere (such as surveys, research articles or journals).

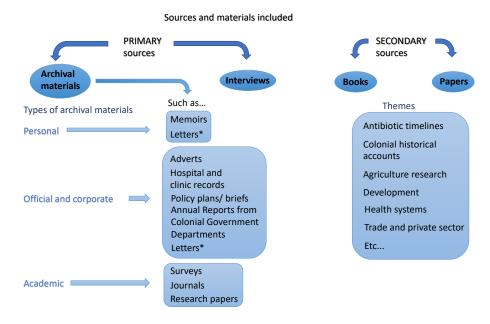


Figure 1: Summary of sources and materials gathered and analysed for this report.

Although primarily academic, journals can also fill a broader role as one of the main information sources for health and agriculture professionals in the period considered here. The great thematic range that journals cover makes them useful tools for historical research of this kind. During the research process, we identified different sorts of antibiotic mentions within these journals. Among these are mentions of antibiotics in research articles directly investigating antibiotic uses (for the treatment and prevention of diseases, growth promotion, preservation of food, etc.), in announcements or news (when a new antibiotic is released or available in a certain region, when supplies are over, when new regulations are implemented, etc.), in trade and investment opportunities and advertisements (among many other drugs and chemicals), or in opinion pieces or letters

to the director. Each of these ways in which antibiotics were mentioned tells a different part of the same story; as such, considering them together will provide a good perspective on the complexities of antibiotic arrivals in African settings.

Different sources provide different kinds of information, and already-existing historical accounts of colonial politics, healthcare, economy and agriculture provide an insight into colonial African contexts that is essential for understanding and further analysing the arrival of antibiotics. This is why, in this report, the sections that refer to the background of antibiotic use draw largely from secondary sources, while specific data about antibiotics themselves had to be found in primary sources as described above. In this section, we will provide a brief description of the status of the three countries in the time period under consideration, relating both the specific and shared characteristics between them. This will situate the arrival of antibiotics within country contexts. All three countries were colonised by the British, but with differing modes, interests and implications for systematisation of health care.

ZIMBABWE

European colonists arrived in the country now known as Zimbabwe with Cecil Rhodes' British South Africa Company (BSAC) in 1880. Through a concession for mining, the first colony of Fort Salisbury was established, which expanded its influence until it was annexed to the British Empire in 1923, becoming the self-governing colony of Southern Rhodesia (Burroughs, 1999). From then on, up to 1965, Southern Rhodesia would follow a system of white minority rule, considering the African population as an underclass. Rhodesian institutions formed a broad system of segregation aimed at attracting a greater flow of white settlers and creating a Western-like society.

From 1953 to 1964, Southern Rhodesia joined with Northern Rhodesia (now Zambia) and Nyasaland (now Malawi) to create the Federation of Rhodesia and Nyasaland, also referred to as the Central Africa Federation. However, although it intended to keep an image of unity and solidity, the Federation was never consolidated as a single power, and the inequalities between the member nations were patent throughout the period (Keatley, 1963). Southern Rhodesia, as the wealthiest and most powerful nation within the Federation, kept its autonomy to a large extent, culminating in its Unilateral Declaration of Independence after the Federation dissolved. The period of existence of the Federation coincided largely with the time of major spread of antibiotics, making it a crucial timeframe to consider for the purposes of this report.

MALAWI

The colonisation of Malawi was carried out throughout the second half of the nineteenth century, with the first settlers being mainly missionaries from the Universities Mission to Central Africa (UMCA) and other similar missionary organisations such as the Scottish Missions of Presbyterian Churches. In 1889, the UK proclaimed the British Central Africa Protectorate, ratified in 1891 and renamed in 1907 as the Nyasaland Protectorate (Burroughs, 1999).

Nyasaland's colonial government functioned through the system of 'indirect rule', which, as opposed to the minority-rule system in Southern Rhodesia, was aimed at maintaining the 'traditional structures' of the colonised societies (Burroughs, 1999). The logic behind this system was that it would barely require any presence of colonial officers on the ground while still forestalling other countries' claims over the land. Therefore, the number of Europeans in Nyasaland was much lower than in Southern Rhodesia and the economy remained rural-based, with little industrial development. As we will see, this also affected the development of a proper health system – and, therefore, the spread of antibiotics.

UGANDA

The colonisation of Uganda has certain similarities with Malawi, as it was also incorporated into the British Empire as a Protectorate following the system of indirect rule. The main difference between the two countries was the existence of the Buganda kingdom before the arrival of Europeans in Uganda, which had a powerful and structured government system that remained throughout British rule (Roberts, 1963; Wrigley, 1957). The Uganda protectorate was established in 1894, after the intervention of the Alliance Imperial British East Africa Company (AIBEAC) amidst a number of religious struggles within the territory. The AIEBAC gave up its 'administrative rights' over the territory and the UK government took over through the Colonial Office. This system was maintained until the independence of Uganda in 1962.

The presence of missionaries was also relevant for the establishment of the colonial system. Particularly, the missionaries of the Church Missionary Society had an important role in healthcare, delivery of medicines, and education, as we will explore in section 2.3.

Findings

The findings are arranged in line with the objectives. Each section draws on material related to both humans and animals.

ANTIBIOTIC ARRIVALS

Objective 1

To establish when and which antibiotics were first introduced in each country of focus.

Objective 2

To investigate the context into which antibiotics were understood to have potential, including the interests of colonial and other powers in each country of focus. HEALTHCARE CONTEXT



Objective 3

To gain insight into the supply chains and channels through which antibiotics were procured and distributed in each country.

Objective 4

To explore the actors behind the introduction of antibiotics, and what it was hoped that these substances could achieve. ACTORS AND INTERESTS

A total of 108 archival sources were identified, thematically coded and analysed. Materials included articles from 23 relevant journals reviewed for the period from 1930 to 1970; archival research carried out in the United Kingdom National Archives and the Uganda National Archives; and materials from the Zimbabwe National Archives. A list of the journals and archival sources reviewed is available in the Annex. The results of this analysis are presented in the subsequent sections, subdivided to reflect the arrival and spread of antibiotics for humans and the arrival and spread of antibiotics for non-human purposes (animal health and agriculture). These spheres are kept separate because they are pictured as such within the analysed data; therefore, in order to represent how antibiotics were understood during the studied period, we have decided to maintain this human–non-human division¹.

1.1. ANTIBIOTICS FOR HUMANS

1.1.1. Starting point of antibiotics

Although this research is focused on the arrival, uptake and scale up of antibiotics in African settings, it is important to situate these substances in relation to their discovery and evolution globally. As we have seen, the impact of these substances is never isolated in a single territory, but they are part of a wider network of actions and exchanges. Therefore, we will consider the broad development of antibiotics before moving on to their specific uses within the African continent.

Officially, the antibacterial action of penicillin mould was discovered by Alexander Fleming in 1928; nonetheless, humanity had to wait until 1940 to take the first steps towards the 'Antibiotic Era'. In the early '40s, Howard Florey and Ernst Chain isolated and purified the substance, initiating human trials shortly after (Bud, 2007). It was probably the perfect moment for antibiotics to arrive: since the beginning of the century, the overall importance of pharmaceutical industry had been on the rise – especially in wealthy countries of the so-called 'Global North'. First, people's trust in the 'vitamins business' (Bud, 2007) created the infrastructure that pharmaceutical companies needed to keep growing, and then the appearance of arsenical compounds (such as Salvarsan and Neosalvarsan) set their hopes even higher. Sulphonamides like Prontosil marked the successful arrival of antibacterial drugs in the early '30s, and the way was paved for the next great discovery. The scientific community was filled with enthusiasm: the 'magic bullet' to get rid of infectious disease was only a matter of time.

Antibiotic development was boosted by the Second World War, when penicillin production stopped being an expensive luxury shut away in labs and started to be widely used to heal soldiers' wounds (Santesmases and Gradmann, 2011). The role of US scientists in the creation of an efficient and relatively inexpensive method of production put the American pharmaceutical industry at the forefront of global antibiotic use and trade. However, US leadership was not undisputed: although it was still under the effect of the war restrictions, the UK rushed to catch up with their Anglophone allies and competitors and soon became a global power in the production and export of the 'new drugs'.

In 1944, streptomycin appeared as the next step towards a disease-free future, followed by 'natural' tetracyclines (such as chlortetracycline, 1945 – distinct from the semi-synthetic tetracyclines that started to be produced in the mid-50s) and chloramphenicol (1949).

¹ For current information about the interrelation of human and non-human uses of antibiotics and its effects, see (Ducrot et al., 2018; Jensen, Nielsen, and Fynbo, 2018; Pearson and Chandler, 2019; Wilkinson, Ebata, and MacGregor, 2019).

For the next decades, more and more antibiotics were discovered, allowing the biomedical community to dodge problems such as the development of resistance of certain infections or bacterial strains, or the adverse reactions of some patients to the treatments.

Table 1 shows a number of examples found in primary sources, establishing a broad timeline of the beginnings of antibiotic use in a global context.

Year of mention	Event/Mention of antibiotics	Publication ²
1929	Discovery of penicillin.	British Journal of Experimental Pathology (UK)
1943	First use of penicillin as a treatment.	Oxford Handbook of Infectious Diseases and Microbiology (UK)
1944	Military use of penicillin in the US and the UK	Chemist & Druggist Journal (UK)
1944	- Conference of US Penicillin Producers: War Production Board. - Announce a more efficient way of production.	Chemist & Druggist Journal (UK)
1944	First report of Streptomycin	Experimental Biology and Medicine (US)
1945	Announcement of coming availability of penicillin for 'civil use' in the UK.	Chemist & Druggist Journal (UK)
1945	First adverts of penicillin-containing products and bases for growing penicillin (only for hospital use).	Chemist & Druggist Journal (UK)
1945	Soviet home drug industry: mention of antimicrobial development: - Krustozin ('Soviet penicillin') - Gramicidin	Chemist & Druggist Journal (UK)
1945	Discovery of chlortetracycline (Au- reomycin) by a team from Lederle labs.	Reviews of Infectious Diseases (US)
1946	First British production of streptomycin by Boots Pure Drug Co., Ltd. (first batch only for clinical trials).	Chemist & Druggist Journal (UK)

Table 1. Timeline of antibiotic beginnings globally

² A complete and detailed list of the references for Tables 1, 2 and 3 can be found in the bibliography.

Year of mention	Event/Mention of antibiotics	Publication ²
1947	- Generalisation of antibiotic use for research and treatments. - Successful trials to use streptomycin for plague and human tuberculosis.	Chemist & Druggist Journal (UK) British Journal of Pharmacology and Chemo- therapy (UK)
1948	Consolidation of streptomycin as the best treatment for human tuberculosis.	British Journal of Pharmacology and Chemo- therapy (UK) 'Tubercle' Journal (UK)
1949	Discovery of chloramphenicol by a team from Parke-Davis (US).	Journal of the American Chemical Society (US)
1950	UK production of streptomycin for export (manufactured by Glaxo).	Chemist & Druggist Journal (UK)
1950	Use of chloramphenicol for treating whooping cough.	Chemist & Druggist Journal (UK)
1950	Antibiotics as the 'star' of London Medical exhibition.	Chemist & Druggist Journal (UK)
1952	"A decade of penicillin": Penicillin had been available for clinical use in the US for 10 years approximately.	American Journal of Public Health (US)

1.1.2. Arrival in Africa

There has been previous interest in the question of the arrival of antibiotics in the African continent. Bud (2007), for example, situates the beginnings of antibiotics in Africa around the 50s, in relation to the massive anti-yaws campaigns that were implemented by the World Health Organisation (WHO) in East Africa. Other historical accounts of health and pharmaceutical development – both global (Kirchhelle, 2018) and specific to African settings (Dube et al., 2009; Ncube, 2012) – have also loosely mentioned the existence of antibiotics in Africa in the middle of the twentieth century. However, a systematic register of the timing and the conditions in which antibiotics arrived into different settings remains missing. Their arrival has been roughly connected to colonial healthcare systems and missionary enterprises, but a detailed exploration does not appear to have been undertaken.

The arrival of antimicrobial drugs in African settings is not easy to situate, given the blurry and complex nature of the delivery of care in these areas – and the interrelation with colonial agendas, in a context that lacked fast and reliable means of communication. The analysis of a number of primary sources (such as journals, scientific papers of the time and institutional reports and memorandums) reveals the existence of early reports of antibiotic imports and use in the colonised areas of the continent. Indeed, antibiotics seem to have been imported to Africa since the very beginnings of their existence, with an early focus on medical research. Not much later on, antibiotics went beyond the research sphere and became a profitable business, boosting the development of African branches of big pharmaceutical companies³.

