



Tackling the Burden of Substandard and Falsified Medicines and Health Technologies in Somaliland and Somalia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: The problem posed by the substandard and falsified (SF) medicines is a rising global challenge. WHO estimates that sales of SF medical products in low- and middle-income countries is around US\$ 30 billion whereby 1 in 10 medical is substandard or falsified.

Objectives: The purpose of this article was to enlighten the actions by the Somali NRA to tackle the scourge of SF medicines in Somalia.

Methods: The literature was reviewed on the topic and evidence from other sources were

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incorporated including reports of post-marketing surveillance surveys, assessments at national and regional levels, as well as author's experiences.

Findings: The medicines regulatory capacity is weak in Somaliland and Somalia, where only 16% of total indicators for the regulatory system was in place as per WHO/IGAD rapid benchmarking of the National Regulatory Authority (NRA) in 2017, increasing the risk of circulation of SF medicines in the local private sector dominated and exclusively import relied pharmaceutical supply chain. Key actions by the NRA to address this problem include: regulatory reliance mechanisms such as using the WHO PQ/EUL for emergency authorization of vaccines, i.e. COVID-19 vaccines, enhanced licensing procedures, information exchange with NRAs in the region as well as technical collaboration with WHO.

Conclusion & Recommendation: However, a lot has to be done and considering the weak laboratory capacity and the porous national borders, the risk of local circulation of SF medicines is high and swift actions are needed to ensure access to safe and quality medicines and health technologies in Somaliland and Somalia.

Keywords: Substandard and Falsified (SF) medicines; WHO; Medicines Quality Monitoring (MQM); pharmaceutical supply chain.

1. INTRODUCTION

"The history of drug counterfeiting dates back to centuries and is considered as one of the oldest crimes in human history (Pathak et al., 2023). "The problem posed by the substandard and falsified (SF) medicines is a rising global challenge. Substandard medical products are authorized medical products that fail to meet either their quality standards or their specifications, or both, whereas, falsified medical products are those that deliberately/fraudulently misrepresent their identity, composition or source (World Health Organization, 2024c). "WHO estimates that sales of SF medical products in low- and middle-income countries account on the order of US\$ 30 billion" (World Health Organization, 2017b).

"An estimated 1 in 10 medical products in low- and middle-income countries is substandard or falsified" (World Health Organization,

2024a). The U.S. Pharmacopeial Convention (USP) reported that a total of 848 samples out of 15, 063, representing 5.6% of total samples, failed the quality test from results of data collected from medicines quality monitoring (MQM) activities spanning the period of 2003–2013 in 17 countries of Africa, Asia, and South America" (Hajjou et al., 2015). "SF medicines are danger to the public health and are associated with detrimental health and socio-economic implications. WHO's report of the situation of counterfeit (fake) medicines in WHO regions for Africa and East Mediterranean revealed that 20 of the participating countries in the survey reported to have carried out seizures of counterfeit medicines" (World Health Organization, 2010). "IMPACT stakeholders estimate proportions ranging from around 1% of sales in developed countries to over 10% in developing countries, depending on the geographical area (International Medical Products Anti-Counterfeiting Taskforce (IMPACT) & WHO, 2006).



Fig. 1. Falsified Harvoni (Hepatitis C medicine) dispensed in Japanese Pharmacies

<https://iris.who.int/bitstream/handle/10665/326708/9789241513425-eng.pdf>

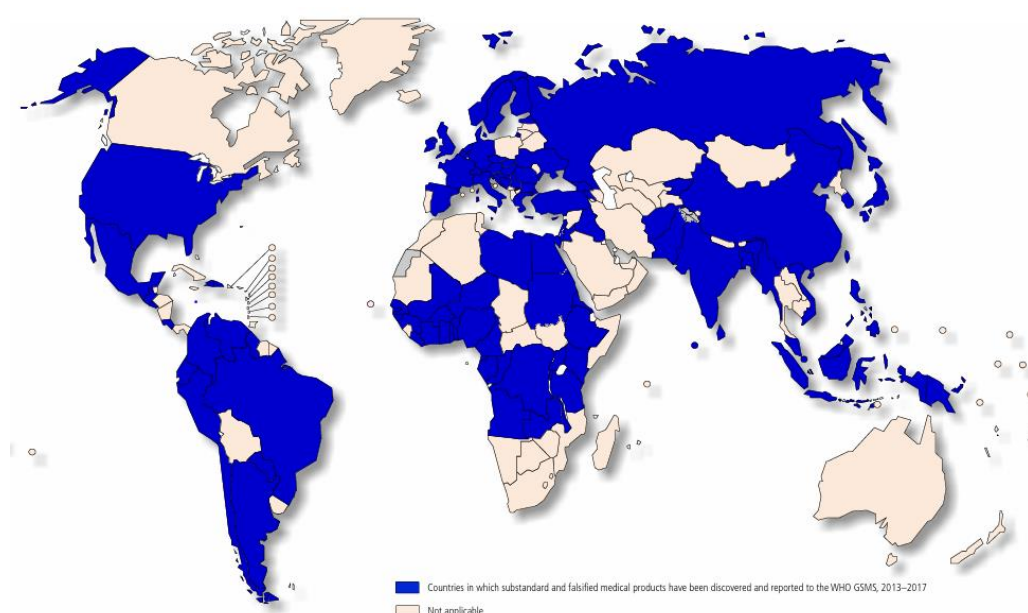


Fig. 2. Countries which have reported substandard and falsified medical products to WHO Global Surveillance and Monitoring System, 2013-17

WHO global surveillance and monitoring system for substandard and falsified medical products

“It is difficult to quantify the extent of the problem, but in some areas of Asia, Africa and Latin America, counterfeit medical products can form up to 30% of the market” (International Medical Products Anti-Counterfeiting Taskforce (IMPACT) & WHO, 2006) “The United States’ Food and Drug Administration (FDA) issued an alert about a counterfeit antiretroviral medicine and the UK officials seized 5000 packets of counterfeit flu medication oseltamivir in 2007 and 2006 respectively (International Medical Products Anti-Counterfeiting Taskforce (IMPACT) & WHO, 2006)

There are many reports about the detection SF medicines in the African Region. Forty-two percent of all reports to the WHO Global Surveillance and Monitoring System on SF medical products reported between 2013 and 2017 came from Africa, highlighting the magnitude of the problem” (Kniazkov et al., 2020). “The Kenyan Pharmacy and Poisons Board (PPB) has issued an alert over a suspicious batch of counterfeit breast cancer treatment drug, Herceptin 440mg (Trastuzumab 440mg), detected in the market in 2024” (Kenya Broadcasting Corporation, 2024). “Recently, a cluster of cases ($n=78$) of AKI among young children due to poisoning from Diethylene Glycol (DEG) that contaminated children’s syrup-based medications was reported in Gambia, a West

African country (Bastani et al., 2023). In January 2023, WHO issued report that over the past “preceding” four months, countries have reported on several incidents of over-the-counter cough syrups for children with confirmed or suspected contamination with high levels of diethylene glycol (DEG) and ethylene glycol (EG) (World Health Organization, 2023). The cases were from at least seven countries, associated with more than 300 fatalities in three of these countries (World Health Organization, 2023). Angola reported falsified artemether-lumefantrine and albendazole tablets in 2012, both medicines containing no active ingredient in them (Newton et al., 2014). Study on the quality of antimalarials in eight countries in Africa reported that the Non-QAACT (Quality Assured Artemisinin based Combination Therapy) accounted for 20% of the market share in the private sector in Kenya, followed by Benin and Uganda (19%), Nigeria (12%) and Zambia (8%) (Newton et al., 2017).

2. HEALTH AND SOCIO-ECONOMIC IMPACT OF SUBSTANDARD & FALSIFIED MEDICINES

Substandard and falsified medicines (SF) have dire health and socio-economic impact and poses a global challenge. The health implications include therapeutic failure, drug

resistance, serious morbidities or even death of the exposed. In 2004, fake medicines led to a trail of death in Argentina where a healthy 22-year-old woman, living in Viedma, Argentina, who had mild anaemia was given injections of an iron-based preparation, she became very sick and died of liver failure after receiving the seventh of a 10-injection treatment (International Medical Products Anti-Counterfeiting Taskforce (IMPACT) & WHO, 2006)

"The channels through which SF medicines can have an impact on a population's health, economic, and social status are manifold" (Hamilton et al., 2016). "A systematic review of 265 studies comprising 400 647 drug samples and meta-analysis of 96 studies comprising 67 839 drug samples reported data on the estimated economic impact were limited primarily to market size and ranged widely from \$10 billion to \$200 billion (Ozawa et al., 2018). In the case of infectious diseases, treatment failure may also increase the risk of transmission to other individuals (Newton et al., 2010).

"The WHO commissioned model for the impact of substandard and falsified (SF) medicines on childhood pneumonia, which was developed by the University of Edinburgh, estimated that based on 10% prevalence of SF antibiotics, up to 72, 430 deaths from childhood pneumonia can be attributed to the use of the SF antibiotics that have reduced antibiotic activity, which can increase up to 169, 271 deaths if the antibiotics have no activity (World Health Organization, 2017a).

2.1 Objectives

The purpose of this article was to describe and provide analysis of the current state of medicines and health technologies regulation in Somaliland, illustrate the capacity of the regulatory system and present recommended and immediate interventions and actions needed by the Medicines Regulatory Authority to tackle the burden of substandard and falsified medical products in Somaliland.

