EPPAD Bulletin

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In This Edition

Editor's Corner

Dear Readers,

In this issue of EPPAD Bulletin (Vol 3, Number 2), various topics are covered. We are also introducing a new column called "Meet EPPAD Board Members." The current issue introduces a new EPPAD Board member, Dr. Eyerusalem Befkadu, PharmD, BCPS. The Bulletin also welcomes Helen HaileSelassie, PharmD, BCPS to the Editorial Team. In subsequent issues, we will run similar blurbs about other members.

Dr. Ermias Tilahun (President of EPPAD) contributed a write-up for the News and Highlights section. He covered various activities of the Association in the past several months, notably about an initiative to prepare an Ethiopian Herbal Pharmacopoeia. The latter effort has gained good traction and EPPAD believes it will come to fruition in due course.

In the Pioneers of Pharmacy section, the illustrious career of Dr. Tesfaye Biftu is presented. His contributions in the drug discovery effort have been simply phenomenal. He is also actively engaged as an advisor to rising scientists in Ethiopia, Adama University in particular. His storied career is indeed stellar and sets an example for future Ethiopian scientists. Dr. Tesfaye also happens to be a member of EPPAD Board and is on the editorial team of this very Bulletin.

Various articles have been included in this issue. Professor Bisrat Hailemeskel contributed an article on the newly launched PhD program in clinical pharmacology at Addis Ababa University, Ethiopia. This program appears to be the first of its kind at that level and in that specialty area. He also wrote a manuscript on digital pharmacy, which seems to be the future of the profession. Ato Aklile gives a panoramic view of neglected tropical diseases, so-called NTDs. He outlines the origin of the NTD program and some of its milestones. It is interesting to note that he himself has been a part of this program. Tilahun Tadesse and co-authors from Haramaya University, Ethiopia present interesting results on a quality improvement (QI) project to reduce medication wastage. In their project, they demonstrated a significant reduction in medication wastage after intervention. Their findings serve as models for other similar institutions.

Dr. Minbale Gashu of Debre Berhan University and Professor Ermias Dagne of Addis Ababa University co-contributed a paper on their investigation of the plant *Inula confertifora* locally known by the name ***Wegnagift***. They describe several compounds isolated from the plant, some of which are biologically active. They hope some of the molecules will have therapeutic implications in the future.

Fekadu Fullas, PhD

Editor-in-Chief,
EPPAD Bulletin

EPPAD News and Highlights

(Contributed by Ermias Tilahun, PhD, President of EPPAD)

1. This year (2023), EPPAD Board decided to dedicate a scholarship program in Dr. Tesfaye Biftu's name. The scholarship program aims to support the future of pharmaceutical profession via promoting excellence in pharmacy practice. The scholarship will aid student pharmaceutical professionals to enhance their leadership skills by supporting them financially. The scholarship review committee awarded the first scholarship to Mr. Wubshet Mulatu, who is in his 3rd year of pharmacy school at the University of Maryland Eastern Shore School of Pharmacy (UMES SOP).

2. EPPAD has signed a memorandum of understanding (MOU) with the Federal Ministry of Health (FMOH), Ethiopia, with a focus on assisting the Traditional Medicine Desk in the preparation of an Ethiopian Herbal Pharmacopeia. With the dedicated support of the Traditional Medicine Working Group (TMWG) at EPPAD, the Ministry has initiated the development of Ethiopia's inaugural pharmacopoeia document.

3. In an effort to promote gender diversity, EPPAD has welcomed three highly accomplished women to its Board of Directors. The newest additions to the Board are:

   a. Dr. Helen HaileSelassie, PharmD, BCPS

   b. Dr. Sarem Hailemariam, PhD

   c. Dr. Eyerusalem Befkadu, PharmD, BCPS

4. In June 2023, EPPAD convened a planning and strategy board meeting. During this session, board members and working group leaders brainstormed on the association's future direction. The primary objectives were to enhance the value provided to members and determine how to maximize impact in the coming years.