As we have seen in section 2.1.1., it is important to highlight that when antibiotics were discovered and beginning to be used across the world, colonised countries already had consolidated health services (M. Gelfand, 1976; Vaughan, 1991). Therefore, there had been taking place a 'facilitating process' for antibiotics: as 'modern' medicine techniques were already playing a role in Africa, with the therapeutic use of sulphonamides among them (Brownlee and Kennedy, 1948), local populations and markets were ready to incorporate the novelty of the 'miracle drugs'. As we will discuss in section VI.1., the provision of healthcare and the characteristics of this provision responded to the agendas of colonising powers; however, these agendas were varied and often contradictory, shaping in very diverse ways the use of medicines in each country.

1.1.3. Early times of antibiotics

Interestingly, if we compare the dates of mentions of antibiotics in European and African settings (as both scientific discoveries and more or less established treatments), we see that they were not far apart. In Table 2, we find various examples of early antibiotic use within African settings.

Year of mention	Event/Use of antibiotics	Publication ⁴
1942	Trial of gramicidin and penicillin to treat trypanosomiasis in African patients that had showed resistance to sulphonamides.	British Journal of Pharmacology and Chemotherapy (UK)
1944-45	Mention of experimental and military use of penicillin in 'Askaris' (African soldiers)	'Penicillin' Journal (US) 'Tubercle' Journal (UK)
1945	Treatment of Rhodesian trypanosomiasis with penicillin.	East African Medical Journal (East Africa – various locations)

Table 2: Early examples of antibiotic use in African settings.

³ Most of these branches started in South Africa and, from there, expanded to the rest of the continent. Other specifically African pharmaceutical companies were also created (such as Lennon & Co., West African Drug Company Ltd., Electro Chemicals Ltd., etc.).

Year of mention	Event/Use of antibiotics	Publication ⁴
1946	The Secretary of State for the Colonies (Colonel Stanley) confirmed that su- pplies of penicillin were now available from the closest supplier (UK, US, Cana- da) for civilian use in the colonies. Department of Supply of Southern Rhodesia.	Chemist & Druggist (UK)
1946	Fall in the price of penicillin in South Africa – announcement of the creation of a 'bank of penicillin' in case of shortage.	Chemist & Druggist (UK)
1946	Penicillin used for the treatment of relapsing fever in Uganda.	East African Medical Journal (East Africa – various locations)
1946	The Secretary of State for the Colonies announces that the supply of penicillin for the African colonies is satisfactory.	Chemist & Druggist (UK)
1948	Penicillin used for the treatment of me- ningitis in Uganda.	The Lancet (UK)
1948	Use of streptomycin and PAS for treating tuberculosis in Southern Rhodesia.	British Journal of Pharmacology and Chemotherapy (UK)
1950	Streptomycin for the treatment of venereal diseases in Southern Rhodesia	The Lancet (UK)
1950	Treatment of syphilis in Africans with penicillin	Journal of Venereal Disease Information (US)
1950	Aureomycin used for treatment of yaws and ulcer in tropical Africa.	Nature (UK)
1950	Campaign for mass administration of 'sterilising' doses of penicillin for the treatment of yaws.	Bulletin WHO (International – various locations)
1952	Treatment of tuberculosis in Nyasaland – use of streptomycin when available.	'Tubercle' Journal (UK)

⁴ See note 2 of this report.

Penicillin for African Colonies

On January 30, SQUADRON-LEADER DONNER asked the Secretary for the Colonies whether he was satisfied that adequate supplies of penicillin were now available for civilian use by the medical authorities on the spot in all the African colonies. MR. CREECH JONES : Yes. There is no restriction on the supply of penicillin to the Colonies. Their full requirements can now be ordered through the usual channels.

Figure 2: Notice about antibiotic supplies for the African colonies (Chemist and Druggist, 1945).

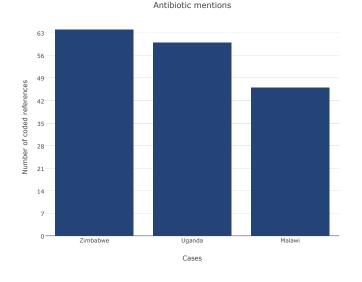


Figure 3: Graphic representing the references to antibiotics within the revised materials classified by country-cases (based on original research data).

As we can see here, anti-yaws campaigns marked an early use of antibiotics in Africa – but not the earliest. Penicillin was used to treat African soldiers in the Second World War and, later on, antibiotics were widely used in research on tropical diseases. However, it is important to recognise that the global scale on which anti-yaws campaigns were implemented by the WHO made them a milestone in the history of antibiotic spread worldwide.

From the sources reviewed during this research, it is possible to infer a degree of differentiation in the use of antibiotics in the three focus countries. As is shown in Figure 3, most references to antibiotics concern Southern Rhodesia (now Zimbabwe) and, to a lesser extent, Uganda. These references are taken here to index the scale of use, because most references describe, often without further specification, disease treatments that can be either experimental or established. Unsurprisingly, it seems that the relative wealth of each setting affects the availability of antibiotics, leaving barely any mention of antibiotic use in the poorer region of Nyasaland (now Malawi). From this, we can start to grasp a hint of the relation between economic interest, colonial powers and antibiotic use.

So far, we have observed that antibiotics were used in the three focus countries for a range of conditions since the 1940s. Next, we must explore how widely they were used, in what ways they were used, and for what and whose purposes they were put to use. For this, we must consider further questions: what were the agendas (political, economic, ideological) that motivated the inclusion of antibiotics in healthcare? What was the availability of medicines on the ground? Who was entitled to administer the 'new drugs'? And, finally, through which channels were these drugs brought to these settings and inserted in local markets?

1.2. ANTIBIOTICS FOR NON-HUMANS

1.2.1. Beginnings of non-human use globally

Antibiotics were used in animals since the earliest times of their existence; however, most historical accounts about them establish a clear separation between antibiotics as drugs to preserve human lives and antibiotics as substances given to animals to make them grow faster and healthier (Bud, 2007). Therefore, this report reflects this separation by the division of human and non-human uses of antibiotics into two different sections.

Non-human antibiotic use has been growing exponentially since the early 1950s, and currently forms a quarter of the global total use (Bud, 2007). Non-human use is also understood as 'agricultural' use, and involves the treatment of animals and, to a lesser extent, plants and seeds. We commonly establish two different kinds of use: therapeutic and non-therapeutic.

Therapeutic use came first, and is documented since the trials of penicillin in treating common animal diseases such as mastitis. One example can be found in the 'Journal of The Royal Agricultural Society of England', which in 1945 published an article listing "diseases of animals", among which it is possible to find mastitis ('Diseases of Animals', 1945). For treating this disease, the article details the most extended use (at that time) of sulphonamides, which only worked partially, alleviating symptoms but not "sterilising" the animal against the infection and preventing it from becoming recurrent. To deal with this the use of 'new agents' is encouraged, "especially the antibiotic penicillin". The same journal displays reports of penicillin becoming more available and widespread among farmers throughout the US and Canada.

However, as soon as the possibilities of using antibiotics as enablers for industrialised agricultural production were known, the degree of non-therapeutic use grew exponentially (Compassion in World Farming, 2011; Kirchhelle, 2018). Antibiotics can prevent infections in crowded animals, reducing the need for space and allowing more efficient production; this, added to the uses for accelerating the growth of young animals, sustained the advance of intensive agriculture (Bud, 2007). And, in turn, the consolidation of these farm-factories sustained the diet changes and released labour, opening the way for 'modern society'.

The relation of antibiotics with 'production' and market systems goes even further. Kirchhelle (2018) has identified certain interwar links connecting US pharmaceutical and feedstuff companies: some industrial researchers devised non-human and non-therapeutical applications as a profitable new source of income beyond the already-saturated human antibiotic market. Hence antibiotic growth promoters (AGPs) – which were supposed to also be prophylaxis against bacterial disease – started to be routinely mixed in animal feeds. And there was more: the use of antibiotics with agricultural purposes kept growing and, from the mid-1950s, streptomycin sprays were used for the treatment and prevention of plant diseases and tetracycline preservatives were included in the treatment of fish, shellfish and poultry (Kirchhelle, 2020). Relatedly, the Food and Agriculture Organisation of the United Nations (FAO) also published directions about the use of antibiotics in agriculture, mentioning the different uses (especially in fish preservation) that took place during the 1950s and '60s (FAO, 1961, 1964a, 1964b).

In Europe, antibiotics started being used for individual animals with therapeutic purposes, but the economic improvements and the arrival of cheaper medicines and AGPs led to the quick spread of antibiotic consumption. By the middle of the '50s, it was legal to use antibiotics without veterinary prescription in all the European territories (Kirchhelle, 2018). In the specific case of the UK, this spread was not regarded with much optimism and the authorities in charge tried to control it – as is proven by the fact that the Penicillin Act and the Therapeutic Substances Acts (1947-54) forbade the use of antibiotics without prescription regardless of the nature of that use. This hesitancy was a response to the already-known threats of antibiotic resistance (AMR) that clashed with the demands for increased productivity. The scales finally tipped in favour of the agricultural benefits that antibiotic use was bringing, based on the belief that the bacteria causing disease in humans and animals were not the same, and that therefore resistance was not a major problem (Bud, 2007).

Accordingly, the situation changed in the UK during the mid-1950s when the use of AGPs began to be allowed; however, the UK government only allowed farmers to purchase premixed antibiotic solutions and feeds, instead of buying the pure drugs and mixing them themselves. Thus, veterinarians kept more control over antibiotics than their peers in the US (Compassion in World Farming, 2011; Kirchhelle, 2020).

According to Kirchhelle, how different sectors incorporated antibiotics in the UK varied greatly – they were faster and more widely spread in poultry than in any other livestock, for example. Specifically, Kirchhelle says "there is not always a correlation between European intensification and antibiotic use but sinking drug prices and pressure for efficiency gradually overcame agricultural hesitancy" (2018). The result was that, in the beginning of the 1960s, most of the mixed animal feeds in Europe and the US contained antibiotics.

1.2.1. Beginnings of non-human use globally

When looking into the early non-human uses of antibiotics in African settings, the landscape seems quite different from the human one. In those colonised settings, antibiotics were known and used in animals since the beginning of their existence, but their use was not as extensive as it was for curing human diseases. Also, unlike in Europe and the US, the early African uses of antibiotics in animals seem almost exclusively therapeutic, with limited mentions in some African scientific journals of attempts to use them as growth promotors – which were not described as overwhelmingly successful. A good example of this can be observed in the Annual Report of the Secretary of the Ministry of Agriculture in the Federation of Rhodesia and Nyasaland (years 1953-54): in this report, the mentions of antibiotics are scarce and slightly hesitant, referring to them more as "various new drugs" still being trialled than as medicines by themselves (Ministry of Agriculture of the Federation of Rhodesia and Nyasaland, 1953 - 1954). 'Antibiotics' as a generic term is mentioned as a treatment in a case of calf diphtheria, but it is accompanied by a cautionary declaration that "it can only be stated that the animal recovered" – as if they were not willing to attribute this to the drug. Penicillin and streptomycin are mentioned more explicitly as experimental treatments for fowl coryza; however, the sulpha drug 'Avisol' is named as the treatment of choice. Similar accounts are found in the 'South African Journal of Agricultural Science' and the 'South African Practitioner', where the uses, although slightly more prominent (it is possible to find a few mentions of veterinary uses in poultry and cattle during the late 1950s), remain mainly experimental and definitely not widespread – as we can observe in Table 3.

An interview with Interviewee #2, a veterinary doctor from Uganda, points to tetracycline (with trade names such as Ngombemycine), streptomycin and penicillin as the most used drugs in the 1960s – in contrast with now, when people use a wide diversity of drugs with ever-changing trade names such as gentamycin, neomycin, etc. The next table describes early uses of antibiotics for non-human purposes in African settings:

Year of mention	Use/Mention of antibiotic	Publication ⁵
1946	Request for penicillin to be available in British colonies.	Chemist & Druggist (UK)
1949	Streptomycin as an effective treatment for tomato canker in South Africa. Fur- ther trials in 1954 and 1960.	South African Journal of Agricultural Science (SA)
1951	Successful use of chlortetracycline for mastitis and other veterinary uses.	Chemist & Druggist (UK)
1953	Aureomycin for the treatment of the <i>Thieileria parva</i> infection in South Africa. Further uses in other parts of East Africa.	Nature (UK)
1954	Use of 'antibiotics' (unspecific) in a case of calf diphtheria. Fowl coryza experiments: penicillin and streptomycin. Both in the Federation of Rhodesia and Nyasaland.	Annual Report of the Secretary to the Federal ministry of agriculture (Federation of Rhodesia and Nyasaland)
1958	Use of penicillin in poultry production in South Africa.	South African Journal of Agricultural Science (SA)

Table 3: Examples of early non-human uses of antibiotics in African settings.

Year of mention	Use/Mention of antibiotic	Publication ⁵
1958	'Aurofac' (chlortetracycline) used in trial for growth promotion in pigs in South Africa	South African Journal of Agricultural Science (SA)
1959	Trial of a series of antibiotics – use as seed protectants in South Africa.	South African Journal of Agricultural Science (SA)
1959	Penicillin used for the treatment of mastitis in South Africa.	South African Practitioner (SA)
1961	Penicillin, streptomycin, bacitracin, terramycin, endomycin, erythromycin, thiolutin, oleandomycin, vancomycin & novobiocin – study of the absorption of antibiotics by soil.	South African Journal of Agricultural Science (SA)

FOWL CORYZA EXPERIMENTS

Fowl coryza experiments were initiated as a direct result of a widespread occurrence of respiratory disease in the Salisbury District.