3. METHODOLOGY

The literature was reviewed on the issue and evidence from other accessible sources were incorporated including reports of post-marketing (PMS) surveys, assessments at national and regional levels, as well as author's experiences. In-depth analysis and presentation of the

regulatory capacity and existing gaps is made to present the core regulatory functions in line with some of main indicators of the WHO Global Benchmarking Tool (WHO GBT) designed to be used for benchmarking and assessment of regulatory systems. "The GBT also incorporates the concept of 'maturity level' or ML (adapted from ISO 9004), allowing WHO and regulatory authorities to assess the overall 'maturity' of the regulatory system on a scale of 1 (existence of some elements of regulatory system) to 4 (operating at advanced level of performance and continuous improvement)" (World Health Organization, 2024b)

In this article, the current status and gaps of the regulatory system were presented covering key indicators and using some of the core indicators in the tool to summarize the findings and allow an element of systematic analysis. However, the article is not by itself a report of full benchmarking assessment of the regulatory system.

4. RESULTS AND DISCUSSION

4.1 Country Profile & the Healthcare System

The Republic of Somaliland is situated north of the equator in the Horn of Africa. The total area of the Republic of Somaliland is 176,119.2 Sq km (Ministry of National Planning and Development, 2021). Somaliland was formerly a British protectorate and reclaimed its independence from the republic of Somalia after non-successful unity with the southern Somalia which was an Italian colony. Somaliland declared its independence from Somalia in 1991. The Somali civil war seriously affected the country politically, economically and socially. The population of Somaliland is 4.2 million where 53% live in urban areas, according to the National Report issued by the Central Statistics Department, Ministry of Planning, Government of Somaliland (Ministry of National Planning and Development, 2021). The healthcare system was affected and the healthcare facilities were totally destroyed. The Ministry of Health Development of Somaliland is charged with health policy development and service delivery oversight functions (Ministry of Health, 2024). A survey in Somaliland reported there are about 21 public hospitals including six regional hospitals, 73 MCHs, 152 health posts and 7 TB centers in Somaliland (Mazzilli, 2009). The private sector is estimated to comprise about: 80 clinics and

hospitals as well as 779 pharmacies (Mazzilli, 2009). Though reliable data is lacking, it's estimated that the private sector takes approximately 70- 75% of total medicines imports into the country.

4.2 The Medicines Regulatory System

Pharmaceutical regulation is designed to ensure safety, efficacy, and quality of the drugs available to consumers (Ali & Nollet, 2024). The legal provisions are not available mainly National Medical Products Law which has been passed by the parliament to provide clear mandate and legal power and support the functions of the National Medicines Regulatory Authority (NMRA).

4.2.1 Legal framework

Strengths: The country has National Medicines Regulatory Authority (NMRA) under the Ministry of Health. The National Medicines Policy (NMP) which designates NMRA and defines its functions has been formulated in 2014. Also, the National Health Policy (NHP II) which calls for establishment for NMRA has been developed by the ministry of health in 2011. The NMP and the Ministerial decree of November 2016 that establish the NMRA are the main available legal documents with provisions and statements to define regulatory framework of registration and/or marketing authorization. Both documents recognize procedures to hold, suspend, and/or withdraw or cancel a MA in case there is/are finding(s) on quality, safety or efficacy issues. Furthermore, NMP explains the establishment of the National Pharmacy Regulatory Board (NPRB) as the regulatory framework, which will be responsible for quality control, evaluation, registration, pharmacovigilance, control of standards of production, importation and marketing. A rapid benchmarking (Assessment) of the NRA's capacity by WHO-IGAD Joint Initiative, according to the WHO GBT, was done in 2017 which found that only 16% of the total indicators for the regulatory system has been implemented.

Weaknesses: The regulatory environment is at its infancy and the government has a limited role in the pharmaceutical sector (Somaliland National Health Policy, 2011). The government does not provide the necessary political and economic support for the NMRA to effectively carry out its national duties. The legal provisions and guidelines are not in place to support the functions of the NMRA. There are some overlaps

in the government bodies engaged in the regulation of the pharmaceutical sector and no clear boundaries of responsibilities are drawn. For instance, the Ministry of Health, National Health Professions Commission (NHPC) as well as the Somaliland's Quality Control Commission (SQCC) have overlapping areas in respect to health facilities licensing, registration and inspections. To address this problem, a nationwide consultation forum would help to revise and amend the legal acts in place as well as exclude the conflict of authorities so do allow mutual coordination and cooperation to improve the government's capacity to regulate the health sector.

4.2.2 Medicines registration (marketing authorization)

Medicines imported into the country are not registered for the ministry of health which increases the likelihood of SF medicines as well as those of unknown origin to circulate in the pharmaceutical supply chain. An important task for a drug regulatory authority (DRA) is to institute a system which subjects all pharmaceutical products to premarketing evaluation, marketing authorization and post marketing review to ensure that they conform to required standards of quality, safety and efficacy (World Health Organization, 2011)

4.2.3 Licensing & inspection activities

The licensing of pharmaceutical premises and healthcare facilities is in place. However, standard operating procedures did not exist previously whereby some of the premises' licenses were not regularly issued and when in the case, initial inspection and assessment of the facility in regards to storage practices, infrastructure, human resources and procurement systems was not mandatory requirement until recently the NMRA has developed inspection tools to assess each facility as part of the licensing procedure. Moreover, Inspection guidelines and adequately trained staff to carry out inspection activities are not available. The NMRA should carry out effective inspections to ensure Good Storage Practices (GSPs) and Good Distribution Practices (GDPs) in the pharmaceutical supply chain. It's a key function of NRAs to require that medicinal products are imported, distributed and manufactured by an authorized persons as well as license and inspect manufacturing premises, importing agents, wholesalers, distributors and retailers (World Health Organization, 2019).



Fig. 3. Counterfeit and substandard pharmaceuticals shown by the Tanzanian Food and Drug Administration (TFDA) to the media; Petro Karungamye
<https://doi.org/10.1016/j.fsr.2022.100302>

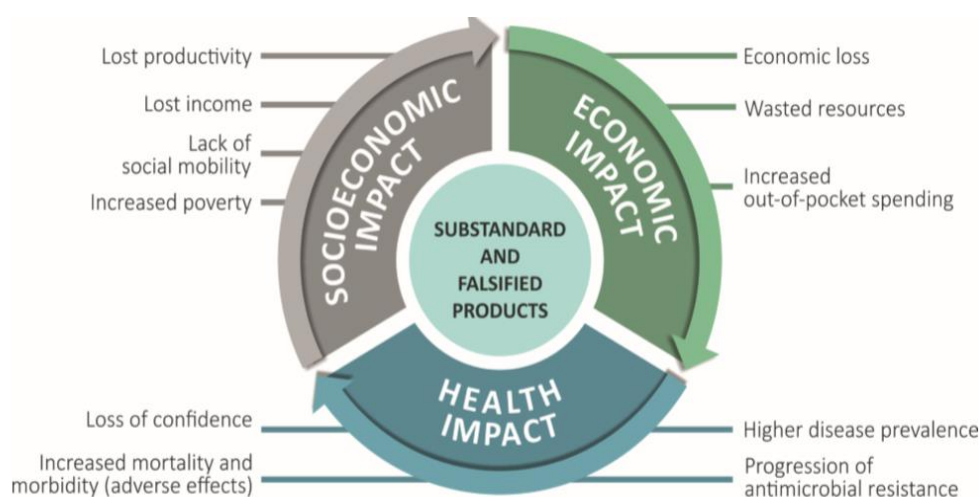


Fig. 4. Impact of SF Medicines, WHO 2017; Licence: CC BY-NC-SA 3.0 IGO.

Prevalence of substandard and falsified products (%)	Number of excess deaths in most likely scenario (two-fold increase in CFR)	Number of excess deaths in alternative scenario (four-fold increase in CFR)
1	8 688	18 372
5	37 018	85 438
10	72 430	169 271

Fig. 5. Impact of SF Medicines on Childhood Pneumonia: WHO Study on Impact Model
<https://www.who.int/publications/i/item/9789241513432>

Regulatory Functions	Indicators		% Impl.	ML
	Implemented	Expected		
01-NATIONAL REGULATORY SYSTEM (NRS)	2	10	16%	1
02-REGISTRATION AND MARKETING AUTHORIZATION	2	6	15%	1
03-VIGILANCE (PVL)	1	6	0%	1
04-MARKET SURVEILLANCE AND CONTROL (MSC)	4	6	0%	1
05-LICENSING PREMISES (LIC)	4	6	17%	1
06-REGULATORY INSPECTION (RI)	4	6	20%	1
07-LABORATORY ACCESS AND TESTING (LAT)	0	10	30%	1

Fig. 6. Summary of rapid benchmarking of the NRA by joint WHO/IGAD assessment, 2017

4.2.4 Medicines safety & rational use

Rational use of medicines involves their correct/proper/appropriate use so that their selection, dose, duration are according to the guidelines, suitable for clinical needs, at the lowest cost to the provider, community and the patient, and are dispensed correctly and taken properly (Kshirsagar, 2016). Worldwide, despite about one-third of the world's population lacks access to essential medicines, around half of all medicines are inappropriately prescribed, dispensed, or sold, and that half of all patients fail to take their medicine properly (World Health Organization, 2002). Irrational over-use of medicines can stimulate inappropriate patient demand, and lead to reduced access and attendance rates due to medicine stock-outs and loss of patient confidence in the health system (Ofori-Asenso & Agyeman, 2016). If medicines are irrationally used, this can result serious consequences such as increased morbidity, mortality and antimicrobial resistance. Irrational use of medicines may result in poor patient outcomes, rapidly increasing antimicrobial resistance, the spread of blood-borne infections, waste resources, and increased adverse medicine events (Vaughn et al., 2019). Antimicrobial resistance (AMR) occurs when microbes become resistant to medicines to which they were initially susceptible (World Health Organization, 2019). Human-related causes – of antimicrobial resistance- include antimicrobial overuse and misuse in medicine (Endale et al., 2023). There were an estimated 4.95 million (3.62–6.57) deaths associated with bacterial AMR in 2019, including 1.27 million (95% UI 0.911–1.71) deaths attributable to bacterial AMR (Murray et al., 2022). Sub-Saharan Africa (SSA) experienced the greatest mortality rate from AMR in 2019 (Moyo et al., 2023).