5. **EPPAD is in the process of planning its 4th Annual Conference, scheduled for November 4th, 2023, from 8:30 am to 6:00 pm at the Holiday Inn in Alexandria, VA**.

EPPAD ANNUAL CONFERENCE

November 4, 2023

Event Highlights

- Keynote speakers
- EPPAD thematic highlights
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Pioneers of Ethiopian Pharmacy

Professor Tesfaye Biftu

An Ethiopian American scientist with over 100 patents for his pharmaceutical inventions

EPPAD bulletin is featuring Dr. Tesfaye Biftu, a renowned medicinal scientist with extensive experience in small and big pharmaceutical companies (Cytomed, Merck-MSD). Dr. Tesfaye ranks among the top medicinal chemists for his exceptional contributions and extraordinary achievements at Merck - the premier and global healthcare leader in the industry.

Dr. Tesfaye is an inventor/co-inventor with over 100 US and international patents in various areas of drug discovery for human and animal health (documented by the American law database system known as Justia and available online at https://patents.justia.com/inventor/tesfaye-biftu?page=2).

After completing his primary education in Agaro, former Keffa province of west Ethiopia, Dr. Tesfaye started his secondary education at the General Wingate senior secondary school in Addis Ababa and went to complete his studies at Bahirdar Polytechnic Institute graduating as an industrial chemist in 1967. It was during his excellent performance at polytechnic that was awarded a gold medal and a pen from Emperor Haile Selassie.

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After a year of his first job as director of the Hawassa oil factory in Sidamo, south Ethiopia, Dr. Tesfaye was given a government scholarship to study in France at Caen and Paris Universities. Dr. Tesfaye arranged for another scholarship to go to the US where he joined Western Michigan University to undertake his undergraduate and graduate studies in chemistry. He earned two bachelor's and two master's degrees in a record four years. Dr. Tesfaye first completed his PhD studies at Brandeis university in two and half years and later earned his MBA from Rutgers University.

35 Years of Work at Merck

After a brief career in academia, Dr. Tesfaye first joined Merck and Co. as a medicinal chemist and later went to CytoMed Inc. as a Senior Director of Medicinal Chemistry and Distinguished Investigator.

He spent most of his professional life at Merck, the premier research-intensive biopharmaceutical US company located in Rahway, New Jersey. Merck was founded in the U.S. 130 years ago by a-23-year-old George Merck as a company to distribute fine chemicals throughout New York City and the neighboring areas.

Dr. Tesfaye had held different positions at Merck, including as a Distinguished Senior Investigator and Director of Discovery Chemistry, and was intensively engaged in R&D of drugs for metabolic

disorders/diabetes, asthma, inflammation/arthritis, immune diseases, cardiovascular disorders, thrombosis, obesity, and infectious diseases.

He was the program lead and key innovator in the discovery of several drug candidates including Marizev™, the Once Weekly DPP-4 Inhibitor anti-diabetic agent and was also a key player in the Januvia™ project and its back-up candidate which has a total sale of over $70 billion since its introduction in 2006.

He served as a member of the Expert Scientific Advisory Committee of the Geneva based Medicine for Malaria Venture (MMV), a committee which helps to identify the best projects worthy of inclusion in the portfolio and continues to monitor progress through an annual review of all projects.

Dr Tesfaye is a member of the board of directors of EPPAD Pharma Inc. a newly established company to manufacture pharmaceuticals in Ethiopia. He is also the first member of the board of advisors of EPPAD.

Between 2009-2013, Dr. Tesfaye lectured on various topics in Medicinal Chemistry and Therapeutics at Jefferson University, State University of New York, The Ohio State University, and at venues in Italy, France, Sweden, Portugal and several others. Dr. Tesfaye has published/presented over 70 professional manuscripts and book chapters.

He has received various international honors, recognitions, and an award as a world-class medical scientist from the International Who's Who of Professionals in 1998. He has also been recognized for his outstanding achievements in R&D in the area of pharmaceuticals by Society of Ethiopians Established in Diaspora (SEED) and Ethiopian Pharmacists and Pharmaceutical Scientists Association in the Diaspora (EPPAD).