The experiments were of two types, viz,-

1. To assay various methods of treatment then in vogue on birds suffering from fowl coryza.

2. To determine whether the infective agent was viral or bacterial. The possibility of avitamonosis A being responsible was covered in the first part of the experiment.

The first part of the experiment consisted of dividing ailing birds into groups, including a control group which was left untreated. The other groups were treated individually with 50,000 units of penicillin intramuscularly daily and in another section of the experiment intratracheally at the same dosage rate.

Treatment lasted for four days in each case. Another group was treated with sulphadiazine and also with sulphadiazine plus cod liver oil by mouth. The results of this part of the experiment revealed little or no change in the birds in all groups, excepting that the penicillin treated groups lost less weight over the experimental period. Evidence was thus inconclusive, especially in view of the small number of experimental birds involved. If anything, the penicillin birds responded better than the sulphadiazine treated ones.

It should be noted that the proprietary brand of "Avisol" is now named as the drug of choice for treatment of fowl coryza and appears to be effective. No experiments involving the use of this drug have been done to date.

The second part of the experiment consisted of dividing healthy susceptible birds into groups and infecting them artificially by different routes with suspension of ground-up lungs in saline, treated and untreated with penicillin and streptomycin in

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Figure 4: Example of antibiotic use in animals. Annual Report of the Secretary to the Ministry of Agriculture (Federation of Rhodesia and Nyasaland, 1954).

As we can see, none of the sources reviewed provide evidence of massive use of antibiotics from the 1940s to the 1960s. Furthermore, this kind of use remained absent until much later in the century. Interviewee #2 revealed that, even though antibiotics seem to have been around since the 1960s, the 'boom' in their use did not happen until the '80s, following the dismantling of the colonial veterinary system: "the misuse started after the SAPs [Structural Adjustment Programmes] because anybody could now import. The moment everybody started importing and the pharmacies mushroomed, then the misuse started".

Indeed, veterinary services were incredibly important for colonial governments. Given that productivity and economic growth were a large part of the colonial agenda and the rural nature of most colonial settings, the aim of boosting commercial agriculture needed to be complemented with a functioning veterinary counterpart (Brown and Gilfoyle, 2010; Hodge, 2007). However, as we will see in more depth further on, the main challenges for settler agriculture could not be solved by using antibiotics; the most pressing threat for livestock production were diseases spread by ticks, and these were prevented by the movement of stock to different areas (free of ticks) and by livestock 'dipping' tanks with insecticide solution. The main animal epidemic treated by antibiotics was East Coast fever – it is possible to identify some accounts of the use of aureomycin and other suppressive antibiotics for its control (Barnett and Brocklesby, 1966; Giblin, 1990). Yet these accounts also mention that antibiotics tended to be regarded as a last resort, with other immunization methods being preferred. As this is also a tick-borne disease, 'dipping' also had an important role in prevention.

The purely commercial side of livestock production was not free of problems itself – there is a consensus in historical literature about the "lack of development of commercial livestock production" in the colonies (Schneider et al., 1974; Zeleza, 1985). A number of initiatives to promote a Western model of commercial production were implemented, but none seem to have been very successful – see, for example, the meat-packing industry that briefly monopolised production in Southern Rhodesia (Phimister, 1978).

Looking at the accounts of the colonial veterinary system in the same way that we look at the health system for humans suggests that the struggle to 'colonise' animal production was greater than its human counterpart – often, veterinary measures were not easily accepted by local populations, and the tension between African pastoralists and farmers and Europeans has been widely reported and evidenced (Anderson, 1993; Kalinga, 1993; Quam, 1978). It is important to mention the differences existing between the countries where African pastoralism dominates (for example, Uganda) and where European farmers emigrated in large numbers (for example, Southern Rhodesia) – in the mostly African countries the struggle was directed to build a Western-like production system, while in places with more white settlers, the main issue were land disputes. This section summarises the ways in which British colonies organised around human and non-human health concerns in the years preceding the advent of antibiotics. The healthcare and veterinary systems are described in the context of the different missions and interests that guided colonial endeavours in the three countries of interest. Regarding human healthcare, we present the formulations and priorities of the Colonial Medical Service as well as missionary healthcare. For the non-human sector, we describe the settings and main worries of the colonial veterinary services. This section relies on interpretations from secondary sources as well as primary materials to describe the context in each selected country.

2.1. COLONIAL MANAGEMENT OF HUMAN HEALTH

Looking at historical accounts of the early colonial period in the late nineteenth century, it becomes evident that in none of the three focus countries did colonial authorities have a clear intention of creating an integrated health system for the whole population (M. Gelfand, 1976; Hokkanen, 2016; Holden, 2015; Ncube, 2012). Vaughan (1991) describes an "impoverished early colonial state" in Nyasaland (now Malawi), which did not provide any kind of education or health services except for white minorities. Similar situations were taking place in the rest of East and Central Africa; in Zimbabwe, for, example, from the start of the colonisation in 1890 to the mid-1920s, healthcare was not provided at all, as the British South Africa Chartered Company – in charge of the management of the colony at the time – did not accept any responsibility for the health of indigenous people (Mutizwa-Mangiza, 1996). As these examples show, early colonial healthcare was scarce and ad hoc, and, up to the 1920s, was focused almost exclusively on maintaining the health of the colonial officers and the early settlers – who were not adapted to the rigours of a warm, tropical climate. Both Vaughan and Mutizwa-Mangiza relate how the environment was perceived as strange, hostile and unhealthy, reinforcing the idea of the need for 'civilisation' and the virtues of the imperialist enterprise.

However, as Marks and Andersson explain (1988), it soon became clear to the colonial powers that the health of European expats was not isolated, but in fact closely connected to the health of the native population. Several authors have described how epidemics provoked the fear of diseases "knowing no colour bar", which was the driver of "drastic interventions" in several parts of sub-Saharan Africa (Marks and Andersson, 1988; Packard, 1990). This fear prompted the appearance of some initiatives to manage the health of Africans in order to avoid it becoming a threat to Europeans' health. These initiatives were formulated on the assumption that African populations were a 'reservoir of disease', a 'risk factor' that should be either avoided or taken care of (Dube, 2009; Ncube, 2012) – a pervasive notion that would persist into the future.

Consequently, the first public-health initiatives were mostly policies of separation, trying to keep the disease 'contained' outside the settler sphere. For this, authorities implemented regulations to segregate housing, food preservation and even washing and laundry (Holden, 2015). With the increased migratory movements of native populations in search

of jobs, the effectiveness and reach of these segregating initiatives was limited. Holden (2015) describes how, in Uganda, the new century brought new notions of development: health was not only a matter of fear and survival anymore. A certain sense of responsibility towards African health – added to the growing economic importance of the African workforce to colonial economies – brought the systematisation of healthcare to the fore of colonial interest.

Further on, during the first decades of the twentieth century, public-health initiatives in Central and East Africa took the form of irregular 'campaigns' for the prevention and treatment of diseases. Vaughan describes how these methods, more similar to military operations than to a healthcare system, considered Africans as a mass, as part of the same hostile, unhealthy and dangerous environment that had to be controlled and contained (Vaughan, 1991). At that time, colonial health systems were based on prevention and health education, responding to the need to fight a "pathological environment" and to the mission to "civilize" and "educate" populations in 'proper' and 'rational' behaviours (Monnais, 2009). These beginnings also set the framework in which further public-health initiatives would be developed, shaping the Colonial Health Service for Africans as a "native service, catering for a non-developed, subject population" (Ncube, 2012) – which would trigger a number of problems in the design and implementation of those public-health initiatives. Relatedly, colonial health discourses shared a view of ill health as "inherently African" (Ncube, 2012), and so formulated policies and bio-cultural theories based on this perception.

Despite the recognition of the importance of maintaining the health of Africans, governmental services still took a while to become functional. Missionaries were the first formal providers of biomedical healthcare in Malawi, Uganda and Zimbabwe (Doyle et al., 2020; Hokkanen, 2016; Pringle, 2019), just as they were in most other African colonies. Missionaries also took the lead in training native health staff. Responding to the need for health staff, as well as taking part in the 'civilisation process', the first native nurses were missionary-trained in 1903 in Sierra Leone.

In Zimbabwe, in common with elsewhere on the continent, missionaries were the only providers of education or healthcare for African people up to the 1930s, especially in rural areas. However, missionary organisations often faced a lack of resources, which limited the range and quality of care they could deliver. Later in the century, during the interwar period, the growing demand for healthcare along with the greater incidence of infectious diseases and epidemics led missionaries to call upon the government for assistance (Waite, 2000). It was only when the British Colonial Office passed the Public Health Act (1925) that the role and obligations of the colonial government were defined (Gelfand, 1953). However, as Mutizwa-Mangiza states in her thesis on the medical profession in Zimbabwe (1996), the Act focused on the colonial government's responsibility to tackle infectious diseases. Up to the Second World War, the Rhodesian healthcare system developed in a "haphazard and uncoordinated manner" due to the lack of expertise and the everchanging circumstances (Mutizwa-Mangiza, 1996). Colonial authorities did not put special emphasis on the provision of curative services, but rather focused on 'preventive measures' such as segregation between settlers and native populations, imposition of Western hygienic prac-

tices and 'disinfection' campaigns (through practices such as the spraying of insecticides in rural areas). The Native Medical Services grew up as a rudimentary health system consisting of some hospitals for Africans in the urban areas and collaboration with missionaries in rural areas (Waite, 2000).

Just as in the example of Zimbabwe, biomedical healthcare in many colonial African settings followed a similar pattern of segregation, Eurocentrism and privilege of the wealthiest social groups. The Second World War meant the beginning of greater government outlay in African healthcare, as well as a more interventionist policy. This entailed the 'secularisation' of the welfare movement (Vaughan, 1991), which, consequently, involved a reduction of the missionary input in health and education.

This was the time when antibiotics appeared in the picture, greatly affecting colonial health systems – both for humans and non-humans –, but also being inserted in and shaped by them. Before getting into the details of antibiotics, in the next sections we will review the main characteristics and activities of these health systems, starting with a description of the governmental and missionary medical services, and concluding with a review of the veterinary service.

2.2. THE COLONIAL MEDICAL SERVICE

The existence of the Colonial Medical Service (CMS) was one of the necessary conditions for the arrival of antibiotics in the three focus countries, alongside the work of missionaries in healthcare. In order to accomplish the goals of the imperial project, colonial powers had to maintain the health of both settlers and African populations. Antibiotics seemed to be the perfect tool for this, as they enabled rapid and effective recovery from diseases, keeping a sufficiently 'healthy' workforce – that is, keeping populations productive. However, as we will see, this was by no means a straightforward process: economic pressures and moral concerns caused a number of tensions and conflicts in the arrival and spread of antibiotics.

On September 4th 1937, the British Medical Journal included a description of 'The colonial medical service' (CMS), covering all the countries under British rule⁶. As described there, the East African branch of the service included Kenya, Uganda, Tanganyika Territory, Northern Rhodesia, Nyasaland, Zanzibar, and British Somaliland, and had a "very wide scope for clinical work, both medical and surgical, as well as for research and for preventive medicine and sanitation". Indeed, the approach of the East African colonial governments to healthcare up to the First World War has been widely characterized as 'public-health oriented' (Doyle et al., 2020), as it was from the beginning focused on prevention and containment of disease rather than on curative practice.

⁶ A more detailed description of the CMS can be found in Appendix 1.

This orientation is not unique to the African context, but rather imported from a Western context, which considered it a personal responsibility to maintain one's own welfare (Bud, 2007; Macfarlane and Worboys, 2008). Health was regarded as a moral duty; therefore, illness meant a failure in this duty – and, as we will discuss later on, bringing this 'superior morality' to colonial settings was one of the main means of legitimisation of the imperial project. This increased concerns for white settlers' health; hence, the governmental attention to the prevention of infectious diseases was, to a large extent, driven by this 'morality of health'.

Using Western medicines was considered a true benefit for African societies; this is described by Iliffe (1998) who, based on his extensive research regarding the professionalisation of African doctors from the 1870s to the present day, illustrates this with the words of a medical officer who worked in Uganda in 1950: "we share with the rest of the medical world the great privilege of treating patients with the newer drugs, especially the sulphonamides and penicillin" (1998: 133). However, this was not without consequences, such as an increased demand for drugs that often was regarded with concern by colonial medical authorities.