Antimicrobials remain available without a prescription in many LMICs (Hossain et al., 2023). A study conducted in North Western Ethiopia identified that rational medicine use is not achieved in terms of most components of the prescribing, patient care, and facility-specific indicators according to the World Health Organization/Network of Rational Use of Drugs (WHO/INRUD) core drug use indicators (Sema et al., 2021). There are a tremendous patterns of irrational medicines use though literature on scientific studies to measure the burden are limited in Somaliland. Also, the under regulated private sector dominated health system adds complexity to the situation. A pharmaceutical systems assessment study conducted in severely disrupted countries including Somalia, Afghanistan, the Democratic Republic of Congo and Haiti reported that informal markets, where medicines are regularly sold in market stalls and unregulated pharmacies, often accompanied by unqualified medical advice, have proliferated (Kohler et al., 2012). A study on community use of antibiotics in Hargeisa highlighted the community's lack of understanding about antibiotic use (AM, 2024). According to a study on drug use and associated factors conducted at Edna Adan University Hospital in Hargeisa, Somaliland, polypharmacy and overuse of brand drugs and antibiotics were prevalent in the study setting (Sidamo et al., 2022). This increases the risk of medication errors and antimicrobial resistance as well as puts patient safety at risk considering the lack of intact regulations to ensure the rational medicines use and safety in Somaliland.

A qualitative study on community use of antibiotics in Mogadishu, Somalia, underscored the need for education and awareness campaigns to address knowledge gaps and

promote responsible antibiotic use (Mohamed & Bashir, 2023). Various interventions can help addressing the issue of irrational medicines such as community education, awareness raising and educating healthcare providers through establishment of Antimicrobial Stewardship Programs (ASPs). The Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America issued guidelines for developing institutional programs to enhance antimicrobial stewardship, an activity that includes appropriate selection, dosing, route, and duration of antimicrobial therapy (Dellit et al., 2007). Effective antimicrobial stewardship programs can be financially self-supporting and improve patient care (Schentag et al., 1993). A hospital based-antimicrobial stewardship program (ASP) is regarded as a globally accepted tool to address the challenge of AMR (Cunha, 2018). The establishment of ASPs is warranted and feasible in hospitals and healthcare setting in Somaliland and can enhance effective antimicrobial prescribing and hence, address the burden of antimicrobial resistance. However, achieving this would need multi stakeholder collaboration among the health authorities, universities and health training institutions to implement stewardship programs in the country. Moreover, understanding the perspectives of pharmacists and other healthcare professionals such as their attitudes, knowledge and perceptions are key for establishing an effective ASP. Healthcare professionals (HCPs) working in hospitals should have adequate knowledge and awareness of AMR, its triggering factors, and strategies required to cope with AMR (Labi et al., 2018). In addition, inclusion of the AMR agenda in the higher pharmacy training curriculums and building capacity of the pharmaceutical workforce related to AMR topic are some of the key interventions that would contribute to addressing the burden of AMR in Somaliland. The International Pharmaceutical Federation (FIP) published a report on AMR and Stewardship Education in 2023 which also incorporates findings of FIP's Survey on AMR education in which 272 respondents across all categories from 81 countries participated and covered case studies from diverse nations, such as Costa Rica, Croatia, Lebanon, Tanzania, Ireland, Norway, Nigeria, the UAE and the European Union, highlighted it is vital that the pharmaceutical workforce, including educators, practitioners, scientists and students, are equipped with the relevant and up-to-date knowledge, skills and attitudes required to avoid

this pressing issue (International Pharmaceutical Federation, 2023). One of the key results of the survey that stood out was to continue strengthening the educational components related to AMR within pharmacy curricula (International Pharmaceutical Federation, 2023).

Furthermore, adherence to evidence-based guidelines plays a key role in promotion of rational medicines use. The principal benefit of guidelines is to improve the quality of care received by patients by promoting interventions of proved benefit and discouraging ineffective or potentially harmful interventions (Guerra-Farfan et al., 2023). Guidelines can also improve the consistency of care, empower patients, influence public policy, drive the development of disease performance measures and evaluations, and direct the planning of high-value interventions (Murad, 2017). Nationwide implementation & effective use of the evidence-based Somaliland Standard Treatment Guidelines (STGs) developed by the MoH in 2017 through the support of WHO could help appropriate therapeutic management of common diseases in line with the National Essential Package of Health Services (EPHS) core programs. Somaliland's Health service delivery is structured around the EPHS framework and health care services are delivered through five tiers: The community-level, the primary health unit (PHU), the health center, the referral health center/district hospital, and regional hospitals (Ministry of Health Development, 2022). There are 3 levels of the STGs for each of the PHU, health center/referral health center and hospital and the guidelines were rolled out widely by the NMRA and Ministry of Health training hundreds of frontline healthcare workers in guideline use. However, the coverage of trainings needs to be expanded to cover all public health facilities and target more healthcare workers.

Though relevant data is limited available in developing countries, many studies report high burden of medication errors in the developed world. For instance, the U.S. Institute of Medicine estimated that up to 98,000 people die each year from medication errors in U.S. hospitals at a cost of up to USD 29 billion per year (LT et al., 2000). A meta-analysis estimated that ADRs alone—excluding medication errors—killed over 100,000 people in 1994 and were the fourth to sixth leading cause of death in the United States (Lazarou et al., 1998). For community-acquired pneumonia, two-thirds of

patients receive an excess antibiotic duration (i.e., days beyond guideline-recommended durations) at discharge, with each excess day increasing the risk of adverse antibiotic events (Joanna Buckley et al., 2015)

4.2.5 Sources of medicines & the pharmaceutical supply chain

The pharmaceutical sector is the least-investigated segment of the health system in Somalia or Somaliland. Importation of pharmaceutical products and medical equipment occurs at multiple land and sea border points with trade flows which results in almost complete ease of entry and exit of pharmaceutical products and the circulation of counterfeit products (Joanna Buckley et al., 2015). This is a serious challenge that affects access to quality essential medicines and medical products in Somaliland like many other countries in Africa and other low resource countries. Access to medicines is defined by WHO as “ensuring that medicines are ‘available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and community can afford’ (Bigdeli et al., 2018). The African sub-region relies heavily on the

importation of medicines and raw materials for the manufacture of their medications (Akande-Sholabi & Adebisi, 2020). There are no local pharmaceutical manufacturing companies in Somaliland and Somalia as well whereby all medicines and other health commodities are imported. In Somalia, at least 60 percent of health services and 70 percent of the country’s medicines are estimated to be delivered by the private sector, primarily in urban areas (Federal Ministry of Health Somalia et al., 2022). A Logistics Indicators Assessment Tool (LIAT), which focused on HIV, TB, and malaria items, reported that 81 percent of the inventory items assessed were either overstocked or understocked according to the facility stockholding parameters, in Somalia (Federal Ministry of Health Somalia et al., 2022). Majority of the supply is shared among the international aid organizations and the private sector. Some International NGOs and UN agencies such as WHO, UNICEF & UNFPA provide drug donations and kits to public health facilities such as MCHs and hospitals. The MoH has Central Medical Stores (CMS) unit in Hargeisa which oversees the public supply system of medical supplies in Somaliland. The CMS oversees Central Warehouse and six regional warehouses.

Deaths attributable to antimicrobial resistance every year compared to other major causes of death

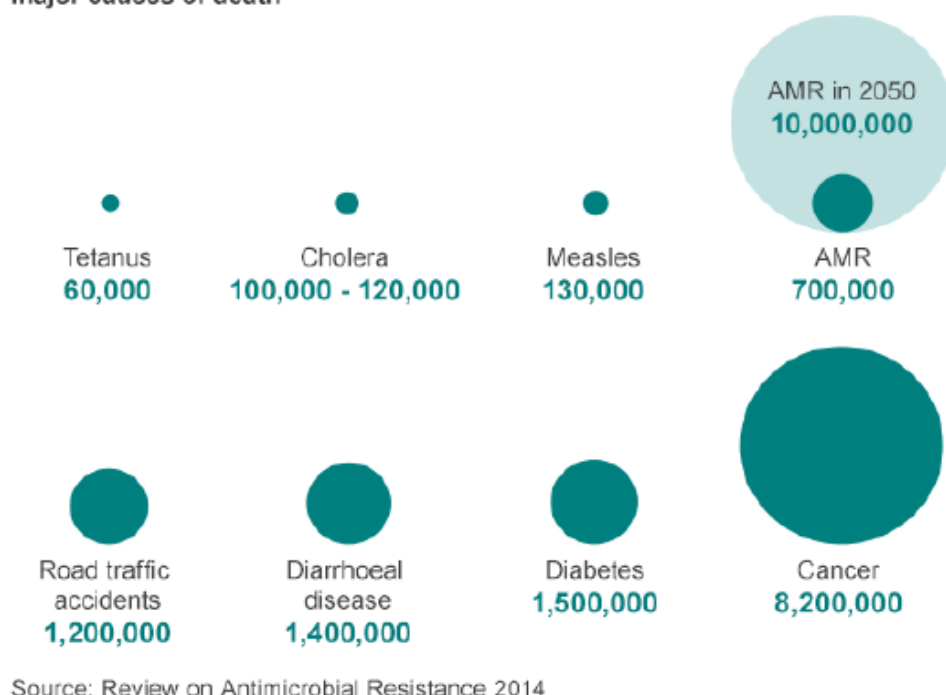


Fig. 7. Global attributable mortality to AMR

Somaliland's healthcare system faces many challenges including availability of funds, access to medicines and poor supply chain capacity. One cause of these challenges is the limited national budget available for public health facilities, while a considerable share of resources for health care is provided by international donors and NGOs, there have also been some initiatives in Somaliland to encourage community involvement through cost-sharing initiatives (Cindy Horst & Nasra Jama, 2016). According to a World Bank Report, conventional donor funding for the health sector in Somalia grew almost three-fold in seven years, passing from US\$23 million in 2000 to US\$62 million in 2006 (Emanuele Capobianco & Veni Naidu, 2008). Supplies represented 29 percent of overall expenditure in the health in Somalia (Emanuele Capobianco & Veni Naidu, 2008)