To help the Ethiopian American community, Dr. Tesfaye played a lead role in laying the foundation for the establishment of the Ethiopian American Community Bank. In the 1990s, Dr. Tesfaye also published the Ethiopian Business and Industry Review (BIR) as a monthly magazine featuring business, culture, science, and technology.

He developed a hypothesis on how Ethiopian wisemen of the old days used to create alphabets. The article with description of his hypothesis has been accepted, documented, and exhibited at the Smithsonian. *(Smithsonian Libraries African Art Index Project DSI: Ethiopic language--Alphabet call #HC845.A1 E84X - Edan-url edanmdm:siris_sil_517742 logic behind the construction of Ethiopic characters / Tesfaye Biftu and Tersit Taddese).*

In June 2016, Dr. Tesfaye was appointed as distinguished Research Professor at Adama Science and Technology University (ASTU) and Director of Institute of Pharmaceutical Sciences to establish a Center of Excellence for pharmaceutical sciences and support academic staff on laboratory research including writing research proposals. He also teaches courses and mentors PhD students in the Food and Nutrition department of Addis Ababa University, Ethiopia.

In May 2023 he signed an MOU with Bahirdar Institute of Technology (BIT, BD University, Food and Nutrition Research Center (FaN) to establish a Nutraceutical R7D Laboratory to train PhD candidates, develop nutraceutical products and clinical sports nutrition. As part of the MOU, Dr. Tesfaye provided/shipped over 130 books to support the nutraceutical lab to be established.

Meet our EPPAD Members

In this new column, we will start presenting short profiles of our Board members. In this issue, we would like to introduce you to one of our new Board members, Dr. Eyerusalem Befkadu.

Eyerusalem Befkadu, PharmD, BCPS is an emergency medicine clinical specialist at Medstar Georgetown University Hospital. She has worked in a wide array of clinical areas working with physician groups to practice evidence-based medicine. In her current role, she practices as a pharmacist clinician providing safe and effective care of patients, primarily in the emergency department. She participates in quality improvement initiatives through the development of institutional clinical guidelines and protocols. She has also successfully implemented a naloxone dispensing program in the emergency department as part of an initiative to improve safe access and provision of life-saving medications.

Prior to her emergency medicine practice at Georgetown University Hospital, she practiced as an emergency medicine clinical pharmacist at Virginia Hospital Center. During her tenure, she established new emergency department clinical pharmacy services that include expanding the role of a pharmacist to participate in medical and trauma emergencies, pioneering a medication reconciliation program, implementing quality initiatives, and conducting various research projects.

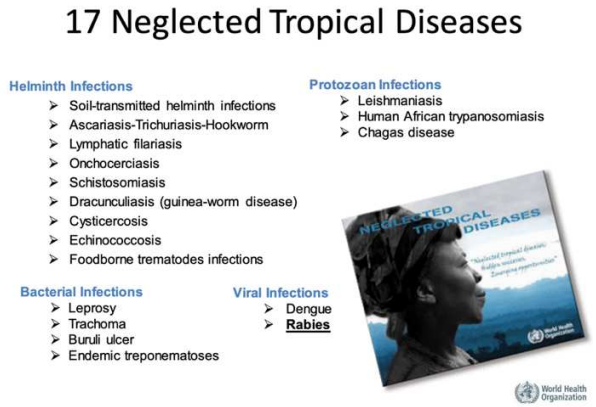
She received her Bachelor of Science degree in biology from the University of Maryland Baltimore county and her Doctor of Pharmacy degree from Touro College of Pharmacy. She completed her Post Graduate Year One (PGY-1) pharmacy practice residency training at Howard University Hospital.

Research, Review and Opinion Articles

Role of Pharma Companies in the fight against NTDS

Gabriel Daniel/Aklile G Giorgis, BPharm, MIA

The World Health Organization (WHO) classifies 20 diverse groups of parasitic, bacterial, and diseases that cause significant morbidity and mortality in more than 1 billion people worldwide, which disproportionately affect poor and marginalized populations. These diseases can cause severe disfigurement and disabilities, including blindness, developmental disabilities, and malnutrition.