A good example of this can be seen in a circular memorandum from the Medical Department of Uganda (1959), which was released to make hospital staff aware of some directions about "the use and misuse of antibiotics". This memorandum lists the "main antibiotics" that are meant to be used only when it is proven that they are potentially effective (that is, when the sensitivity of the pathogen to the antibiotic has been proven, or when there have been past positive results). Their use in "desperate situations" is allowed even if the diagnosis is in doubt, but they recommend keeping these occasions to a minimum. As for the use of particular antibiotics, oral penicillin is considered "an expensive luxury", with injections being the standard form of administration. Penicillin courses are recommended to be kept "short", with a standard course of five days/shots that can be shorter if necessary. Use of penicillin as "prophylaxis" after cold surgical operations is disapproved of. Another antibiotic mentioned is streptomycin, whose use is discouraged given that "it is far more expensive than penicillin" –use of cheaper alternatives is encouraged when possible, for financial reasons. Finally, the broad-spectrum antibiotics "should not be used indiscriminately because of their great expense and because suitable alternatives are often available".

We can observe in this example the constant presence of economic concerns within the Medical Department. These concerns resulted in measures such as the reduction of antibiotic courses and the constant search for the cheapest alternative (which often was not the most effective one). And these measures were a major force that shaped the use of antibiotics in the African colonies – and, as we will discuss in further sections, it can be related to some uses today.

Holden states that "colonial medical services were constantly overburdened and under-resourced and frequently forced to concentrate on curative services with their quick results rather than on preventive measures" (2015: 73). Another consequence of this was the expansion of the reach of the CMS, looking for collaborations beyond the state – formally and informally. These collaborations were established with a range of non-governmental groups with an interest in the African territories (Greenwood, 2016). And, as we will see further on, the role of missionaries stands out among these collaborations.

2.3. MISSIONARY HEALTHCARE

A number of historical accounts about the medical missions in Africa refer to the high level of collaboration between missionary doctors and the CMS (Chanaiwa, 1981; Greenwood, 2016; Hokkanen, 2016; Pringle, 2019). Moreover, delivery of healthcare by missionaries often went beyond the scope of the CMS, and was the main provider of medicines within rural areas up to the 1930s – and, in some places, up to the 1950s and '60s. Therefore, missionary organisations played an essential role in the arrival and spread of antibiotics in Africa.

A number of authors have highlighted the importance of missionary work in the three focus countries (Mutizwa-Mangiza, 1996; Pringle, 2019; Vaughan, 1991) – which, most likely, resembles many other British colonial settings on the African continent. This meant that, for most Africans, their only contact with Western biomedicine was through missions – which gave them an explicitly religious and moralising version of it (Vaughan, 1991).

The nature of missionary work was never well defined, as the 'missionary' element was rather vague (Pringle, 2019). The broad idea was to make the native population more receptive to Christian messages through the 'amazement' produced by the effects of Western medicine – which meant missions profited from the adoption of the latest therapeutical techniques. In this sense, antibiotics were received with enthusiasm, as they had the potential to be another powerful 'evangelisation tool'.

Undoubtedly, there was a strong religious motivation underlying missionary medical services. Healthcare, in its capacity of provoking a 'sense of wonder', was meant to create an association of the 'goodness of medicines' with the 'goodness of God'. Therefore, medical treatment of Africans came to be recognised as an important part of missionary work, and one of the ways in which native populations were attracted to the 'Western way' (Gelfand, 1976). Additionally, as Vaughan (1991) points out, long-term healthcare opened up new possibilities for conversion – which drove missionary interest in the care of people with chronic illness or in need of long-term treatments (such as leprosy, tuberculosis, etc.). The long stay in a Christian environment with a constant exposure to religious imagery, rites and preaching was supposed to encourage patients towards their conversion to Christianity. Also, physical transformation was regarded as a direct sign of spiritual transformation – thus, the healing of the body was directly related to the healing of the soul. Therefore, the arrival of the new effective antimicrobial drugs played a very important role in this consideration, as, on one hand, they boosted the healing rates, but, on the other hand, they reduced the treatment times, threatening this long-term conversion strategy.

Another important aim of missionary healthcare was in line with the colonial project, in the sense that they sought to displace witch-doctors and traditional healers (Doyal and Penne-II, 1979; Gelfand, 1976). Antibiotics, being effective treatments for long-dreaded infectious diseases, were meant to be the definitive proof of the superiority of the Western system of thought, and, by extension, of the superiority of Christian beliefs. For the missionaries, the 'cure of souls' was not compatible with traditional beliefs, necessarily involving Christian conversion. Traditional medicine was considered to be 'witchcraft' and 'sorcery', and so uncivilised and evil (Digby and Sweet, 2002) – hence, the role of missionary doctors was to convert Africans away from this. Dube (2009) considers this rivalry between traditional and Western health providers as a manifestation of the missionary agenda of turning Africans into "a new class of individualist westernised Christians operating in the market economy". Biomedicine and, specifically, antibiotics, appear here as a political tool for weakening the foundations of traditional society.

2.3.1. Collaboration and tensions between the CMS and missions

We mentioned at the beginning of section 2.3. the close contact that existed between the CMS and missions. This contact became a source of collaborations, as missionaries and medical officers shared knowledge and, on occasions, resources – among which were antibiotics. However, there were also conflicts and power struggles between them, making the relation between missionaries and the CMS complex and changing throughout the colonial period.

When talking about collaborations, the intertwinement between the two organisations was such that sometimes the same person was performing a dual role as missionary and colonial medical officer, as is described by Pringle (2019). This was possible because, although missionary organisations and the Colonial Medical Service had different agendas, they had overlapping interests – as we have seen in previous sections. The mission doctors had developed important skills, such as communication in local languages, and were attentive to record keeping. This made them useful for the establishment of colonial rule, and they were frequently asked by government officers for advice. Moreover, up to the Second World War, their will to take charge of African healthcare meant a welcome relief for the small government services – which were, in most African colonies, allocating all their energies and resources to maintain the health of government employees or to carry out high-profile campaigns against epidemic diseases (Hokkanen, 2016; Iliffe, 1998; Messac, 2014). Furthermore, as Hokkanen (2016) says, in Nyasaland the lack of government facilities in rural areas meant that, eventually, even government officers and their families were relying on missionary healthcare. It is likely that this situation was repeated in the rest of the focus countries.

It is also important to pay attention to the informal exchange of medicines and information – in Nyasaland, the Medical Department provided some missions with medicines during the interwar period (C. M. Good, 2004; Hokkanen, 2006, 2017), and, during most of the colonial period, missionaries and their assistants played a crucial role in the implementation of campaigns against epidemic disease. Medical missions and government services also exchanged knowledge, materials and staff in Uganda (Pringle, 2019) and other East African colonies (Crozier, 2007), with similar dynamics to the ones described for Malawi (frequent, but irregular and circumstantial exchanges). However, in spite of these collaborations, both groups still maintained their boundaries – and their particular agendas.

One of the friction points between governments and missions was different diagnoses of the root causes of disease in African societies (Vaughan, 1991). While the secular medical institutions used a model of 'collective pathology' that attributed the prevalence of disease to 'modern life' and the 'disintegration' of traditional African societies, the missionaries placed the focus on individuals. For the missionaries, disease was not a direct consequence of Western 'civilisation', but it could only be conquered through the adoption of a Christian morality and a sanitised and modern 'family life' (Vaughan, 1991).

Nonetheless, both tensions and collaborations point to the close relation between missions and the Colonial Medical Service, which was situated within a network of connections between doctors, patients, administrative staff, materials, medicines, pharmaceuticals, etc. This network was both built and constantly re-shaped by different flows of interest, which created the connections and conflicts between health actors. The place of antibiotics within this network was, therefore, highly influenced by these interests, which, to a great extent, were driven by colonial agendas.

2.4. COUNTRY-SPECIFIC HEALTH CARE CONTEXTS

Up until now, we have explored the formation, history and characteristics of the broader health system constructed by both missionary organisations and government medical departments. This is important because, by following the development and particularities of the colonial health systems, it is possible to see the political agendas that lay behind them and identify certain flows of interest that shaped the environment in which antibiotics arrived – and, indeed, have continued to re-construct it up to the present moment. However, antibiotics also filled the role of being vehicles for these flows, facilitating their expression and expansion when being traded, used, imagined, planned, disputed, etc.

To achieve a full understanding of how these flows operated, it is crucial to explore how they appear within the broader context of the British Empire, and, especially, how they are shaped by the different agendas of colonial authorities and other relevant actors. Comparing the three focus countries and the parallelisms and differences that can be established between provides depth to the analysis when considering the relationship between colonial agendas and healthcare.

2.4.1. Malawi

First, we can look into the particularities of the health system of Malawi (Nyasaland Protectorate during the colonial period). We have already mentioned the relatively small scope of Western medicine during the first decades of colonisation, and the great importance of missionary organisations as the main providers of healthcare. This situation changed in the 1930s and during the Second World War, when, as described by Messac (2014), biomedical services for Africans expanded, becoming more structured and more widely available. This expansion responded to the interests of colonial authorities, as the generalisation of and free access to Western healthcare would boost the productivity of African workers – a healthy workforce being far more profitable than a sick one. It also stood to eliminate potential associations of traditional healing practices with local identities – which threated to incite revolutionary behaviours (Gelfand, 1976) – while, additionally, bringing the 'gift' of biomedicine (considered the best and most efficient way of healing people) would justify the colonial objectives of British imperialism, supporting their 'civilisation' mission.

The expansion of free access to colonial healthcare for Africans in Malawi also coincided with early advances in the pharmaceutical industry and with the growing use of chemotherapy for the treatment of infectious disease – which meant the possibility of providing healthcare without the need for expensive infrastructures, using mainly drugs (Venkat, 2016). According to Messac (2014), this system continued throughout the colonial period, and its footprint reached long after: healthcare fees in Malawi remained some of the lowest for most of the twentieth century.

2.4.2. Zimbabwe

In contrast with to the case of Malawi, the health system of Zimbabwe (then Southern Rhodesia) was clearly designed around the need to cover the white settlers that populated the country. Even though they were a minority, they constituted an important part of the economic system of the country, as they owned the most productive lands, which made this group an important lobby group and point of interest for the colonial government (Chanaiwa, 1981; Duggan, 1980; Mutizwa-Mangiza, 1996).

Moreover, as Southern Rhodesia was a self-governed colony, their aim was to attract more white settlers who would reinforce the power of the white minority, rendering the colony more like a Western-like setting. With this aim, hospitals for Europeans were modern and expensive, designed to resemble the ones found in European contexts (Good, 1974; Mlambo, 1998). Consequently, as we have seen, practically the only healthcare available for Africans was delivered by missionary doctors, especially in the case of rural or more inaccessible areas (Gelfand, 1976; Ncube, 2012).

It is important to note here that the situation in these two countries shifted slightly when the Federation of Rhodesia and Nyasaland was created. The political union of both territories was an attempt to increase economic and political growth, and to face the social changes within the territories by 'uniting forces' (Gear, 1960; Keatley, 1963). Thus, the appearance of the federation caused an alignment of the two countries' interests, to the extent that the medical services and other 'health' matters started to be a prerogative of the Federation. However, this apparently harmonic union did not last long, and it was always possible to find inner differences of decision-making power. Southern Rhodesia, as the wealthiest region, had more weight in the Federation than the other two countries, and maintained autonomy in many political and administrative decisions.

2.4.3. Uganda

As Uganda was also a Protectorate, the healthcare situation was similar to the one in Malawi (Holden, 2015; White, 1995) – with the difference of the pre-existence of the Kingdom of Buganda, which allowed a more efficient application of indirect rule (Roberts, 1963). Again, we find in Uganda a small, unorganised medical service that depended to a large extent on the activities of missionary doctors.

The main healthcare worries for the Ugandan colonial government were concerned with migrant labour as it became an important part of the workforce, which is reflected in the Annual Reports of the Medical Department (Uganda Medical Department, 1945-1951). In 1948, the Department warned about the increasing incidence of disease among African migrants and urged the government to act. The reasons outlined range from the "humanitarian point of view" to explicit concerns about how "the immigrant's productivity as a labourer is lowered", and about how "it is bound to harm the indigenous population directly and indirectly".

Looking at these examples, it becomes clear how colonial interests shaped the different health systems, as these systems were designed to fulfil the colonisers' ultimate purposes.

2.5. VETERINARY SERVICE

It was not only human health that was shaped by the interests of colonial powers: commercial agriculture was also an important asset for the British Empire, and this became a point of major interest and concern in the colonisation of Africa. However, the expansion of trade that was carried out to reach these colonial goals had an unwanted side effect, disseminating Old-World pathogens to the newly incorporated territories and causing major epizootics during the second half of the nineteenth and first decades of the twentieth centuries (Brown and Gilfoyle, 2010). Diseases like rinderpest became a major problem, requiring a fast and efficient solution and leading to the creation of colonial veterinary services – and the allocation of a large amount of funds to the matter, as is demonstrated by the announcement that Mr. James Griffiths (Secretary of State for the Colonies) made in 1950 of the issue of £146,865 from the Colonial Development Welfare Research Funds for veterinary projects to assist in the coming African cattle diseases. A good example of colonial veterinary systems – and how they were shaped by these fears and interests – is described by Figuié, Binot and Caron (2015), who analyse the interventionist policy that the colonial government adopted in Southern Rhodesia. The Rhodesian Veterinary Service was created in 1896 under the authority of Elias Grey (its first head) and, in the same year, the 'Animal Disease Act' was passed to give power to the Service to quarantine or cull sick animals. This "authoritarian colonial veterinary regime" implemented preventive measures (such as compulsory vaccination of imported animals, which were more susceptible to disease), which culminated in the 1930s with the 'Land Apportionment Act' of 1931 that gave absolute power to the Veterinary Service to control animal growing and production in the country following the foot and mouth disease epizootic (Figuié et al., 2015).