However, the CMS has not yet started public procurement function and there are no regional supply chain officers, the latter a challenge which hinders the operational efficiency of the public supply management system. Health facilities are irregularly supplied, with an inadequate selection of drugs through a kit system (meaning that every month there is wastage and stock-outs (Somaliland National Health Policy, 2011). Analysis from UNICEF and WHO indicates that 50 percent of LMICs suffered stock-outs of at least one routine immunization vaccine at the national level, in 2021 where almost half of these countries experienced service interruptions owing to stock-outs in 2020, representing a 30 per cent increase from 2014 (Ken Legins et al., 2023) The use of automation and technologies are crucial in supply planning, monitoring stock levels, service utilization as well as allowing product traceability particularly detection of substandard and falsified products in the supply chain. On average, LMICs have reported using as many as 34 different supply chain related information systems simultaneously but they tend to be poorly connected or harmonized, making it hard to make informed decisions (Wyss et al., 2022). In LMICs, governance structures, tools and technical capacity for active monitoring for falsification are limited and traceability systems are either non-existent or in the early stages of development (Wyss et al., 2022). The use of these technologies could be even more critical during the COVID-19 where the incidents of SF medical products have exacerbated. Since the beginning of the pandemic, the Infectious

Diseases Data Observatory (IDDO) identified hundreds of incidents with SF COVID-19 medical products and described some of the risks they hold for public health (Medicine Quality Research Group, 2022)

The storage condition of medicines is also key aspect apart from the original quality where inappropriate environmental conditions can considerably change product quality in the supply chain. This is a significant issue considering the weather conditions in Somaliland and Somalia which can be humid and hot in some regions such as the coastal areas or during rainy seasons. According to the WHO Report on Stability Conditions of Member States, Somalia is in the 30 °C/65% RH (World Health Organization, 2021) and Zone IVa- Hot/humid/tropical zone according to the ICH guidelines (Ankur Choudary, 2019). Availability of essential medicines is a critical component of health services & irregularities in their supply system hampers efforts to provide quality & effective healthcare. Inappropriate storage of essential medicines that need cold chain storage such as oxytocin and biological products is also widespread. As the national capacity in cold chain is still inadequate despite significant improvements in the last two decades, strengthening the cold chain capacity as well as training health workforce in good storage and cold chain practices would be critical in ensuring appropriate handling and preserve medicines quality. To address these challenges in the public supply sector, there is a National Supply Chain Master Plan 2014-2019 developed by the MoH in collaboration with partner agencies to guide efforts to improve the public supply sector and the implementation of the plan can help at least address some of the existing challenges in the supply chain.

Other challenges in the public procurement system includes inadequate rules, regulations and structures; public sector staff with little experience in responding to market situations; lack of decentralized supply system, absence of a comprehensive procurement policy; government funding which is insufficient and/or released irregularly; donor agencies with conflicting procurement regulations; fragmented drug procurement at provincial or district level; push supply which leads to frequent oversupplies which expire at public warehouses. Moreover, there is a problem with medicines selection at national level. The NMRA has finalized the first ever national essential

medicines list (nEML) in 2019, an evidence-based document reflecting the national epidemiological patterns as well as the safety, efficacy and cost profile of medicines included, with WHO's technical support which can serve as the policy document to guide public procurement and donor aid. The nEML has been endorsed by the then Minister of Health Development of Somaliland after wide consultation with the D.G and technical teams. The adoption of such strategic document can help streamline procurements for the public health sector and enhance access to essential medicines in Somaliland. The Essential medicines are those that satisfy the priority health care needs of a population (World Health Organization, 2023a). Selection of a limited number of essential medicines as essential, taking into consideration national disease burden and clinical need can lead to improved access through streamlined procurement and distribution of quality-assured medicines (World Health Organization, 2023a).

4.2.6 Access to quality control laboratories and the risk of sf medicines prevalence

There are no existing well established medicines quality testing laboratories in the country. The ministry of health has two minilab kits donated by WHO and were operational from 2009. A team of lab technicians and pharmacists were also trained abroad on how to use the kits. The minilab kit can perform basic quality testing and is effective to control the quality of medicines at ports of entry and remote areas in low resource countries. The NMRA has conducted several post-marketing quality surveillance surveys from 2009 – 2012 using the minilab covering samples collected from the private pharmaceutical supply chain. Moreover, the minilabs were re-activated with the receipt of new reagents and supplies from WHO in 2019 and were used by the NMRA to conduct post-marketing surveillance of medicines, particularly, antimalarials and antiretroviral drugs on a quarterly basis.

The Minilab kit system is developed by Global Pharma Health Fund (GPHF), a charitable organization supported by the German Merck KGaA pharmaceutical company and verifies label claims on drug identity and content and detects counterfeit medicines containing the wrong, much to high, much to low or zero levels of active ingredients (Global Pharma Health Fund, 2024). The Minilab covers 120 compounds taking into account medicines prevailing in developing countries for priority

infectious diseases, mother & childcare, cardiovascular and diabetic disorders as well as some impurities (Global Pharma Health Fund, 2024). The quality standards which pharmaceuticals must comply with, as well as the methods to prove their compliance or non-compliance, are defined in the pharmacopeias, such as the International Pharmacopeia, the United States Pharmacopeia and the British Pharmacopeia. However, the equipment required for pharmacopeial analysis are expensive and delicate, requiring an appropriate laboratory and regular maintenance and operation by skilled personnel. This is a challenge for most of poor resource countries and settings like Somaliland or Somalia.

Medicine quality screening with the GPHF Minilab is a cost-effective way to contribute to the global surveillance for substandard and falsified medical products (Gnegel et al., 2022). Ten faith-based drug supply organizations in seven countries of Africa and Asia were each equipped with a Minilab and tested 869 medicine samples, 21 were confirmed to be substandard or falsified medical products and authors concluded that surveillance of poor-quality medicines can be carried out by local organizations in low- and middle-income countries using such simple but low-cost technology (J Sherma, 2007). Despite there is a critical need for establishing quality control laboratories that can undertake full analytical testing of medical products quality in the country, also the utilization of the Minilab kits with maintenance of its operational capacity and scaling up its coverage nationwide and at port of entries would help monitoring of medicines quality in the pharmaceutical supply chain in Somaliland.

IGAD regional PMS survey conducted in 2019 to assess quality of oxytocin and amoxicillin samples collected from cross border sites of six member countries involving a total of 86 samples of oxytocin and 37 and 29 of amoxicillin DT & suspension respectively showed that 20.9 percent (18/86) of the oxytocin were substandard (8 out of 9 from Somalia) while all amoxicillin samples have passed the quality tests (64). The registration status of the samples also showed that 41.7 percent of oxytocin products and 70 percent of amoxicillin products circulating in the region were not registered by the relevant Medicine Regulatory Authorities of the region (Promoting the Quality of Medicines (PQM) Program. US Pharmacopeial Convention, 2019)

Table 1. Laboratory Test Results: Report of Post-Marketing Quality Surveillance of Antimalarial & Antiretroviral Medicines Samples Collected from Public Health Facilities in Hargeisa, NMRA, MoHD.2019

Product/Category			Quality Control Test Parameters					
			Identity		Assay (API Content)		Disintegration	
			Pass	Fail	Pass	Fail	Pass	Fail
Antiretroviral Antimalarial	Artemeter + Lumefantrine (AL) tabs	1	1	0	1	0	1	0
	Quinine Sulphate tabs	1	1	0	1	0	1	0
	Zidovudine + Lamivudine (3TC/ZDV tabs	1	1	0	1	0	1	0
	Zidovudine (ZDV) tabs	1	1	0	1	0	1	0

Table 2. Assay Results & Registration Status of Collected Samples; Adapted from IGAD-MRH Expert Working Group on PMS (2019). Results of Regional Post-Marketing Survey to Assess the Quality of Oxytocin and Amoxicillin at IGAD Cross-Border Sites. Promoting the Quality of Medicines (PQM) Program. US Pharmacopeial Convention. Rockville, Maryland. 2019

Product Name	Manufacturer	Origin Country	Registration Status in Somalia	Total Samples Tested/Product	Assay Result (in Samples)	
					Passed	Non-compliant
Oxytocin	Opsonin Pharma Limited	Bangladesh	Not registered	9	1	8
Oxytocin	ISIS Pharmaceuticals & Chemical Works	Pakistan	Not registered			
Oxytocin	Huzhoun Pharmaceuticals	China	Not registered			
Amoxicillin suspension	Athlone Labs limited	Ireland	Not registered	2	2	0
Amoxicillin suspension	Riva Pharma	Egypt	Not registered			
Amoxicillin DT	Beyoum Pharmaceuticals	China	Not registered	6	6	0
Amoxicillin DT	Huzhoun Pharmaceuticals	China	Not registered			