Fourteen of the major Neglected Tropical Diseases (NTDs) kill an estimated 534,000 people worldwide every year. Although as many as 179 countries and territories reported at least one case of NTD in 2021, 16 countries accounted for 80% of the global NTD burden. Around 1.65 billion people globally were estimated to require treatment for at least one NTD.

Billions of tablets, capsules, intravenous and oral solutions have been donated, along with the manufacturing, supply chains and research necessary to support these efforts. Industry engagement has stimulated other donors to support NTDs with funds and oversight so that the 'heath benefit' return on investment in these programs is truly a 'best value in public health'. Many current donations are 'open-ended', promising support as long as necessary to achieve defined health targets.

Mass Drug Administration

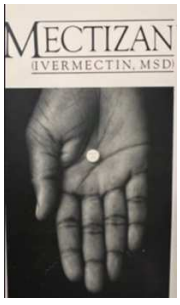
Mass drug administration (MDA) is a means of delivering safe and inexpensive essential medicines based on the principles of preventive chemotherapy, where populations or sub-populations are offered treatment without individual diagnosis.

MDA is the recommended strategy of the World Health Organization to control or eliminate several neglected tropical diseases (NTDs). Since 2016, more than a billion people a year have been treated via MDA.

NTD programs have used several delivery platforms to distribute medicines to eligible populations including school-based distribution, typically targeting school-age children and community-based distribution, either door-to-door or household distribution; or can take place centrally within the community (e.g., community center, place of worship, market, or home of a community leader or medicine distributor); or can be a combination of the two.

Pharma Donation of drugs

Drugmakers have been criticized in the past for not doing enough to fight diseases of the poor as they concentrate instead on conditions more prevalent in rich nations.



Merck & Co. Inc. had a product - ivermectin - that had been developed to treat parasitic worms in animals. A Merck scientist, Dr. William Campbell, realized the drug may work on parasitic diseases in humans and Merck agreed to develop a human formulation. Dr. Campbell later won a Nobel Prize for developing Mectizan®.

In 1987 Merck made a pledge to provide its medicine Mectizan® (ivermectin) to all who need it for as long as required to control river blindness (onchocerciasis) globally.[2] As a result, about 5 billion tablets and millions of persons are protected in 25 countries.

Jimmy Carter, Rosalynn Carter, Roy Vagelos CEO Merck and Gabriel Daniel of Africare visit MDA site in Chad.

After the donation was announced, Merck established the Mectizan Donation Program (MDP or the Program) in partnership with Task Force for Global Health, to create a dedicated public-private partnership working to coordinate technical and operational activities among WHO and its regional offices, governmental and nongovernmental organizations, local communities, donors, research institutions, academia, and the private sector.

This decision soon stimulated other pharmaceutical companies to make similar donation commitments and pledged to donate an average of 1.4 billion treatments each year to those in need, according to the International Federation of Pharmaceutical Manufacturers & Associations (IFPMA).

"The Mectizan donation story is a powerful reminder that it is possible to help people change their lives," President Carter said. "This partnership among private, public, and nonprofit organizations has significantly improved the health of millions of Africans who are at risk for river blindness.

Partnership Accomplishments

The above statistics shows the accomplishments of the NTD partnership of key stakeholders such as WHO, CDC, USAID, The carter Center, Bill & Melinda Gates Foundation, MDP, RTI, ITI, Eisai, GlaxoSmithKline, Johnson& Johnson, Merck MSD, Merck KGaA, Novartis, Sanofi, Pfizer, DHL, NGOs (Africare, MSH, Sight Savers, Children without worms…), academic/research institutions, host governments etc.