The case of the Ugandan Veterinary service is also useful in illustrating the role of antibiotics and their insertion and use within the system. To achieve a better understanding of the functioning of this service we can refer to the interview carried out with Interviewee #2, a Ugandan veterinary doctor who carried out his work starting in the late 1950s. Uganda's Veterinary Service was reinforced in the '50s following a serious epidemic of rinderpest that obliged colonial authorities to strengthen their control of vaccinations and surveillance, and they started to widely train local people as veterinary staff. As Interviewee #2 remembers it, by the year 1956, a good-quality veterinary service was already running in Uganda.

During the late years of colonial rule (around the '50s and '60s), Uganda, like several other British domains in Africa, was trying to improve its economy by raising its productivity (Bolt and Green, 2015; Quam, 1978). A system was created in which the so-called 'progressive farmers' were encouraged to move out of subsistence to commercial production (a similar program was implemented in Nyasaland, called the 'Master Farmer's Scheme' (Kalinga, 1993)). This program provided these farmers with subventions and grants in order to help, for example, those wanting to fence off their farms, develop better pastures or control ticks (Bowden and Moris, 1969; Carswell, 2002). Among these aids, an amount of imported goods was provided to the farmers, and these included drugs – however, they were not allowed to use the drugs themselves, being instead obliged to report to the Veterinary Office.

The Colonial Veterinary Office, according to Interviewee #2, included professional veterinary officers, diploma-holding animal husbandry officers and certified veterinary assistants – complemented on the ground by 'field assistants' (also called 'veterinary scouts'), who held a specific surveillance role. Therefore, all the supplies of drugs were tightly controlled by the government, who regulated and restricted their use.

It was after independence, when the Structural Adjustment Programmes came into force in 1993, that the private sector took over this strictly controlled system and the trade and use of antibiotics grew exponentially.

2.5.1. Key concerns of the colonial veterinary service

We have already established the crucial importance of the veterinary system for the colonial authorities during and after the colonisation process. However, as we have mentioned, antibiotics do not seem to have constituted a great part of this system until much after African countries became independent. This can be attributed to the conjunction of multiple factors, such as the economic constraints that the colonies were constantly facing (which obliged them to prioritise and figure out the most efficient ways of using resources) and, as the scientific literature of that time shows, the nature of the major veterinary threats (for which antibiotics were not so useful).

The main worries for farmers and veterinarians in colonial Africa were related to the insertion of new breeds and farming techniques into a foreign environment, which often caused a disruption of the ecological balance and, therefore, prompted the appearance of epizootic diseases with dramatic consequences (Anderson, 1993). These problems were not unknown by the colonial authorities, as is shown by the records of the Annual Conferences of the Professional Officers of the Department of Research and Specialist Services that was organised by the Federal Ministry of Agriculture of Rhodesia and Nyasaland (Federal Ministry of Agriculture, 1956, 1960, 1963). In these conferences, the difficulty of carrying on with Western ways of farming and land use in those latitudes is acknowledged, to the extent of considering research into "native agricultural ways". Nonetheless, discussions always seem to have concluded in favour of keeping trying with 'modern' techniques that, ultimately, would ensure the production and efficiency of the system.

These conferences also echo the key concerns that are depicted and analysed in scientific journals and papers of the time, all of them related to the climate and the soil: erosion and uncontrolled floods that affect crops, leading to malnourished livestock and the propagation of tick-borne diseases. As a consequence, the use of antibiotics made little sense under these circumstances, and chemicals like fertilisers, insecticides, protein/nutritional supplements, etc. were prioritised instead.

When observing concerns about disease at this time, we see that most major epizootics had a parasitic or protozoic origin. During 1956, Dr. LeRoux travelled through the territories of the Federation investigating animal parasitism and the effects that it may had in the livestock industry there (Leroux, 1957). He identified a high number of helminths and made recommendations to the government for their treatment and control – focusing on the use of insecticides, quarantines and movement of the herds.

In the literature available about this topic (Brown and Gilfoyle, 2010; Figuié et al., 2015; Steele, 1981), three diseases stand out as most problematic:

- Animal trypanosomiasis: a protozoic disease transmitted by ticks, usually prevented by the use of insecticide 'dipping'.
- Rinderpest: an infectious viral disease affecting mostly cattle, usually controlled by quarantines.
- East coast fever: another protozoan parasitic disease, often transmitted by ticks; even though there is some evidence of antibiotic use to treat it (Neitz, 1953), other control methods such as insecticide 'dipping' are generally preferred.

As we can observe, the main control technique was based on the use of insecticide and 'dipping tanks' for cattle – while the importance of antibiotics is secondary, being used only rarely. In the interview carried out with Interviewee #2, the vet from Uganda, he talked about how there were some attempts to treat rinderpest with antibiotics, but the colonial government did not allow it based on the inefficacy of the drugs to fight a viral disease: "when an animal is sick [with rinderpest], it dies. Animals infected with tick-borne diseases may die or cure, if you treat them with antibiotics they may cure, but if it was rinderpest, we had to automatically kill them. At that time, antibiotics were in the hands of government officials who obeyed the procedure".

The other great worry was soil erosion. According to Duggan (1980), almost all the government expenditure in the 1940s and most of the 1950s was on basic soil to maintain the fertility of the land. Maintaining soil fertility was the only way to provide proper standards of living and nutrition, so colonial ministries of agriculture put a great deal of effort into that (Hodge, 2007).

Veterinary and soil scientists attributed the issue of erosion to overgrazing, so they pushed for measures to control it. These measures were based on controlling the grazing of the herds and limiting the number of animals, forcing African farmers to reduce their herds – which made these measures unpopular and caused tensions between governments and farmers. The most immediate reaction to the difficulties caused by land degradation was the insertion of new inorganic and mechanical techniques of cultivation, such as the use of artificial fertilisers, mechanic ploughing and other methods that entailed radical changes in local farming systems (Hodge, 2007). However, these methods did not make a significant impression on local farmers, and the strain of land degradation kept growing alongside rapid population growth and the abandonment of the rural environment through urban migration.

So far we have documented and contextualised the first appearances of antibiotics in African colonies. We now turn to the channels through which they arrived, and where they were coming from.

The role of colonial governments was undoubtedly crucial in the arrival of antibiotics. Very early on, the 'Chemist and Druggist' journal ('Penicillin for African Colonies', 1945)⁷ mentions the Department of Supply of the different African colonies as the institution that takes care of the provisions of commodities (antibiotics among them). Another article explains to young entrepreneurs how to 'pioneer in East Africa' as a pharmacist by being employed in the British Government's scheme for the production of groundnuts in East and Central Africa – revealing the role of pharmacists also within the government medical services. In July of 1946, this journal also talks about the concession of licenses for exporting penicillin to the British Colonies.

Hokkannen (2017) describes how in the late 1920s and early 1930s, the Nyasaland government took the initiative of selling drugs 'at landed cost price' (without freight costs in their arrival at the coast) to support the medical provision that large employers were offering to their employees. This 'aid' was beneficial for the government's own interests, ensuring that it would remain the major supplier of medicines to European employers operating in Nyasaland. This provoked criticism from the Nyasaland Pharmacies Company, who considered it an example of 'unfair competition', as this policy made the purchase of drugs from the government more appealing.

A similar tension appeared between the Colonial Office and the Proprietary Remedies Export Group in 1947 ('Proprietary Remedies Export Group', 1947), as the Colonial Office advised the import control authorities in the Colonies to refuse to grant import licenses for British goods. As the absolute majority of Western drugs used in the colonies were purchased from British suppliers (Hokkanen, 2017), the companies forming the Proprietary Remedies Export Group suffered losses because of colonial buyers turning to other sources of supply.

Indeed, the beginnings of pharmaceutical companies in colonial Africa were closely linked to their ability to import from the UK and the US, and so they were gathered in the wealthiest spots – most drug companies that established branches in Africa were settled in South Africa or, to a lesser extent, in Southern Rhodesia. Since the very beginning, many large pharmaceutical companies opened specifically African branches, which often still exist today – in Figures 5 and 6 we can see some images of logos of companies that had branches in Rhodesia, Nyasaland or Uganda. One good example of this is the case of Glaxo (now GSK), which opened its first African branch in Kenya in 1930 and now has extended its coverage over the whole continent. We can see more about this in Table 4, which reproduces an extract from the book *Making Medicines in Africa* written by Banda et al. (2016)

⁷ See Figure 2.

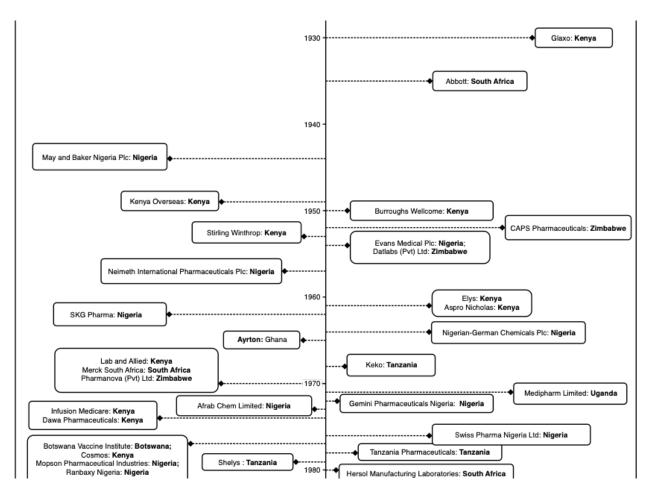


Table 4: Fragment of the table of selected pharmaceutical companies with a presence in African countries (Banda et al., 2016).

In the table, we can also observe how, after some years, a few factories for the manufacture of antibiotics were opened – for example, CAPS Pharmaceuticals opened its doors in Zimbabwe during the 1960s. However, the great majority of antibiotics used in most African countries still come in from other parts of the world through transcontinental trade. As we advanced above, in the period that this report is covering, the vast majority of antibiotics were imported from the UK and the US. These imports increased greatly over time, with the early addition of South African influences. There is strong evidence of American exports of chemicals – and, among them, antibiotics – to the British African colonies, particularly to the Federation of Rhodesia and Nyasaland, but also to Uganda. In Table 5, we can see a relation of these exports in the period around the 1950s and '60s - which we can compare with Table 6, showing the antibiotic imports of the Federation overall.

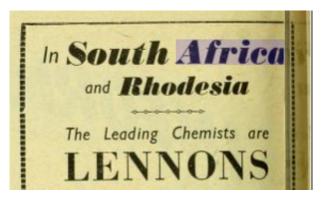


Figure 5: Example of pharmaceutical company with presence in Africa (Chemist and Druggist, 1950).

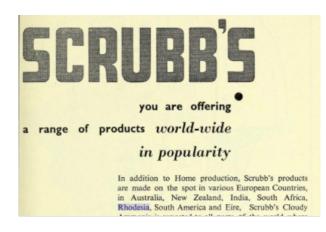


Figure 6: Example of pharmaceutical company with presence in Africa (Chemist and Druggist, 1953).t

Table XVII.—United States Trade With the Federation of Rhodesia and Nyasaland, by Commodity Groups and Principal Commodities, 1952–54

[Quantity in units indicated; value in thousands of U. S. dollars]

Commodity		Quantity			Value		
		1968	1954	1952	1953	1954	
	Exports to Federation of Rhodesia and Nyasaland						
Agricultural machines, implements, and parts				286 1, 334	257 963	213 685	
Tractor parts and accessories				977 571	543 329	200 894	
Motortrucks, buses, and chassis, new, commercial typesnumber Passenger cars and chassis, new "	27	21	467 25	110 47 414	19 44 206	583 46 265	
Railway transportation equipment	6	8		1,140	508 375	34	
Chamicals and related products 1 Medicinal and pharmaceutical preparations Biological products, cortisone and ACTH, all forms				559 95	554 79	848 109 61	
Antibiotics Chemical specialties				24 129	17 104	40	
Industrial chemicals 1. Synthetic collecting reagents	4, 395	2,666	6, 621	824 287	347 310 16	559 519 21	
and the second							

Table 5: Fragment of a list of American exports to the Federation of Rhodesia and Nyasaland, including antibiotics (Weeks and Macy, 1956)

Table XV.—Imports of Merchandise, by Commodity Groups and Principal Commodities, 1954—Continued

[Quantity in units indicated; value in thousands of pounds sterling]

Commodity	Quantity	Value	
Drugs, chemicals, and fertilizers, total		4, 490	
Other sodium compounds, n. e. e	,	201	
and pests, including cattle and sheep dip Disinfectants and germicides1,000 lb Chemicals, n. e. e	1, 726	521 91 258	
Medicinal preparations, n. e. e., nonspirituous Antibiotic agents and their salts Fertilizers:		645 203	
Superphosphates	112, 064 135, 490	587 1, 059	

Table 6: Fragment of a list of the total drug imports of the Federation of Rhodesia and Nyasaland, including antibiotics (Weeks and Macy, 1956)

4.1. Who could administer antibiotics?

Previously in this report, we talked about colonial governments' efforts to control medical practice through the imposition of a register of medical practitioners. The Colonial Medical Service controlled medical appointments in the self-governing colonies, such as Southern Rhodesia, and other territories under British control; positions were not in general open to candidates from the United Kingdom ('Registration Of Foreign Practitioners In Great Britain And The Dominions And Colonies', 1937). In the remaining territories that fell under the administrative direction of the Colonial Office, the appointments were made by the Secretary of State for the Colonies in that country.