Due to the lack of effective quality assurance system of medicines, it's not possible to estimate the burden of SF medicines in Somaliland. This leaves medicines imported into Somaliland to be supplied directly to consumers and patients without passing through the necessary quality screening to assure their safety, quality and efficacy. An example of quality assured products could be those supplied by some of the aid agencies such as WHO and UNICEF which have

quality assurance system and procure from prequalified suppliers (suppliers undergoing thorough assessment of capacity to manufacture/supply quality and safe drugs including GMP inspections of source manufacturers). A little is known about the products supplied in the private pharmaceutical chain. Prequalification is one of the key elements in ensuring purchase and supply of pharmaceutical products of acceptable

quality(World Health Organization, 2014). Prequalification of source suppliers and closed bids helps to ensure safety, quality and efficacy of procured medicines. The Expert Committee on Specifications for Pharmaceutical Preparations of the World Health Organization (WHO) adopted a Model quality assurance system for procurement agencies (MQAS) during a meeting in Geneva, Switzerland in 2005, and the MQAS have been adopted by many procurement agencies in the world while some donor organizations (including the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM)) have endorsed the MQAS as part of their quality assurance policy for the procurement of pharmaceutical products with their funds(QUAMED, 2024). The MQAS could be used to build and assess capacity of the Central Procurement Agency of the MoHD which would require technical and financial resources to achieve this goal.

5. FACTORS THAT HELP CIRCULATION OF SF MEDICINES

The poor medicines regulatory capacity in lower- & middle-income countries, in general, and Somaliland, in particular, increases the risk of circulation of SF medicines. WHO recognizes that substandard and falsified medical products are most likely to be found where access to affordable, quality, safe and effective medical products is constrained, standards of governance are low and the tools and technical capacity to ensure good practices in manufacturing, quality control and distribution are limited(United Nations Office on Drugs and Crime, 2019). Sales of medicines also contribute to the problem where illegal outlets exist selling medicines of unknown origin to the patients without medical prescriptions (International Medical Products Anti-Counterfeiting Taskforce (IMPACT) & WHO, 2006).

There is a large under-regulated private pharmaceutical sector in Somaliland which lacks the capacity and intention, to some extent, to procure safe medicines from reliable sources. The lack of marketing authorization of medicines exacerbates the situation.

6. TACKLING THE CHALLENGE AT GLOBAL & REGIONAL LEVEL

Having so far discussed on the magnitude of the problem arising from substandard and falsified medicines as well as its detrimental implications,

the question comes to how it can be addressed. Facing this challenge is a global shared responsibility that needs multi-stakeholder and collaborative approaches that create partnerships and coordinated platforms to enlighten the issue, increase awareness of the stakeholders and harmonize efforts to better and effective action. These approaches can encompass on prevention of the sales and distribution of SF medicines, develop mechanisms that allow early detection of these products and subsequent regulatory action and incident management by health authorities.

On a global scale, the World Health Organization spearheaded the creation of the WHO IMPACT coalition, which is supported by national medicines regulatory authorities of WHO Member States and a number of international stakeholders including Interpol, Organization for Economic Cooperation and Development, World Customs Organization, World Intellectual Property Organization, World Trade Organization, European Commission, Council of Europe, International Federation of Pharmaceutical Manufacturers and Associations (International Medical Products Anti-Counterfeiting Taskforce (IMPACT) & WHO, 2006).To achieve its mandate, IMPACT focuses on legislative and regulatory infrastructure, regulatory implementation, the use of technology and communication as priority areas. Also, the WHO's Global Surveillance of Medicines System (GSMS) sets the three corner stone strategies of prevent, detect and respond to address the challenge posed by the SF medical products.

Building the capacities of National Regulatory Authorities (NRAs) as well as public supply chain systems could be an effective strategy to ensure safe, effective and quality products are manufactured, procured, distributed and consumed. Creating technical information sharing and collaboration among NRAs allows early detection and unified regulatory responses at regional, continental and international level.

The African Medicines Regulatory Harmonization (AMRH) initiative is a typical example of harmonized African initiative which aims to improve access to quality, safe and efficacious medicines by providing an enabling regulatory environment for pharmaceutical sector development in Africa. The African Medicines Regulatory Harmonization (AMRH) initiative was launched to accelerate access to

quality, safe, effective medical products by optimizing the regulatory environment on the continent (Ndomondo-Sigonda et al., 2018). The AMRH Strategic Plan defines the strategic direction for the medicines harmonization agenda in Africa and provides direction to advance the development of the pharmaceutical sector and provides guidance in monitoring and evaluation. The AMRH initiative's goal was for NRAs within each of Africa's regional economic communities (RECs) to address this problem – *long time for drug approvals in Africa* – by coordinating their activities, relying on the work of one another and other trusted regulatory authorities, and applying other principles of smart regulation (Ndomondo-Sigonda et al., 2023). The resulting improvements in regulatory efficiency would make it easier and faster for medicines manufacturers to register quality products (Ndomondo-Sigonda et al., 2020).

The African Ministers of Health unanimously adopted the Treaty for the establishment of the

African Medicines Agency (AMA) in Geneva, 2018. The Treaty for the Establishment of the African Medicines Agency (AMA) entered into force as of 5th November 2021, thirty (30) days after the deposit of the 15th instrument of ratification, on the 5th of October 2021, by the Republic of Cameroon at the African Union Commission (Article 38, AMA Treaty) (African Union, 2021). The AMA will promote the adoption and harmonization of medical products regulatory policies and standards, provide regulatory guidance and provide technical assistance on regulatory matters to countries that lack the capacity and resources to do so. The regulation of pharmaceuticals is an essential part of improving health care while supporting social and economic productivity of the African population and therefore, AMA is intended to be an organ of the African Union (AU), legally mandated by Member States (MS) with the goal of increasing availability of affordable, quality, safe and efficacious medicines and other health products on the continent (African Union, 2016).

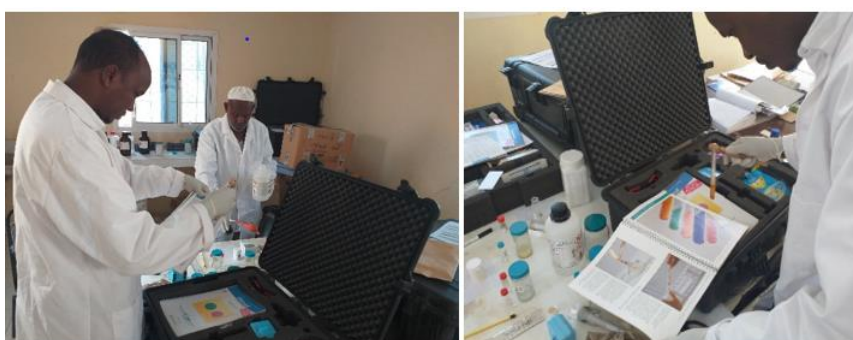
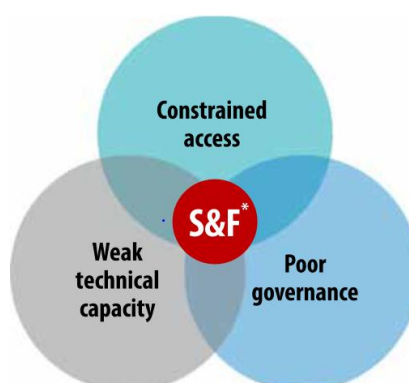


Fig. 8. QC & laboratory personnel analyzing medicines samples collected from public health facilities with Minilab, Antimalarials & ARVs survey 2019, NMRA QC lab, NMRA, MoHD, Hargeisa



*S&F : substandard and falsified medical products

Fig. 9. Contributory factors to emergence of sf medical products, adapted from who global monitoring & surveillance system for SF medical products

<https://iris.who.int/bitstream/handle/10665/326708/9789241513425-eng.pdf>



Fig. 10. WHO GSMS approaches to tackle SF medicines
<https://iris.who.int/bitstream/handle/10665/326708/9789241513425-eng.pdf>

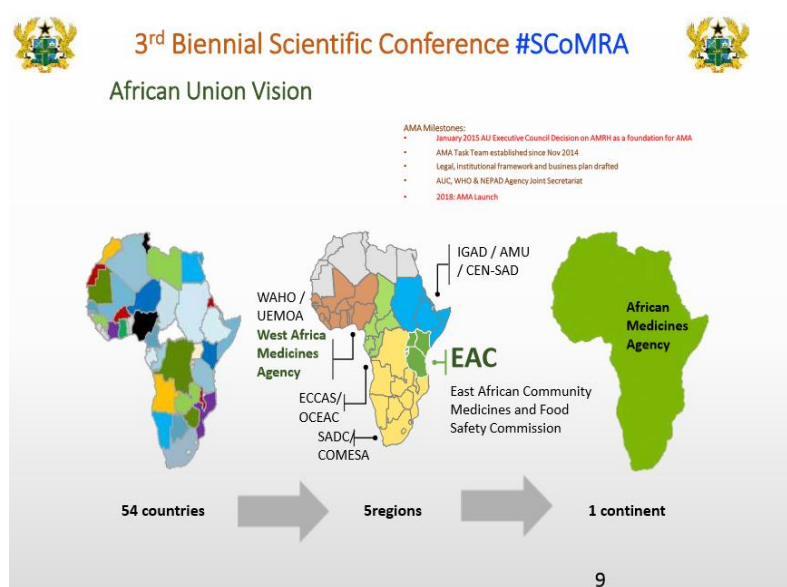


Fig. 11. The African Medicines Regulatory Harmonization (AMRH) Initiative: update on continental progress
<https://amrh.nepad.org/>