Essential NTD medicines donated by pharmaceutical companies through the WHO and other agencies (data sourced from the WHO's 2030 NTD draft roadmap[22] and independent industry consultation)

Reports show that the number of people requiring NTD interventions fell by 80 million between 2020 and 2021, and eight countries were certified or validated as having eliminated one NTD in 2022 alone. As of December 2022, 47 countries had eliminated at least one NTD and more countries were in the process of achieving this target. In early 2021, WHO developed a roadmap for the treatment and elimination of NTDs in this decade. By 2030, it strives to “free more than one billion people who currently require interventions against neglected tropical diseases.”

Pharma Company	Donation
Bayer	Nifurtimox to treat Chagas disease/HAT, niclosamide, praziquantel for taeniasis/cysticercosis.
Eisai	Diethylcarbamazine (DEC) for lymphatic filariasis (LF) - over 2.2 billion tablets
Gilead	AmBisome® for visceral leishmaniasis
GlaxoSmithKline (GSK)	Albendazole to treat soil-transmitted helminths (400 million tablets per year) and to combat lymphatic filariasis (600 million tablets per year)
Gilead	Liposomal amphotericin B for Visceral Leishmaniasis 800,000 vials
Johnson & Johnson	Mebendazole for soil-transmitted helminths (200 million tablets per year)
Merck KGaA	Praziquantel for bilharzia (up to 250 million tablets per year indefinitely)
Merck MSD	Mectizan® (Ivermectin) to combat river blindness and lymphatic filariasis (as much as needed as long as needed)
Novartis	Multi-drug therapy (rifampicin, clofazimine and dapsone) for leprosy ($100 million to advance R&D directed towards NTDs, with a focus on novel drug candidates for Chagas disease, visceral leishmaniasis, dengue fever and parasitic diarrhea).
Pfizer	Zithromax® (Azithromycin) for blinding trachoma
Sanofi	Eflornithine, melarsoprol, pentamidine, fexinidazole, for Human African Trypanosomiasis (HAT)DEC tablets for Lymphatic Filariasis (120 million tablets)

Useful References/Resources:

WHO https://www.who.int/health-topics/neglected-tropical-diseases#tab=tab_1
CDC https://www.cdc.gov/globalhealth/ntd/global_program.html
USAID https://www.neglecteddiseases.gov/
Bill & Melinda Gates Foundation https://www.gatesfoundation.org/our-work/programs/global-health/neglected-tropical-diseases
MDP https://mectizan.org/
The royal society publishing https://doi.org/10.1098/rstb.2013.0434
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7842096/#bib2

The Evolution and Impact of Digital Pharmacy

Bisrat Hailemeskel, Professor & Vice-Chair, CAPS
College of Pharmacy, Howard University

Digitalization has revolutionized numerous industries, and healthcare is no exception. The concept of a digital pharmacy is changing traditional practices and enhancing patient care through innovative technologies. This transformation includes various aspects of pharmaceutical services, ranging from medication management to patient engagement. The emergence of digital pharmacy holds the promise of improved accessibility, efficiency, and patient outcomes, while also posing new challenges and opportunities.

The overall definition of Digital Pharmacy is the integration of digital technologies into pharmaceutical practices to optimize patient care, medication management, and healthcare delivery. It includes a wide range of applications as described below.

Key Areas of Impact:

I. Medication Adherence: Digital pharmacy solutions play a pivotal role in addressing medication non-adherence, a significant challenge in healthcare. Mobile apps and smart pill dispensers provide reminders, track dosages, and offer educational content to ensure patients adhere to their prescribed regimens [1,2].

a. Smart pill bottles: Smart pill bottles are electronic pill bottles that track when and if pills have been taken. They can send alerts to patients or caregivers if pills are not taken on time, and they can also provide educational information about the medication. Smart pill bottles typically have sensors that detect when a pill is removed from the bottle. They can also have a built-in timer that reminds patients to take their medication. Some smart pill bottles also have a built-in camera that can be used to take pictures of the medication to ensure that the correct dosage is being taken.

b. Medication reminders: Medication reminders are text messages, emails, or phone calls that remind patients to take their medications. They can be personalized to the patient's specific medication schedule and can be sent at a time that is convenient for the patient. Medication reminders can be sent from a variety of sources, such as the patient's pharmacy, healthcare provider, or a medication adherence app.