Around 1945, mass production of penicillin started after the war scarcity. South Africa experienced a fall in the price of penicillin, creating a 'bank of penicillin' in defence against possible future shortages – a situation not well received by the United Kingdom, who accused South Africa of using 'too much' penicillin ('Penicillin in South Africa', 1946). The control of antibiotic use in each country responded to similar logics: the UK itself released the 'Penicillin Act' in 1947, safeguarding the governmental prerogative of deciding who could use and prescribe the 'new drug' (Bud, 2007). In 1951, aureomycin and chloram-phenicol were also brought within the scope of this act, which made them only available under prescription of health centres approved by the Ministry of Health.

In the colonies, the situation was far from so controlled, but some attempts were made to meet the standards – as shown by the 'Pharmacy, Poisons and Dangerous Drugs Act' that was established in Southern Rhodesia in 1952 ('Medical Council of Southern Rhodesia', 1955). Three years later, the Federation of Rhodesia and Nyasaland tried to establish a Medical Council in the Federation, similar to the one existing in Southern Rhodesia, since they considered that the separation of legislation was not providing 'satisfactory results' – however, this initiative never went through.

Another point of struggle involved private practitioners and their role in the delivery of healthcare in the colonies. In contrast to missionaries, private doctors mostly cared about white settlers, being driven by the aim of profit and business – to which end antibiotics helped a great deal (Bud, 2005). The governments agreed with this situation as long as it meant a reduction of the healthcare burden for themselves. However, problems were frequent – for example, in 1956 the Federal Assembly (of the Federation of Rhodesia and Nyasaland) complained about the government officers coming to the private practice in order to profit, charging fees to their patients while receiving government funding ('In the Federal Assembly', 1956). The competition of private doctors with other medical workers has also been described by Iliffe (1998), who traces the complaints of ex-public service workers who were not allowed to dedicate themselves to private practice until the late 1980s.

4.2. Tensions between medical practitioners and pharmaceuticals

Among the power struggles that arose in relation to antibiotic use, probably the main one was that between pharmacy workers and medical practitioners. The rise of a strong and effective pharmaceutical industry in the UK meant the increasing reliance of people on medicines as a way of maintaining their health (Bud, 2007).

But, as we have already mentioned, the spectre of resistance made concerns about overuse increasingly audible, leading to government restrictions on the sale and production of antibiotics in the UK. However, these restrictions became lighter under the pressure of a pharmaceutical industry that claimed not to be able to invest in the discovery of new antibiotics unless they were able to make a profit from their production.

This struggle to sell antibiotics over the counter was reproduced in our African focus countries and continues up to the present day (Bud, 2007; Iliffe, 1998). A correspondence exchange between the Chief Pharmacist of Kagardi Hospital (Uganda) and the Medical Superintendent as late as 1972 (Mapusl, 1972) can serve as a good example of these tensions between pharmaceuticals and medical practitioners. In this exchange, the Super-intendent urges the Chief Pharmacist to take measures regarding the failures of a drug dispensary in distributing antibiotics – apparently, the drugs were not reaching the in- and out-patients as they should have been. The instructions are to stop the activities of the dispensary until further notice – orders that the Pharmacist rejects in a further letter, making reference to a previous letter that allowed them to dispense 'minor antibiotics'. This cut and thrust points to the long-lasting struggle about who had the right of providing antibiotics to the general public, and how.

Talking about the patterns of penicillin use in the UK, Bud follows "the radical shifts in patients' attitudes to doctors that took place during the years after the Second World War" (2007:140). Around the 1950s and '60s, Bud describes a fall of trust in doctors: the accelerated 'pace' of living drove patients to demand drugs to get a 'quick fix' of their health problems, similar to what authors have noted in East Africa today (Denyer, Willis and Chandler, 2019). Although this situation was convenient for the more and more overwhelmed doctors, there started to be claims that regarded this situation as a deterioration of their service, advocating for going back to a model of healthcare that allowed doctors to build a relationship with their patients. As we can see from comparison with today's world, this patient-doctor relationship was never the same following the inclusion of the figure of the pharmaceutical (Macfarlane and Worboys, 2008), which established an interconnection covering patients, doctors, insurance bodies, pharmaceutical companies and the state.

These tensions around the administration of antibiotics were also taking place in African settings. There started to be a generalised feeling that patients needing modern drugs did not necessarily need doctors. Iliffe makes reference to this fact by pointing out that "as Trowell told the Frazer Committee in 1955, between 30 and 60 per cent of those attending Mulago Hospital could have treated themselves with drugs bought at a pharmacy" (1998: 134). Iliffe explains that, in Uganda, the arrival of antibiotics had consequences beyond

the obvious expansion of attendances in medical units (due to the ease and availability of effective treatments) – it also made the availability of drugs a central point of criticism of the medical system (meaning that a 'good' health system was defined by the disposal of medicines) and bred frustration among doctors if they could not provide their patients with the necessary drugs.

4.3. The informal sphere

The combination of the lack of resources with the perception of a decreasing need for professional doctors to use chemotherapy boosted the presence of antibiotics in the informal sphere. Many authors have made reference to this phenomenon – see, for example, Holden (2015), who describes how the black-market trade and theft of medical equipment were perennial problems for the colonial healthcare of Uganda, speaking about the "many accounts of the orderly that set up a centre outside of the hospital offering injections given with a blunt safety pin".

This phenomenon was also described by Iliffe, who talks about the figure of the 'needle man' in the Bunyole area of Uganda, a "retired tribal dresser or totally untrained practitioner with a syringe and some stolen phials of penicillin" (1998: 134). He also mentions the 'bush doctor' – who is described as a former health worker of lower range than a doctor "who has acquired needles and syringes illegally and some antibiotics and chloroquine. [... He] tries to combine both traditional and western medicine in his practice often with tragic results" (1998: 190). According to Iliffe, it was not unexpected to find former nurses and paramedics with less training than a doctor opening small illegal clinics or, more simply, selling drugs and injections from their own houses.

Wilcox (1949) saw this as a problem in the context of Southern Rhodesia, considering native medicines and extra-hospital treatments as 'risk factors' for the treatment of venereal diseases. In particular, he described the 'sophisticated' methods of the ex-medical orderlies who became 'native herbalists' and gave stolen drugs or useless injections to their patients.

This phenomenon was rooted in the interaction between the growth of chemotherapy and the weakening of the colonial state: the governmental ordinances that restricted drug administration and sale to anyone but authorised professionals were losing their power, opening the way for the rise of self-medication. Iliffe relates how "by the 1950s the repression of needle men and drug sellers was increasingly difficult, as can be seen from amendments to the law" (1998: 134). However, Willcox was optimistic about the possibilities of bringing people to the 'right path', stating that "when adequate, free, rapid and, if desired by the patient, out-patient treatment is given by both the government and the municipal clinics, the popularity of these persons [illegal practitioners] should gradually decline, provided that a proper check is kept to see that the penicillin is not being misappropriated" (1949). What Willcox did not take into account is that this rise of self-medication went beyond the pure accessibility of medicines, and was more like a change of mindset. This can be observed in the fact that it was not limited to Western drugs: it also extended to indigenous medicine (Iliffe, 1998). The simplicity, convenience and privacy of chemotherapy became more and more appealing amid religious diversity and augmented spatial mobility, making clear that "behind the triumph of self-medication lay not only the power of pharmaceutical companies but a larger process of social change" (1998: 135).

When talking about colonial medicine it is important not to forget that, for many Africans, Western healthcare was either not well known or not easily accessible. Vaughan reminds us that "for most, mission and government hospitals were peripheral agents of health-care" (1991: 33). Talking about Malawi, Vaughan stated that until well beyond the middle of the twentieth century there was not a high number of dispensaries, so African families did not fully engage with Western medicine – and, when they did, it was often in their own terms, following their own expectations and priorities. Similarly, Pringle points out that in Uganda, although the expansive reach of Western medicine is undeniable, it remained on the periphery of a larger therapeutic landscape (Pringle, 2019).

Talking about patients in Uganda, Orley notes that they "looked for a system that worked, and if one traditional remedy failed then another could be tried and so on until eventually Western medical treatment could also be given its chance" (Orley, 1970; seen in Vaughan, 1991: 33). And, additionally, this happened also in the opposite direction: some African peoples tended to assimilate some aspects of Western medicine into their own healing systems (Vaughan, 1991) – a fact that clashed with the tight control that medical departments and missionaries wanted to exert over medical practice. Indeed, the medical and pharmaceutical authorities of the time looked at these unorthodox uses of medicines with a mix of amusement and disapproval – in Figure 7 we can see a brief article about the "odd uses" of well-known medical commodities by African people.

We have already mentioned the role that colonial authorities wanted African health staff to fulfil – as agents of displacement of traditional healing practices in favour of Western biomedicine. This is rooted in the belief that African health workers would be compelled by the superiority of Western medicine over indigenous healing techniques, which would drag them away from their traditional background to spread the goodness of colonial healthcare (Digby and Sweet, 2002). However, colonial officers did not adequately recognise the resilience of traditional beliefs or the convenience that having a choice between medical systems could represent for the native peoples. These factors gave rise to a certain kind of medical pluralism that has survived up to today.

Applied Pharmacy.—Odd uses to which the some West African natives put common place commodities are listed in a statistic and economic review published . . . by the United Africa Company. They is clude a hair-cream which in some parts the Gold Coast is "spread on bread are eaten with great relish." Carbolic some became surprisingly popular after some one, by chance, used it as fish bait ar found it was irresistible to one type of fish A perfume is used to impregnate a lump sugar, which is regarded as a delectab sweet and surgical rubber tubing is used as a bicycle guard to prevent the native long robes getting entangled in the fram and rear wheels of their bicycles.-*Morning Advertiser*.

Figure 7: Example of colonial perspective on the African use of antibiotics (Chemist and Druggist, 1949).

Discussion

Throughout this project we have pursued four distinct but interrelated objectives. First, to establish when and which antibiotics were first introduced in each country of focus. We find that this was not so different from Europe: the earliest mentions of antibiotics in Africa date from the mid-1940s, and refer to the same antibiotics that were being discovered and used in the rest of the world. Second, to investigate the context in which antibiotics arrived. We describe this as a set of already-functioning healthcare and veterinary systems, which were established by the colonial governments and missionary organisations throughout the first decades of the twentieth century. Third, to gain insight into the supply chains through which antibiotics were procured and distributed in each country. This was primarily through pharmaceutical companies from the UK and the US, which saw the market opportunities that drugs (and particularly antibiotics) offered in the colonised African territories. Finally, our fourth objective is to explore the actors behind the introduction of antibiotics, and the interests motivating them. We identify these as colonial governments, medical practitioners (private, colonial officers and missionaries) and pharmaceutical companies, who variously worked to ease the healthcare burden, and improve productivity and profit.

In this discussion section, we will discuss the findings of the arrivals, incorporation and distribution of antibiotics through three themes. First, by looking at the different colonial agendas, we link their interests to the presence of antibiotics. Second, we look at the ways that antibiotics shored up economy and productivity, both for humans and animals. And third, we look at antibiotics as commodities, escaping the structures of previous health care schemas.

Colonial agendas and antibiotics

Throughout this report, we have looked into the agendas of the main actors in colonial healthcare – missionary organisations, the Veterinary Service and the Colonial Medical Service – and related them to the particular contexts in which they were inserted. Now, we will briefly look at the political agendas that can be identified by analysing the ways in which antibiotics were used in colonial contexts.

For the successful development and maintenance of the colonial project, it was crucial to keep social and civic order. To this end, antibiotics were used to move African people away from traditional healing practices and cultural beliefs that were threatening colonisation – as happened, for example, in Rhodesia during the first indigenous rebellion of 1896 (Gelfand, 1976). Both missionaries and settlers considered that antibiotics would open the door to Western ways of behaviour and smooth the 'civilisation process' that, amongst other things, would deter people from 'evil' practices of witchcraft and 'charlatanism'(Iliffe, 1998).