AMA ratification and operationalization is currently underway with so far over 27 countries signing the treaty for establishment of AMA as of February, 2024 (Grant Castle et al., 2024). Moreover, Technical Committees (TCs) of the agency have been restructured and currently operationalization of core TCs ongoing, an effort led by the African Union Development Agency (AUDA-NEPAD). The technical committees will be responsible for carrying out specific

assessments and conducting scientific reviews of dossiers, including quality aspects, and clinical trial applications; inspection of manufacturing facilities; and providing scientific opinion to facilitate the proper functioning of the AMA. However, there were challenges reported in the ratification process include the fact that the process is slow and there is limited understanding of the process (Ncube et al., 2024)

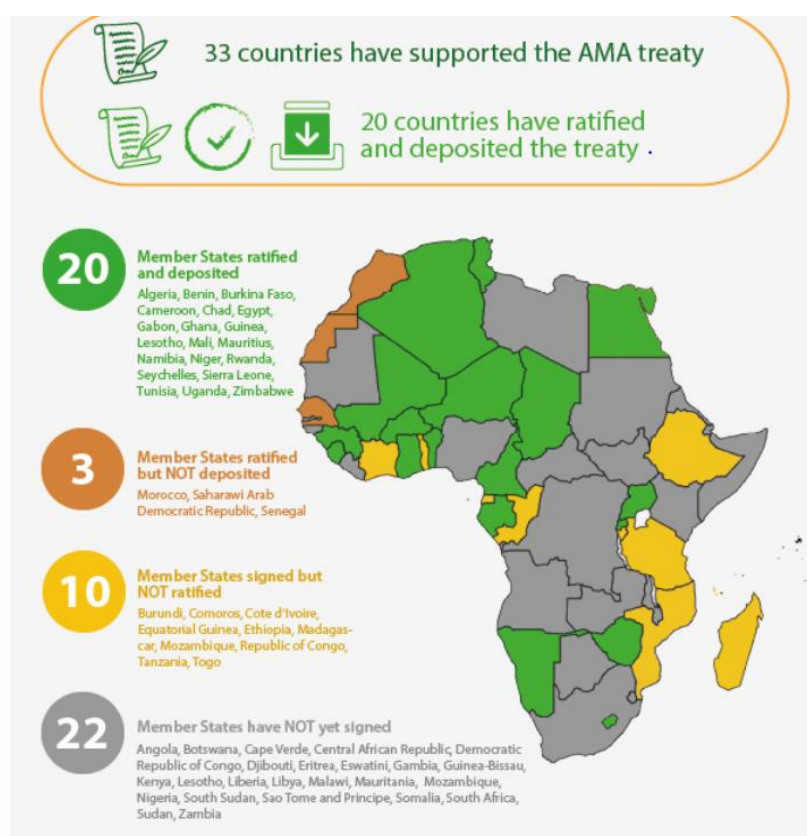


Fig. 12. AMA treaty signing and ratifications, by end of 2021, Source AUDA-NEPAD
<https://www.nepad.org/publication/african-medicines-agency-ama-brochure-for-pharmaceutical-sector>

7. CONCLUSION

The following section presents key conclusions highlighting the current situation, major gaps and challenges as presented in the article. It also suggests the recommendations and specific interventions that could have future implications and help address the pressing challenges in medical products regulation in the country. Key points could be summarized as:

- i. In light of the weak regulatory capacity and the porous national borders, the risk of SF medicines circulating in the pharmaceutical supply chain is very high and swift actions are needed to tackle this issue.
- ii. The NRA lacks the functional capacity as well as resources and tools required to regulate medical products in the country. Also, the legal provisions are not in place.
- iii. The testing laboratory capacity is limited and the Ministry has 2 minilab kits which were used to analyze drug samples collected from private sector and for quarterly samples collection for antimalarial and anti-retroviral medicines.

- iv. There is a fragmented pharmaceutical supply chain system mainly dominated by the private sector while the public sector mainly relies on drug donations from UN and international aid agencies. Some of the challenges include the absence of guidelines for drug donations, cold chain infrastructure & resource challenges, drug shortages, push supply system, lack or limited use of automation and product traceability technologies as well as lack of procurement policies and guidelines.

8. RECOMMENDATIONS

The following are some of the recommended actions that are covering priority areas and immediate interventions that can significantly address the existing challenges:

- i. Formulation of the National Medical Products Act, a law to be passed by the Parliament of Somaliland, to provide the legal framework for the National Medicines Regulatory Authority (NMRA) to regulate the import, export, distribution, sale, use

- and manufacture of medical products in the country.
- ii. Strengthening the technical and functional capacity of the NMRA with allocation of sufficient human and financial resources as well as legal autonomy to execute its national duties.
 - iii. The Government of Somaliland should provide mechanisms and strategies for the implementation of the National Medicines Policy including strategies for ensuring affordability and financing schemes for essential medicines to the people of Somaliland. This could also be supported by the implementation of the National Essential Medicines List (nEML) and prioritize the use of the list to guide public procurement and donations.
 - iv. Development and implementation of an Institutional Development Plan (IDP) for the NRA based on a full benchmarking of the regulatory system, guiding building its capacity for 5 years period and with prioritization of core regulatory functions such as: licensing and registration of medicines and medical devices, laboratory capacity and access, post-marketing surveillance and pharmacovigilance as well as inspections and imports control.
 - v. Strengthening the public supply chain system by developing an effective public procurement policies and guidelines, building the supply chain capacity particularly the human resources and technical aspects to switch from the current push to pull systems, the efficient use of data, use of automated systems and technologies for supply chain monitoring, planning and product traceability.
 - vi. Enhancing coordination and collaboration among the key government authorities such as the MoHD, SQCC, NHPC, the Ministry of Interior and Customs Authorities as well to monitor and control drug imports and tackling substandard and falsified medical products sale and distribution in Somaliland.

The implementation of such interventions can be vital to ensure access to safe, quality & efficacious medicines and health technologies in Somaliland and will help safeguarding the public health and health security as well as contribute to achieving the national health targets in line with the national medicines policy, national health policy and strategic plans of the Ministry of Health Development of Somaliland.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- African Union. (2016). *AFRICAN MEDICINES AGENCY Business Plan Version 05*. https://au.int/sites/default/files/newsevents/workingdocuments/32060-wd-draft_ama_business_plan_rev_05_26_january_2017_final.pdf
- African Union. (2021, November 9). *Treaty for the establishment of the African Medicines Agency (AMA) enters into force | African Union*. <https://au.int/en/pressreleases/20211109/treaty-establishment-african-medicines-agency-ama-enters-force>
- Akande-Sholabi, W., & Adebisi, Y. A. (2020). The impact of COVID-19 pandemic on medicine security in Africa: Nigeria as a case study. *The Pan African Medical Journal*, 35(Suppl 2), 73. <https://doi.org/10.11604/PAMJ.SUPP.2020.35.2.23671>
- Ali, F., & Nollet, L. M. L. (2024). Global Regulations of Medicinal, Pharmaceutical, and Food Products. *Global Regulations of Medicinal, Pharmaceutical, and Food Products*, 1–332. <https://doi.org/10.1201/9781003296492>
- AM, A. (2024). Community Use of Antibiotics in Hargeisa, Somaliland: A Qualitative Study. *Vaccines & Vaccination Open Access*, 9(1), 1–5. <https://doi.org/10.23880/VVOA-16000169>
- Ankur Choudary. (2019). *Climatic Zones for Stability Studies: Pharmaguideline*. <https://www.pharmaguideline.com/2010/12/different-climatic-zones-for-stability.html>
- Bastani, P., Jammeh, A., Lamar, F., Malenfant, J. H., Adewuyi, P., Cavanaugh, A. M., Calloway, K., Crisp, C., Fofana, N., Hallett,