c. Virtual medication coaches: Virtual medication coaches are healthcare professionals who provide support and guidance to patients to help them stay on track with their medications. They can provide education about the medication, answer questions, and offer encouragement. Virtual medication coaches can be accessed through a variety of channels, such as phone, video, or text chat.

d. DripCaps: DripCaps are a type of smart pill bottle that dispenses medication automatically at the correct time. They can be helpful for patients who have difficulty remembering to take their medications or who have difficulty opening pill bottles. DripCaps typically have a built-in timer that releases the medication at the correct time. They can also be programmed to dispense different medications at different times.

e. Wearable devices: Wearable devices, such as fitness trackers and smartwatches, can be used to track medication adherence. They can send alerts to patients if they have not taken their medications on time, and they can also provide data on the patient's activity levels and sleep patterns. Wearable devices can be used to track the number of times a patient opens their pill bottle, the time of day they take their medication, and whether or not they take the full dose.

II. Telepharmacy Services: Telepharmacy enables remote pharmacist-patient interactions, extending pharmaceutical care to underserved populations and rural areas. Patients can access medication counseling,

prescription verification, and clinical support via video consultations or virtual platforms [1].

Telepharmacy can be used for a variety of purposes, including:

a. Medication counseling: Pharmacists can use telepharmacy to provide medication counseling to patients, such as reviewing their medication list and answering questions about their medications.

b. Prescription refills: Pharmacists can use telepharmacy to refill prescriptions for patients who are unable to come into the pharmacy in person.

c. Medication therapy management: Pharmacists can use telepharmacy to provide medication therapy management (MTM) services to patients, such as monitoring their medication adherence and making adjustments to their medication regimen as needed.

d. Remote dispensing: Pharmacists can use telepharmacy to dispense medications to patients remotely, such as through a mail-order pharmacy.

E-Prescribing: Electronic prescribing eliminates paper-based prescriptions, reducing errors and facilitating seamless communication between healthcare providers and pharmacies. E-prescribing systems enhance prescription accuracy, minimize delays, and enable real-time information exchange [3]. E-prescribing has a number of benefits, including:

a. Improved accuracy: E-prescribing can help to reduce medication errors by eliminating the need for handwritten prescriptions.

b. Increased efficiency: E-prescribing can help to streamline the prescription process and reduce the amount of time it takes for patients to receive their medications.

c. Improved patient safety: E-prescribing can help to improve patient safety by providing prescribers with access to real-time patient information, such as allergies and drug interactions.

d. Reduced costs: E-prescribing can help to reduce costs by eliminating the need for paper prescriptions and by improving the efficiency of the prescription process.

Personalized Medicine: Digital pharmacy integrates patient data, genetics, and medical history to tailor treatments and optimize therapeutic outcomes. Advanced algorithms analyze patient profiles to recommend personalized medication options, dosages, and interventions [4,5]. There are a number of different technologies that are being used to develop personalized medicine, including:

1. Genomics: Genomics is the study of genes and their function. It can be used to identify genes that are associated with certain diseases or that may affect how a patient responds to a particular medication.

2. Proteomics: Proteomics is the study of proteins. It can be used to identify proteins that are involved in disease and to develop new drugs that target these proteins.

3. Epigenomics: Epigenomics is the study of changes in gene expression that are not caused by changes in the DNA sequence. These changes can be caused by environmental factors, such as diet or smoking, and they can affect how a patient responds to a particular medication.

4. Artificial intelligence: Artificial intelligence (AI) is being used to develop algorithms that can analyze large amounts of data to identify patterns that may be associated with disease or that may predict how a patient will respond to a particular medication.

Data Analytics: Digital pharmacy refers to data analytics to gain insights into medication utilization patterns, patient adherence rates, and treatment outcomes. These analytics inform evidence-based decisions, enabling healthcare providers to adapt interventions and improve patient care [4].

Data analysis can be used to improve a variety of pharmaceutical processes, including:

1. Medication safety: Data analysis can be used to identify potential medication errors, such as drug interactions or duplicate prescriptions.