Despite all this, we should not forget that situations tend not to be as straightforward as they can appear in institutional documents or scientific papers: there were often contradictory motives driven by the fact that the doctors were both health professionals and colonisers at the same time (Fanon, 1994). Maintaining the health of African populations was an important part of the colonial agenda because of the colonial interest in legitimisation, productivity and safety of the white minorities, but it was also a commitment by itself. Just as in Western countries, antibiotics represented the battle against infectious disease, the major antagonist of humankind (Ranger and Slack, 1995) – and the opportunity to develop new 'weapons' against it.

Mutizwa-Mangiza (1996) explains this mix in her history of the Zimbabwean health system: "in reality colonial healthcare was a tension between broader colonial ambitions and the routine interests of the different stakeholders involved in the delivery and consumption of healthcare services". Colonial doctors had to adapt to a new cultural environment through pseudo-ethnographic techniques and a constant reliance on their mission of civilisation, perceiving themselves as 'saviours' in a wild, dark world (Mutizwa-Mangiza, 1996). Non-human antibiotic uses (and non-uses) also point directly to the political agendas lying behind the colonisation process. As we have seen in previous sections, when looking at animal health the colonial imperatives of productivity and economic growth become even more evident – as productivity itself is regarded as a benefit in itself, not needing any sort of moral justification. The formulation of veterinary and agricultural policies, then, is heavily influenced by the capitalist orientation of Western economies, who brought it to African countries through the process of colonisation.

Economy and productivity

Some difficulties the British Empire had finding a balance between legitimacy and productivity in the provision of healthcare have been mentioned in section 1.2, as economic constraints limited the ability to provide a proper health service for whole populations.

Probably the best way of explaining the colonial struggles for productivity is by illustrating it through the case of Southern Rhodesia in the middle of the century. Hodge (2007) describes how, during the 1940s, the Southern Rhodesian government concluded that local resource management was not guaranteeing proper colonial living standards – even for the white settler population. If those standards were to improve, the use of these resources needed to be more efficient, and consumer demand would need to be raised "since Britain was in no position (despite the rhetoric of the CD&W Acts) to finance the social services and other non-productive works such as erosion control that the empire so desperately needed".

In this context, we could say that the lack of resources influenced the use of antibiotics in both humans and non-humans, as we can see by the constant mentions of money-saving initiatives in governmental reports and plans. As an example, looking into the international concerns about syphilis gives insights about the interrelation between economy and medicine. In March 1952, the American Journal of Public Health published an extensive article about the incidence of syphilis in countries other than the United States or Western Europe. In this article, the concerns about the loss of productivity dominate the narrative: "In Northern Rhodesia it has been estimated that 100,000 man-days of labor are lost each year as a result of venereal disease" (Meleney, 1952).

Commercial agriculture

Commercial agriculture was a crucial part of the colonial agenda of the British Empire. Attempts to raise productivity and stimulate economic development were constantly part of government reports and plans in the three focus countries – and, as Brown and Gilfoyle (2010) put it, "veterinary medicine was by no means for the benefit of all", but was skewed towards the colonial agenda.

This is particularly clear in the case of the Federation of Rhodesia and Nyasaland. The Federation was formed with the clear objective of 'unifying forces' and creating a powerful African state (Keatley, 1963). This model was influenced largely by South Africa, to such an extent that the Federation implemented "Co-Operative Movement" (through the 'Co-Operative Companies Act'), entering into negotiation and economic cooperation with the Union of South Africa. One of the ways of proving the proper functioning and solidity of this state was through the use of new technologies to achieve economic growth. The Annual Report to the Ministry of Agriculture of 1954 starts by congratulating the Federation, who produced the report, on the increased production and points out that this this is not "due to Nature only" but is the result of "better farming systems and scientific practices". The main idea of the report is that the maintenance - and increase - of the levels of production can only be achieved by the application of these "scientific practices" to all the farming systems of the country. Similarly, a US-produced and -directed manual for investing in the Federation (Weeks and Macy, 1956) also highlights this economic growth, and attributes it to the "slowly growing realization" that problems cannot be solved without "the aid of science and technology". The Federation is pictured as having placed a growing emphasis on productivity by investing in more economic farming units and "heavier capitalization".

However, despite all this propaganda and promises, the Federation did not last enough to prove the success of their initiatives, and there is evidence of some less-than harmonic – and effective – development of commercial agriculture in those countries (Bolt and Green, 2015; Duggan, 1980; Kalinga, 1993; Keatley, 1963).

Likewise, elsewhere in East Africa it was common to find a "lack of development of commercial livestock production" (Brown and Gilfoyle, 2010), which was largely attributed to the inability and unwillingness of the native population to 'adapt', 'learn' or even 'obey' the prerogatives of development and modern agriculture. This view is shown by an exchange of letters between the Director of Veterinary Services in Uganda and the Chief Secretary (during 1929-30) (Perryman, 1929) about the administration of the Soroti stock farm – one of the 'stock farms' that demonstrated how to farm commercially and supplied breeding material for the 'progressive farmers' already mentioned. In the mail exchange, it is matter of debate whether the farm should remain under native administration or if the protectorate should take over; the conclusion is that, as native management is less effective, it would be more profitable for the government to take control.

This tendency to mistrust native agricultural systems and label them as incorrect or 'irrational' can be also seen in a 'Review of Nutrition' that was carried out by the Medical Department of Uganda in 1949 (Uganda Medical Department, 1949): production of livestock is declared 'problematic' due to the over-consumption of supplies, tsetse and "the relative neglect of animal husbandry". To overcome this, it is suggested that the Veterinary Department intervene in the conservation of livestock by taking measures such as the suppression and control of epizootic disease, the "steady development of the market system", the active encouragement of pig breeding, the supervision of native dairying or the economic and hygienic production and marketing of milk, ghee and butter. More modern and nuanced accounts offer alternative explanations for this failure. For example, Bolt and Green (2015) suggest, talking about Nyasaland, that domestic colonial policies played a limited role, and that colonial economic measures should be better understood in the context of regional mobility of workforce and global markets – which, ultimately, determined the value of the output. They state that, since Nyasaland was one of the poorest colonies in Africa, "to assume that the colonial authorities had the capacity to direct developments in a desired direction given these circumstances makes little sense" – colonies had to adapt to the global circumstances, and that adaptation depended on circumstantial factors such as the strength of colonial authority, ecological conditions and socio-political developments.

These conditions also determined the convenience or inconvenience of using antibiotics as part of those attempts at technological farming and 'development'. The South African examples already mentioned are useful for illustrating this fact – even in the wealthiest part of colonial Africa, antibiotics were rejected because of their price (Kruger, 1959, 1960a, 1960b). On other occasions, their use was considered 'unnecessary' if there was proper nutrition – as was the conclusion of the study looking into the effects of including 'Aurofac' in pig rations (Pieterse and Verbeek, 1958).

> It appears that the factor that most influenced the use of antibiotics in African livestock production was the import of exotic breeds for commercial purposes. As Interviewee #2, the vet from Uganda, puts it, local breeds could grow up without needing any kind of treatment or prophylaxis. However, exotic animals were not resilient to the local climate, parasites and other diseases, and so had a greater need of medical care. Additionally, exotic breeds required a greater investment, as their purchase was more expensive for the farmers, so farmers "will try all advice given to sustain the animal's life". Therefore, the rise of commercial production influenced greatly the use of antibiotics.

> Regarding the inclusion of antibiotics in feeds, Interviewee #2 describes them as a late addition, mostly driven by the same will of 'securing' the investment carried out when purchasing the animals. The so-called 'medicated feeds' worked as an 'insurance', guaranteeing both that the feed was free of bacterial infection and that it would act as a 'soft' prophylaxis against bacterial disease. So, we can infer from this that the use of these feeds was also related to the commercial production of animal products.

Antibiotics as commodities

Finally, it is important to add a brief comment on how the trade of antibiotics brings to light their materiality and their construction as commodities that have a market value – a value that can be seen apart from their therapeutic properties.

The conceptualisation and formation of antibiotics as commodities has been detailed by Bud (2007), who talks about how penicillin was considered a 'tool' "prudent for patients' health and useful in the practical business of medicine". During the early twentieth century, preventive healthcare was complemented by a new pharmaceutical model of treatment driven by consumers, industry and science. This was the beginning of the dynamic of treating medicines as consumer goods, with a mix of traditional medicines supplemented by commercial ones (Bud, 2007). It is also important to note the growth of 'ethical pharmacy', with its claims for an evidence-based development of new drugs, advocating for a 'scientific' model of production. When we reached the middle of the century, the modern pharmaceutical industry was perceived as powerful and effective thanks to a mixture of good marketing and science-based trust.

This highlights the insertion of drugs into a sphere beyond medical practice: the marketing and business sphere. Bud discusses at length the implications of this 'brandification' of penicillin for its broader use: when we contemplate penicillin use through the 'logic of the brand' (as opposed to the logic of the chemical, which would be the one used by doctors and medical authorities concerned about misuse and resistance), certain patterns of consumption that were labelled as 'irrational' become rational and logical. Media studies scholars have analysed brands as being more than a label for a product; as material semiotics, these labels carry a set of expectations, hope, personal experiences and reputation – therefore, we could state that constructing penicillin as a brand made it reliable and trustworthy by default, while doctors still needed to prove themselves valid to patients.

Following this, thinking of antibiotics as commodities allows us to consider their existence outside the medical community – and, as such, outside the control and authority exerted by the Western practice of biomedicine. This, of course, has some dangers related to misinformation and mercantile interest promoting consumption – leading to problems like resistance or accessibility. But this also explains how, in societies like those of colonial Africa, where the medical community could not exert a great deal of control, the use of drugs was not necessarily attached to Western medicine – and antibiotics became assimilated by cultures used to dealing with new medicines (Bud, 2007).

Santesmases and Gradmann (2011) have studied the circulation of antibiotics around global settings – 'circulation' implying a transit between countries, not so much circular as a fluid movement with many different ends. In their conceptualisation, they make reference to 'permanent feedback' taking place between the actors and spaces involved in the history of antibiotics – this relates to the different flows that were carried by antibiotics. By circulating among different countries, antibiotics carried along a diversity of standards, contributing "to the rearrangement of antibiotic cultures and practices" (2011: 303). The history of antibiotics is intrinsically related to the history of patenting and industrial regulation (Santesmases and Gradmann, 2011). The development of antibiotics set in motion a process of 'regularisation' that culminated when, around the 1950s, standardised and 'branded' products displaced the individual prescriptions by dispensing chemists that had been the norm until then (Bud, 2007; Macfarlane and Worboys, 2008). Marketing became the main source of information about drugs for the general public, and, through this, antimicrobial drugs helped to consolidate the authority and power of the pharmaceutical industry.

In the colonial world, pharmaceuticals appear to have had an initially marginal role, but soon, as we have already discussed, they became important tools for the medicalisation of colonial empires (Monnais, 2009). Hence, following Monnais (2009) we can consider modern medicines as part of a colonial economy of health where the colonised subject became "a consumer of healthcare through practices of pharmaceutical consumption", even though – as we also have mentioned before – colonial and health authorities were not always able to channel and direct this process. Throughout this report, we have observed and analysed an extensive and exhaustive combination of archival research, literature and oral interviews. However, the process through which this kind of work is developed is always subject to a certain loss of information: faced with obvious limitations of time, space and a necessary degree of legibility of the final product, the researcher must carry out some 'classificatory practices' – that is, grouping, generalising and deciding which examples to include. These practices are necessarily hierarchical, meaning that the researcher organises the facts by their relative importance, prioritising some over others – based on their own training and experience.

However, these categories are not absolute, but always subjected to change, contestation and negotiation, keeping the research 'alive' and becoming more and more nuanced. In this project, we have been looking into the use of antibiotics from the 1940s to the 1960s in the three focus countries of Zimbabwe, Malawi and Uganda. But this is only the beginning; the next question is, what else might it be useful to do?

This research's objective is to be an introductory account to the history of antibiotics in colonial Africa; now, the way is open for further research and alternative accounts to come. First, it would be important to ask what was happening on the rest of the continent; the socio-political context of French, German, Portuguese and Belgian colonies was often radically different from the context of the British Empire. Knowing more about the early uses of antibiotics in these territories could help us to understand how these uses relate to different colonial administrations – each of them with their particular agendas and institutions.

Not less important would be to address what happened after the independence processes that most African colonies went through. The nature of these independences, the way in which they were carried out and the evolution of their resulting countries, varies immensely. Looking into how these fluctuations have affected the use of antibiotics in comparison to colonial times would provide important insights into the socio-political insertion of the drugs.

We have mentioned the international circulation of antibiotics and the flows that are generated through this; another point that calls for further research would be looking into how these international flows evolved. Especially important for this would be the investigation of the changes that the arrival of generics brought along, and the role played by Asian markets (such as China and India).