- T. C., Jallow, A., Muoneke, U., Nyassi, M., Thomas, J., Troeschel, A., Yard, E., Yeh, M., & Bittaye, M. (2023). Acute Kidney Injury Among Children Likely Associated with Diethylene Glycol-Contaminated Medications - The Gambia, June-September 2022. *MMWR. Morbidity and Mortality Weekly Report*, 72(9), 217–222. <https://doi.org/10.15585/MMWR.MM7209A1>
- Bigdeli, M., Shroff, Z. C., Godin, I., & Ghaffar, A. (2018). Health systems research on access to medicines: unpacking challenges in implementing policies in the face of the epidemiological transition. *BMJ Global Health*, 2(Suppl 3), e000941. <https://doi.org/10.1136/BMJGH-2018-000941>
- Cindy Horst, & Nasra Jama. (2016). Resources for Health Care in Somaliland: From the International to the Communal? Peace Research Institute-Oslo Prio Policy Brief, 23. In *Policy Brief*. <https://www.prio.org/publications/9227>
- Cunha, C. B. (2018). Antimicrobial Stewardship Programs: Principles and Practice. *The Medical Clinics of North America*, 102(5), 797–803. <https://doi.org/10.1016/J.MCNA.2018.04.003>
- Dellit, T. H., Owens, R. C., McGowan, J. E., Gerding, D. N., Weinstein, R. A., Burke, J. P., Huskins, W. C., Paterson, D. L., Fishman, N. O., Carpenter, C. F., Brennan, P. J., Billeter, M., & Hooton, T. M. (2007). Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship. *Clinical Infectious Diseases*, 44(2), 159–177. <https://doi.org/10.1086/510393>
- Emanuele Capobianco, & Veni Naidu. (2008). *A Review of Health Sector Aid Financing to Somalia, World Bank Working Paper No. 142*. <https://openknowledge.worldbank.org/server/api/core/bitstreams/ece8afd3-a0d3-52b4-b152-c8b8363c78a3/content>
- Endale, H., Mathewos, M., & Abdeta, D. (2023). Potential Causes of Spread of Antimicrobial Resistance and Preventive Measures in One Health Perspective-A Review. *Infection and Drug Resistance*, 16, 7515–7545. <https://doi.org/10.2147/IDR.S428837>
- Federal Ministry of Health Somalia, World Bank Group, & Global Financing Facility. (2022). *Investment Case for the Somali Health Sector, 2022- 2027*. <https://www.globalfinancingfacility.org/sites/default/files/Somalia-GFF-Investment-Case.pdf>
- Global Pharma Health Fund. (2024). *GPHF / GPHF-Minilab™ - Fact Sheet*. <https://www.gphf.org/en/minilab/factsheet.htm>
- Gnegel, G., Häfele-Abah, C., Neci, R., & Heide, L. (2022). Surveillance for substandard and falsified medicines by local faith-based organizations in 13 low- and middle-income countries using the GPHF Minilab. *Scientific Reports* 2022 12:1, 12(1), 1–13. <https://doi.org/10.1038/s41598-022-17123-0>
- Grant Castle, Mosa Mkhize, & Roderick Dirkzwager. (2024, February 12). *EMA announces €10 million of funding to support the establishment of the African Medicines Agency | Cov Africa*. <https://www.covaffrica.com/2024/02/ema-announces-e10-million-of-funding-to-support-the-establishment-of-the-african-medicines-agency/>
- Guerra-Farfan, E., Garcia-Sanchez, Y., Jornet-Gibert, M., Nuñez, J. H., Balaguer-Castro, M., & Madden, K. (2023). Clinical practice guidelines: The good, the bad, and the ugly. *Injury*, 54, S26–S29. <https://doi.org/10.1016/J.INJURY.2022.01.047>
- Hajjou, M., Krech, L., Lane-Barlow, C., Roth, L., Pribluda, V. S., Phanouvong, S., El-Hadri, L., Evans, L., Raymond, C., Yuan, E., Siv, L., Vuong, T. A., Boateng, K. P. oku, Okafor, R., Chibwe, K. M., & Lukulay, P. H. (2015). Monitoring the quality of medicines: results from Africa, Asia, and South America. *The American Journal of Tropical Medicine and Hygiene*, 92(6), 68–74. <https://doi.org/10.4269/ajtmh.14-0535>
- Hamilton, W. L., Doyle, C., Halliwell-Ewen, M., & Lambert, G. (2016). Public health interventions to protect against falsified medicines: A systematic review of international, national and local policies. *Health Policy and Planning*, 31(10), 1448–1466. <https://doi.org/10.1093/heapol/czw062>
- has been produced by the Medicine Quality Research Group, C. of T. M. & G. H. N. D. of M. U. of O. (2022). *Medical Quality*

- Product Report-COVID-19 issues. Issue 15, Jan-March.
https://www.iddo.org/sites/default/files/publication/2022-09/Medical%20Product%20Quality%20Report_Covid-19_Issue15_January-March2022_V1.1.pdf
- Hossain, M. J., Jabin, N., Ahmmed, F., Sultana, A., Abdur Rahman, S. M., & Islam, M. R. (2023). Irrational use of antibiotics and factors associated with antibiotic resistance: Findings from a cross-sectional study in Bangladesh. *Health Science Reports*, 6(8), e1465.
<https://doi.org/10.1002/HSR2.1465>
<https://doi.org/10.1001/JAMA.279.15.1200>
<https://doi.org/10.1093/HEAPOL/CZAE017>
<https://doi.org/10.18103/MRA.V6I2.1668>
https://www.unodc.org/documents/treaties/publications/19-00741_Guide_Falsified_Medical_Products_ebook.pdf
- International Medical Products Anti-Counterfeiting Taskforce (IMPACT) & WHO. (2006). *Counterfeit Drugs Kill*.
<https://www.gphf.org/images/downloads/impactbrochure.pdf>
- International Pharmaceutical Federation. (2023). *Antimicrobial resistance and stewardship education Supporting the pharmaceutical workforce in AMR and AMS 2023 FIP Development Goals*.
<https://www.fip.org/file/5655>
- J Sherma. (2007). Analysis of counterfeit drugs by thin layer chromatography. *Acta Chromatographica*, 19(19).
https://www.researchgate.net/publication/268255040_Analysis_of_counterfeit_drugs_by_thin_layer_chromatography
- Joanna Buckley, Liz O'Neill, & Ahmed Mohamed Aden. (2015, March). *Assessment of Private Health Sector in Somaliland, Puntland and South Central, Final Report-Health & Education Advice & Resource Team (HEART)-DFID*.
<https://assets.publishing.service.gov.uk/media/57a0899bed915d622c0002e3/Assessment-of-the-Private-Health-Sector-in-Somaliland-Puntland-and-South-Central.pdf>
- Ken Legins, Jonathan Moody, & Raphael du Boispean. (2023). *SUPPLY CHAINS SAVE LIVES Unlocking access for children, their families and communities: UNICEF*.
<https://www.unicef.org/supply/media/20346/file/Supply-chains-save-lives.pdf>
- Kenya Broadcasting Corporation. (2024, May 11). *Poisons board issues warning on counterfeit Herceptin 440mg in Kenyan market – KBC*.
<https://kbc.co.ke/poisons-board-issues-warning-on-counterfeit-herceptin-440mg-in-kenyan-market/>
- Kniazkov, S., Dube-Mwedzi, S., & Nikiema, J. B. (2020). Prevention, Detection and Response to incidences of substandard and falsified medical products in the Member States of the Southern African Development Community. *Journal of Pharmaceutical Policy and Practice*, 13(1), 1–7. <https://doi.org/10.1186/S40545-020-00257-9/FIGURES/3>
- Kohler, J. C., Pavignani, E., Michael, M., Ovtcharenko, N., Murru, M., & Hill, P. S. (2012). An examination of pharmaceutical systems in severely disrupted countries. *BMC International Health and Human Rights*, 12(1), 34.
<https://doi.org/10.1186/1472-698X-12-34>
- Kshirsagar, N. A. (2016). Rational use of medicines: Cost consideration & way forward. *The Indian Journal of Medical Research*, 144(4), 502.
<https://doi.org/10.4103/0971-5916.200901>
- Labi, A. K., Obeng-Nkrumah, N., Bjerrum, S., Aryee, N. A. A., Ofori-Adjei, Y. A., Yawson, A. E., & Newman, M. J. (2018). Physicians' knowledge, attitudes, and perceptions concerning antibiotic resistance: A survey in a Ghanaian tertiary care hospital. *BMC Health Services Research*, 18(1), 1–12.
<https://doi.org/10.1186/S12913-018-2899-Y/FIGURES/3>
- Lazarou, J., Pomeranz, B. H., & Corey, P. N. (1998). Incidence of adverse drug reactions in hospitalized patients: a meta-analysis of prospective studies. *JAMA*, 279(15), 1200–1205.
- LT, K., JM, C., & MS, D. (2000). *To Err is Human: Building a Safer Health System*. National Academies Press.
<https://doi.org/10.17226/9728>
- Mazzilli, C., et al. (2009). *The Private Sector and Health: A Survey of Somaliland Private Pharmacies*. - Social Science in Humanitarian Action Platform.
<https://www.socialscienceinaction.org/resources/private-sector-health-survey-somaliland-private-pharmacies/>
- Ministry of Health Development, R. of S. (2022). *National Health Policy III 2022*.