2. Medication adherence: Data analysis can be used to identify patients who are not taking their medications as prescribed.

3. Clinical trials: Data analysis can be used to analyze the results of clinical trials to determine the efficacy and safety of new drugs.

4. Pharmacoeconomics: Data analysis can be used to assess the cost-effectiveness of new drugs.

5. Pharmacy operations: Data analysis can be used to improve the efficiency of pharmacy operations, such as inventory management and staffing.

Challenges and Future Directions:

a. Privacy and Security: Safeguarding patient data and ensuring compliance with data protection regulations are paramount in digital pharmacy implementation. Robust cybersecurity measures are essential to maintain patient confidentiality [6].

b. Digital Divide: Disparities in digital literacy and access to technology may create inequities in patient engagement and medication management. Addressing these disparities is crucial to ensure inclusivity in digital pharmacy adoption.

c. Regulatory Framework: The evolving landscape of digital healthcare requires clear regulatory guidelines to ensure the safety, efficacy, and quality of digital pharmacy services [6].

In summary, the evolution of digital pharmacy marks a transformative shift in pharmaceutical practices, offering lots of opportunities to enhance patient care, medication management, and healthcare delivery. Through telepharmacy, e-prescribing, personalized medicine, and data analytics, digital pharmacy empowers patients and healthcare providers alike. As digital pharmacy continues to evolve, it holds the potential to reshape the pharmacy landscape, improve patient outcomes, and contribute to a more connected and efficient healthcare ecosystem.

References:

[1] Smith, A. C., Thomas, E., Snoswell, C. L., Haydon, H., Mehrotra, A., Clemensen, J., & Caffery, L. J. (2020). Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). Journal of Telemedicine and Telecare, 26(5), 309-313.

[2] Khan, S. A., Aljuhani, N., & Almazroi, M. (2019). E-Pharmacy: Current status, challenges, and opportunities. Saudi Pharmaceutical Journal, 27(5), 684-688.

[3] Bounthavong, M., & Nguyen, C. (2019). E-prescribing: Preserving patient safety, privacy, and the patient-provider relationship. The Journal of Medical Practice Management, 34(3), 153-157.

[4] Yanez, N. D., Davila, J., Celedon, M. L., Kanter, M. H., Ota, L. M., & Romero, M. L. (2020). Data analytics and precision medicine to improve health and wellness. Procedia Computer Science, 176, 36-43.

[5] Dascalu, M. I., & Korsching, P. F. (2021). Opportunities and challenges of AI-driven precision medicine: A systematic review. Artificial Intelligence in Medicine, 113, 102045.

[6] FDA. (2021). Digital Health Innovation Action Plan. U.S. Food and Drug Administration. Retrieved from https://www.fda.gov/media/106331/download

AAU Opened the first Ph.D. program in Clinical Pharmacy for Ethiopia

Bisrat Hailemeskel, Professor & Vice-Chair, CAPS
College of Pharmacy, Howard University

Addis Ababa University's College of Health Sciences, School of Pharmacy, is delighted to announce the long-awaited approval of the Doctor of Philosophy (Ph.D.) in Clinical Pharmacy program. After over a decade of dedicated efforts and overcoming numerous challenges, the program was recently approved and is now ready to admit its first batch of students. This achievement comes on the heels of successfully establishing the Master of Science in Clinical Pharmacy or Pharmacy Practice, which has seen hundreds of students graduate. However, the Ph.D. program faced its own set of hurdles, mainly due to a shortage of preceptors and faculty members. Gratitude is extended to the administration, Deans, Department Chairs, and faculty members of AAU for making this milestone possible.

The partnership between Addis Ababa University and Howard University, supported by a grant from PEPFAR/HRSA in collaboration with the American International Health Alliance (AIHA) Twinning Center, not only resulted in the establishment of the clinical pharmacy program but also brought about transformative changes in pharmacy education in Ethiopia.