And, of course, more questions could be asked – what was the exact role of private markets, and how is this history interconnected with international movements (such as 'essential medicines', rational use, stewardship, One Health, etc.)? In this report, we have carried out a first effort that we hope will begin a long and fruitful series of contributions to the topic of the history of medicines – a topic that, as relevant as it is, has not yet been developed to its full potential.

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Annex

For much of its existence, the British Empire can be characterised as having central concerns of control and legitimacy. The aim was to create a solid, centralised and stable system that was profitable or, at the very least, self-sufficient, but the lack of resources and human capital challenged this project. In the next sections we will dig into the particular elements and the intersections between control, economy and legitimacy.

CONTROL

Many colonial initiatives can be read as attempts to achieve this homogenisation; for example, in 1947 there appeared in The Lancet an article about the 'Empire Reciprocity in Social Insurance' ('Empire Reciprocity in Social Insurance', 1947). In this article, the preparatory training of medical officials from an array of countries (including Southern Rhodesia) is described in order to set the bases of 'reciprocity in the field of social insurance' – that is, the aim of keeping a constant exchange of professionals and resources from and to the colonies.

The main tool for this was the regulation of medical practice by the obligatory register of all medical practitioners – national and foreign. These regulations were aimed at, first, creating a standard of quality of medical service – not only in the public health service, but also in private practice – and, second, consolidating the position of the government as the authority that controlled, not only how healthcare was delivered, but also who was able to deliver it. In the British Medical Journal ('Registration Of Foreign Practitioners In Great Britain And The Dominions And Colonies', 1937), we find a roster of the requisites for foreign practices that wanted to set up a private consulting room (see the table below).

Nyasaland	Accepted everyone with a British, British Indian or British Colonial degree (also Europe, US and Japan).
Southern Rhodesia	Accepted if completed five year's training within the British Empire.
Uganda	"Any person registered in the UK is eligible for registration in Uganda, but the prospects of private practice are very limited".

As we can see, rules and requisites differ within territories, depending on the local interests and the availability of medical positions. These regulations also provide a good insight into the conditions of each focus country: the rules are stricter in Southern Rhodesia (now Zimbabwe) than in the other two countries, given its status as self-governing colony. Also, even though in the UK Government notice No.942 of 1948 it is stated that medical practitioners registered in the UK can also register in "British

colonies, protectorates and dependencies where the rules are identical with those of the UK", Southern Rhodesia had its own rules for registration ('Medical Practitioners in Southern Rhodesia', 1956). This differentiation allows us to grasp how the reality of the colonies was very different from the theory of a strong, London-dependent empire.

Moreover, the difficulties and delays in communications and the lack of staff meant that bureaucracy was more an obstacle than a help to the smooth functioning of the CMS. A memorandum on medical policy by the Ugandan colonial government in 1943 (*Medical Policy*, 1943) argued that some improvements should be made in the structure of the colonial service in order to "deviate the Secretariat bottleneck". It also criticised the homogenisation of the colonial administration, stating that "it is wrong to put a standard pattern for all the Colonies". As we can see, given the difficulties of exerting rigid external control over the colonies, health policies were often designed and implemented without the British government's permission – or even knowledge (Hokkanen, 2016).

Despite these difficulties, the CMS always tried to keep some sort of control over the native populations, and one of the main ways of doing this was the direct intervention by training native staff. Holden (2015) describes how training of local staff was an accepted part of nurses' work – initially, it was carried out by missionaries but, from 1940s on, governments undertook this task, trying to systematise it. This was, in part, responding to the necessity of human resources in healthcare, but it was also considered part of the 'civilisation' mission of the Empire: educating Africans in Western medical practices would bring them closer to the 'rationality' of European thought, and would help in its expansion (Digby and Sweet, 2002).

Indeed, the figure of the nurse had an important role in solving the clash between local traditional health systems, where nursing was regarded as part of a kinship relationship, and the Western disease-based care system (Kuper, 1965; seen in Holden, 2015). In a monograph on this topic, Welch (1941) described the "future challenges" regarding the training of African nurses, which ranged from the necessity of "separat[ing] native nurses from ideas of 'magic''' in order to "help their patients to do so", to "find[ing] 'better quality' girls" who should be separated from their home backgrounds in order to become 'good nurses'. Welch also highlighted the 'educational' role of the nurse, as preventive medicine requires a professional who is both nurse and educator – the idea was that the nurses should supply all these services to families, acting as a family friend.

CONTEXT AND RESOURCES

Despite all the colonial authorities' efforts, we have seen that the imperial dream of a solid and centralised management remained just a dream. This was, to a large extent, due to the obligation of self-sufficiency and economic tightness that characterised the imperial project since its very beginning. It has been said that the financial limitations that played a role in the underdevelopment of health services in African settings should be viewed "more in terms of colonial priorities than simply the lack of funds" (Chikumbu, n.d.). Although this is likely to be the case, the simple fact is that, whatever the reasons, there was a lack of funds – which definitely affected the shape of the CMS.

However, the CMS's priorities clearly favoured white settlers over African populations. This can be observed in the description that The Lancet made of, on one hand, the health system of Southern Rhodesia, and, on the other hand, the medical practice in East Africa (Davidson, 1954): the hospitals in Rhodesia were built, owned and administered by the Rhodesian government. The largest European hospitals in Salisbury and Bulawayo are described as "well constructed and excellently equipped", probably related to the fact that European patients were asked to pay their hospital fees. African patients were located in separate hospitals that were "antiquated and overcrowded", with staff drawn from the Rhodesian Medical Service. There was the option of private practice for Europeans, with a lot of competition among the practitioners.

The medical practice in 'East Africa' (which, in this context, meant Kenya, Tanganyika and Uganda) was heavily influenced by the scarce European population – which, the article says, did not offer many opportunities for private practice. The CMS there is described as "barely having any resources", which rendered it more difficult to provide Western medicine for even a minority of the African population. To tackle this problem, the CMS announced increased training of African staff in Makerere University and the construction of a medical school at Kampala (Uganda). Additionally, penicillin, sulphonamides and 'new synthetic drugs' are portrayed as playing an essential role in "convincing Africans that Western medicine is an improvement on the medicine of the witch-doctor".

Nonetheless, getting enough of the 'Western medicines' was also hampered by the lack of resources: in a description that Goodall (1955) made about the treatment of tuberculosis in Zomba African Hospital (in Nyasaland), he noticed the lack of proper facilities to treat the disease – as Nyasaland was a poor agricultural country, treatment was delivered depending on what was available. Little money could be spared, so cheaper drugs were preferred – it was not possible to treat patients "following the 'expert' recommendations from the UK and the US". Relatedly, in the 'Tubercle' journal it is stated that "an effective and cheap combination of antituberculosis drugs would thus be of outstanding value in the control of tuberculosis in Africa" ('A Co-operative investigation in East African Hospitals and Laboratories', 1959). These limitations continued through time; even as late as 1972, it is possible to find a letter from the Secretary of the Ministry of Health of Uganda mentioning restrictions in antibiotics supply in Tororo Hospital (Mapusl, 1972).

LEGITIMACY AND ECONOMY

Another important concern for the British Empire concerned the legitimacy of the imperial project itself. For this reason, the CMS was praised as one of the greatest institutions that the Europeans had brought to the colonies. Western medicine was regarded as the best, most reliable and most effective medicine, and was a vital tool to achieve progress, essential in a modern society. In The Lancet (Keir, 1954), we find an article called 'Western medicine in the modern world', in which is detailed the 'goodness' that colonial medical services had brought to the 'uncivilised' rest of the world.

Nonetheless, as we have discussed in the main report, the lack of resources hampered the availability of Western medicine for most African populations. The arrival of antibiotics seemed a promising solution for this issue, because, as Hutton et al. (1956) said: "it was important to know how far, if at all, in a poor country chemotherapy could obviate the need for the costly organization which has been built up in Europe to deal with the disease". Hutton et al. refer here to the necessary infrastructure for some treatments, such as bed therapy, collapse therapy or major surgery. Therefore, antimicrobial drugs were regarded as an alternative for this lack of resources. Additionally, these trials were considered to be a unique opportunity to test chemotherapy alone – without the influence of other treatments – which made the colonies 'test labs' for cheaper drugs and treatments (Fox et al., 1956).

Looking at the case of Zimbabwe, we can observe to what extent the government relied on missionary healthcare to provide healthcare to rural Africans: even though, as we mentioned previously, the Southern Rhodesian government was obliged to set up some sort of health services by the 1925 Act, they solved the situation by giving missionaries an annual grant so they could provide these services in the rural areas. It was not until the 1930s that the government expanded the health system to reach rural settings and, even then, missionaries remained the major provider (Mutizwa-Mangiza, 1996).

The missionary health service has been described as 'curative-oriented', in contrast with the preventive focus of the governmental medical services. Some authors have attributed this individual focus to the mission's interest in using medicine as a 'tool for evangelisation' – which, on occasions, would have affected the quality of the service provided, justifying an uneven, second-rate care with the "spiritual benefits of the healing" (Doyle et al., 2020; C. M. Good, 2004). However, there is evidence of missionary hospitals that were not only considered good by mission standards, but were also highly thought of among colonial officers – such is the case, for example, of Mengo Hospital, in Uganda, which was constantly accepting patients (mostly white, but also a number of African and Indian) referred by colonial medical services across the country (Pringle, 2019).

Moreover, as Doyle et al. (2020) describe, also in Uganda, even though conversion was always an explicit aim in medical missions, it is undeniable that missionaries pioneered the provision of certain health services that targeted disadvantaged groups (such as for those with physical impairments, leprosy and other similar ailments). Additionally, they put a great deal of effort and interest into child and maternal healthcare (Doyle et al., 2020; Pringle, 2019; Stirling, 1947). One example of this can be seen in the Central African Medical Journal's portrayal of medical work at Nyadiri Mission (in the Federation of Rhodesia and Nyasaland) (Dabb, 1956): the mission is described as "very concerned with maternity issues", and most of their work revolves around the great incidence of preventable diseases in this field – the writer highlights the importance of educating mothers in sanitation, as the failure to comply with hygienic measures is regarded as the main cause of disease.

The same happened in Nyasaland in Blantyre Mission (Dabb, 1956), which stressed the importance of maternity care and took pride in their maternity ward, and in the Bonda Mission Hospital (also in Nyasaland), where, apart from the usual treatment facilities – and chapels, to care for the 'spiritual health' of the patients – they constructed a tuberculosis ward to cope with this problem.

Even though evangelisation was not always successful, missionaries were, in general, fairly well accepted in rural African societies (Dube et al., 2009). It has been said that one of the keys of the lasting success of missionary medicine is rooted in African understandings of illness and healing, as more a 'personal' matter than a 'professional' one. Dube (2009) describes how, in Zimbabwe, missionaries visited the sick in their homes and provided outpatient services for those patients going to their hospitals and dispensaries.

Medical missions did not escape the lack of resources that the governmental medical services were facing, so they started training African staff from the beginning of the twentieth century. In Malawi, Vaughan describes how this African medical staff was almost exclusively male up to the 1930s (the so-called 'dawa' or 'dispensary boys'). They often occupied positions of high responsibility, given the lack of European doctors (who were always prioritised).

Training of African health staff was also carried out as a strategy to "put the witchdoctor out of business", as stated by one of the pioneers in the training of African nurses, Dr. McCord, in 1932 (Digby and Sweet, 2002). The main idea was that African health assistants could carry out basic tasks and go to the most remote regions to 'fight' traditional medicine and beliefs (Pringle, 2019) – but, in practice, this was far more ambiguous and a source of constant struggle.

In fact, it is not clear to what extent Christian conversion and mission education affected African health behaviour (Doyle et al., 2020): some evidence suggests that secular publichealth campaigns influenced people's behaviour regardless of their religion or education. The nature of these changes, however, was not always aligned with colonial or missionary agendas.

Although they were part of the colonial system, missionaries' interests and perspectives were not necessarily the same as those of secular colonial institutions. For example, Vaughan (1991) describes the opposition of missionaries to the system of 'customary' and 'traditional' rule – while colonial governments were looking for the efficiency of the system of 'indirect rule', missionary agendas were directed to bringing 'enlightenment', 'progress' and 'civilisation', gaining the populations' souls for the Christian cause. Therefore, missionaries promoted social engineering, Western-type education and Christian evangelisation (Vaughan, 1991).

Missionaries were in close contact with local populations for a long while, which placed them in a position of mediation between the colonial state and African societies (Hokkanen, 2016). Although always under their own terms, missionaries often had the role of translating knowledges and practices between the two worlds, informing the colonial administration about people's health conditions, and assessing their improvement. This put the missions in an influential position, as they were able to participate in the decisionmaking of the healthcare system.

The importance of the medical missions decreased towards the middle of the century; healthcare was taken over by colonial governments which, apart from making healthcare free, also started to provide free medical training for Africans – while missionaries had to stick with their fees, as their funding was not enough to maintain the healthcare system by itself (Messac, 2014; Vaughan, 1991). This meant a drastic change in the content of missionary work, even though the discourse remained the same (Vaughan, 1991).

Designed by Andrea Palanco