- Ministry of Health. (2024). *Somaliland Ministry of Health: Mission and National Duties*. <https://somalilandmohd.com/>
- Ministry of National Planning and Development. (2021). *Somaliland in Figures, Edition 19: Data 2020*. <http://www.somalilandcsd.org/>
- Mohamed, S. A. M., & Bashir, A. M. (2023). A Qualitative Study on Community Usage of Antibiotics in Mogadishu-Somalia. <https://doi.org/10.21203/RS.3.RS-3791665/V1>
- Moyo, P., Moyo, E., Mangoya, D., Mhango, M., Mashe, T., Imran, M., & Dzinamarira, T. (2023). Prevention of antimicrobial resistance in sub-Saharan Africa: What has worked? What still needs to be done? *Journal of Infection and Public Health*, 16(4), 632–639. <https://doi.org/10.1016/J.JIPH.2023.02.020>
- Murad, M. H. (2017). Clinical Practice Guidelines: A Primer on Development and Dissemination. *Mayo Clinic Proceedings*, 92(3), 423–433. <https://doi.org/10.1016/J.MAYOCP.2017.01.001>
- Murray, C. J., Ikuta, K. S., Sharara, F., Swetschinski, L., Robles Aguilar, G., Gray, A., Han, C., Bisignano, C., Rao, P., Wool, E., Johnson, S. C., Browne, A. J., Chipeta, M. G., Fell, F., Hackett, S., Haines-Woodhouse, G., Kashef Hamadani, B. H., Kumaran, E. A. P., McManigal, B., ... Naghavi, M. (2022). Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *The Lancet*, 399(10325), 629–655. [https://doi.org/10.1016/S0140-6736\(21\)02724-0/ATTACHMENT/4504FC2B-08AE-46D6-BD75-80811DF8B5E6/MMC1.PDF](https://doi.org/10.1016/S0140-6736(21)02724-0/ATTACHMENT/4504FC2B-08AE-46D6-BD75-80811DF8B5E6/MMC1.PDF)
- Ncube, B. M., Dube, A., & Ward, K. (2024). The process of ratifying the treaty to establish the African Medicines Agency: perspectives of national regulatory agencies. *Health Policy and Planning*, 39(5), 447–456.
- Ndomondo-Sigonda, M., Azatyan, S., Doerr, P., Agaba, C., & Harper, K. N. (2023). Best practices in the African Medicines Regulatory Harmonization initiative: Perspectives of regulators and medicines manufacturers. *PLOS Global Public Health*, 3(4), e0001651. <https://doi.org/10.1371/JOURNAL.PGPH.0001651>
- Ndomondo-Sigonda, M., Mahlangu, G., Agama-Anyetei, M., & Cooke, E. (2020). A new approach to an old problem: Overview of the East African Community's Medicines Regulatory Harmonization initiative. *PLoS Medicine*, 17(8). <https://doi.org/10.1371/JOURNAL.PMED.1003099>
- Ndomondo-Sigonda, M., Miot, J., Naidoo, S., Ambali, A., Dodoo, A., & Mkandawire, H. (2018). The African Medicines Regulatory Harmonization Initiative: Progress to Date. *Medical Research Archives*, 6(2).
- Newton, P. N., Green, M. D., & Fernández, F. M. (2010). Impact of poor-quality medicines in the “developing” world. *Trends in Pharmacological Sciences*, 31(3), 99–101. <https://doi.org/10.1016/J.TIPS.2009.11.005>
- Newton, P. N., Hanson, K., & Goodman, C. (2017). Do x in Africa meet quality standards? The market penetration of non quality-assured artemisinin combination therapy in eight African countries. *Malaria Journal*, 16(1). <https://go.gale.com/ps/i.do?p=HRCA&sw=w&issn=14752875&v=2.1&it=r&id=GALE%7CA496375968&sid=googleScholar&linkaccess=fulltext>
- Newton, P. N., Tabernero, P., Dwivedi, P., Culzoni, M. J., Monge, M. E., Swamidoss, I., Mildenhall, D., Green, M. D., Jähnke, R., de Oliveira, M. dos S., Simao, J., White, N. J., & Fernández, F. M. (2014). Falsified medicines in Africa: All talk, no action. *The Lancet Global Health*, 2(9), e509–e510. [https://doi.org/10.1016/S2214-109X\(14\)70279-7](https://doi.org/10.1016/S2214-109X(14)70279-7)
- Ofori-Asenso, R., & Agyeman, A. (2016). Irrational Use of Medicines-A Summary of Key Concepts. *Pharmacy (Basel, Switzerland)*, 4(4), 35. <https://doi.org/10.3390/PHARMACY4040035>
- Ozawa, S., Evans, D. R., Bessias, S., Haynie, D. G., Yemeke, T. T., Laing, S. K., & Herrington, J. E. (2018). Prevalence and Estimated Economic Burden of Substandard and Falsified Medicines in Low- and Middle-Income Countries: A Systematic Review and Meta-analysis. *JAMA Network Open*, 1(4), e181662–e181662. <https://doi.org/10.1001/JAMANETWORKOPEN.2018.1662>
- Pathak, R., Gaur, V., Sankrityayan, H., & Gogtay, J. (2023). Tackling Counterfeit Drugs: The Challenges and Possibilities. In

- Pharmaceutical Medicine* (Vol. 37, Issue 4, pp. 281–290). Adis.
<https://doi.org/10.1007/s40290-023-00468-w>
- Promoting the Quality of Medicines (PQM) Program. US Pharmacopeial Convention. (2019). *Results of Regional Post-Marketing Survey to Assess the Quality of Oxytocin and Amoxicillin at IGAD Cross-Border Sites*.
- QUAMED. (2024, October 20). *Model quality assurance system for procurement agencies*.
<https://helpdesk.quamed.org/en/blog/model-quality-assurance-system-for-procurement-agencies-background-the-expert-committee-on-specifications-for-pharmaceutical-preparations-of-the-world-health-organization-who-adopted-a-model-quality-assurance-system-for-procurement-agencies-mqas-during-a>
- Schentag, J. J., H. Ballow, C., L. Fritz, A., A. Paladino, J., D. Williams, J., J. Cumbo, T., V. Ali, R., A. Galletta, V., B. Gutfeld, M., & Adelman, M. H. (1993). Changes in antimicrobial agent usage resulting from interactions among clinical pharmacy, the infectious disease division, and the microbiology laboratory. *Diagnostic Microbiology and Infectious Disease*, 16(3), 255–264.
[https://doi.org/10.1016/0732-8893\(93\)90119-R](https://doi.org/10.1016/0732-8893(93)90119-R)
- Sema, F. D., Asres, E. D., & Wubeshet, B. D. (2021). <p>Evaluation of Rational Use of Medicine Using WHO/INRUD Core Drug Use Indicators at Teda and Azezo Health Centers, Gondar Town, Northwest Ethiopia</p>. *Integrated Pharmacy Research and Practice*, 10, 51–63.
<https://doi.org/10.2147/IPRP.S316399>
- Sidamo, T., Deboch, A., Abdi, M., Debebe, F., Dayib, K., & Balcha Balla, T. (2022). Assessment of Polypharmacy, Drug Use Patterns, and Associated Factors at the Edna Adan University Hospital, Hargeisa, Somaliland. *Journal of Tropical Medicine*, 2022, 2858987.
<https://doi.org/10.1155/2022/2858987>
- Somaliland National Health_Policy (2011).
- United Nations Office on Drugs and Crime. (2019). *Combating Falsified Medical Product-Related Crime: A Guide to Good Legislative Practices*.
- Vaughn, V. M., Flanders, S. A., Snyder, A., Conlon, A., Rogers, M. A. M., Malani, A. N., McLaughlin, E., Bloemers, S., Srinivasan, A., Nagel, J., Kaatz, S., Osterholzer, D., Thyagarajan, R., Hsaiky, L., Chopra, V., & Gandhi, T. N. (2019). Excess antibiotic treatment duration and adverse events in patients hospitalized with pneumonia: A multihospital cohort study. *Annals of Internal Medicine*, 171(3), 153–163.
https://doi.org/10.7326/M18-3640/ASSET/IMAGES/AIME201908060-M183640_VISUAL-ABSTRACT.PNG
- World Health Organisation. (2011). *Marketing Authorization of Pharmaceutical Products with Special Reference to Multisource (Generic) Products: A Manual for National Medicines Regulatory Authorities (NMRs)*.
http://whqlibdoc.who.int/publications/2011/9789241501453_eng.pdf?ua=1
- World Health Organization. (2002). *Promoting rational use of medicines: core components*.
https://iris.who.int/bitstream/handle/10665/67438/WHO_EDM_2002.3.pdf
- World Health Organization. (2010, April). *Counterfeit medical products Report by the Secretariat: Sixty-Third World Health Assembly Provisional Agenda Item 11.20*.
https://apps.who.int/gb/ebwha/pdf_files/WHA63/A63_23-en.pdf
- World Health Organization. (2014). *TRS 986 - Annex 3: Model Quality Assurance System for Procurement Agencies. WHO Expert Committee on Specifications of Pharmaceutical Products, Forty-Eight Report*.
<https://www.who.int/publications/m/item/trs-986-annex-3>
- World Health Organization. (2017a). *A Study on the Public Health and Socioeconomic Impact of Substandard and Falsified . Licence: CC BY-NC-SA 3.0 IGOMedicines*.
<https://www.who.int/publications/i/item/9789241513432>
- World Health Organization. (2017b). *WHO GSM 2017*.
<https://iris.who.int/bitstream/handle/10665/326708/9789241513425-eng.pdf?sequence=1&isAllowed=y>
- World Health Organization. (2019). *Annex 5 Guidelines on import procedures for medical products Background, WHO Expert Committee on Specifications for Pharmaceutical Preparations Fifty-third report*.
<http://apps.who.int/medicinedocs/documents/s21962en/s21962en.pdf>

- World Health Organization. (2019). *Health Workers' Education and Training on Antimicrobial Resistance Curricula Guide*.
- World Health Organization. (2021, March). *Stability Testing of Active Pharmaceutical Ingredients and Finished Pharmaceutical Products: Stability Studies by Member States by Region*.
- World Health Organization. (2023a). *WHO Model List of Essential Medicines - 23rd list, 2023*.
<https://www.who.int/publications/i/item/WHO-MHP-HPS-EML-2023.02>
- World Health Organization. (2023b, January 23). *WHO urges action to protect children from contaminated medicines*.
<https://www.who.int/news/item/23-01-2023-who-urges-action-to-protect-children-from-contaminated-medicines>
- World Health Organization. (2024a). *1 in 10 medical products in developing countries is substandard or falsified*.
<https://www.who.int/news/item/28-11-2017-1-in-10-medical-products-in-developing-countries-is-substandard-or-falsified>
- World Health Organization. (2024b). *Global Benchmarking Tools*.
<https://www.who.int/tools/global-benchmarking-tools>
- World Health Organization. (2024c). *Substandard and falsified medical products*.
<https://www.who.int/news-room/fact-sheets/detail/substandard-and-falsified-medical-products>
- Wyss, N., Myers, C., VillavicencioPeralta, X., & Coflan, C. (2022). *Mapping and Analysing EdTech initiatives in Latin America and the Caribbean*.
<https://doi.org/10.53832/edtechhub.0111>

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