In this over a decade-long work, several changes have been made in pharmacy education in the country. One significant change was the shift from a traditional product-focused approach to a patient-focused model. Historically, pharmacy education primarily centered on the preparation and dispensing of medications, with limited emphasis on patient care and clinical practice. However, through the collaboration with Howard University and the expertise shared by the American partners, the curriculum of the pharmacy program at Addis Ababa University underwent a fundamental transformation. The focus broadened to include comprehensive patient care, medication therapy management, and pharmaceutical care principles, aligning with international best practices. This shift in perspective empowered pharmacy graduates to play a more active role in healthcare teams, providing direct patient care, counseling, and optimizing medication regimens to improve patient outcomes.

Furthermore, in response to the evolving demands of the healthcare sector and to elevate the quality of pharmacy education, the Bachelor of Pharmacy degree program was extended from a 4-year to a 5-year duration. This extension allowed for more in-depth and comprehensive clinical education working with physicians and other healthcare professionals.

In order to address the shortage of instructors for the undergraduate program, the University successfully established a Master of Science (M.Sc.) program in clinical pharmacy or pharmacy practice. Over time, the M.Sc. program at Addis Ababa University has seen substantial growth and has produced hundreds of highly skilled pharmacy graduates who have made notable contributions to the advancement of pharmaceutical care and research in Ethiopia.

The newly approved Ph.D. in Clinical Pharmacy is a four-year full-time program aimed at producing highly trained specialists in clinical pharmacy and pharmaceutical care, well-equipped for practice, research, and teaching. The curriculum will encompass both coursework and research components. Students will undertake 41-50 ECTS of coursework, covering various aspects such as pharmacokinetics, clinical pharmacology, pharmaceutical care, drug information, and research methods. An additional 32 ECTS will be allocated to the Ph.D. dissertation, allowing students to pursue independent research in their chosen area of expertise.

The teaching methods will include lectures, seminars, clinical attachments, and independent study. To be eligible for admission, candidates must possess a master’s degree in pharmacy practice, clinical pharmacy, or PharmD from a recognized institution, with a minimum CGPA of 3.00 out of 4.00. Proficiency in the English language is essential, and each foreign master's degree will be evaluated individually for research competency. An applicant must also have at least one publication in a peer-reviewed journal, if applicable. Graduation requirements entail successfully completing all coursework with a minimum GPA of 3.0, submitting a Ph.D. dissertation, passing a comprehensive examination, and successfully defending the dissertation.

With an esteemed faculty from Howard University and other diaspora and Addis Ababa University, this program will offer an excellent opportunity for those seeking a terminal degree and a career in clinical pharmacy.

Research, Review and Opinion Articles

BIOACTIVE SUBSTANCES FROM ETHIOPIAN INULA CONFERTIFLORA

Minbale Gashu and Ermias Dagne
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Background:

The flora of Africa is rich in plants used by people since time immemorial as medicines, flavors, and fragrances. These plants constitute important sources of novel compounds with diverse biological activities such as antitumor, anti-cancer and anti-fungal, activities [1].

Inula confertiflora A. Rich, locally known as *Weynagift* (Fig 1), is one of the endemic medicinal plants found in Ethiopia. Traditionally, it is used to treat skin diseases with diverse etiology. Its roots are smoked as a fumigant during childbirth and also used to treat leprosy. Maceration of its pounded leaves in water is used to treat cattle with ocular issues, asthma, and cough [2,3].

In this paper, compounds isolated from *Inula confertiflora* with known bioactivities are reported.

Fig. 1 *Inula confertiflora* leaf (Left) and root (Right) (Photo by MG at Ankober Palace Lodge)

Antifungal Sesquiterpene lactones isolated from *Inula confertiflora*

I. helenium, *I. racemosa*, *I. hupehensis*, *I. britannica* and *I. britannica var. chinensis* are highly investigated for their chemical compositions, and more than 400 compounds, including sesquiterpene lactones, were isolated and characterized. These sesquiterpene lactones are reported to display a wide range of biological properties including anticancer, anti-inflammatory, antifungal and antibacterial activities [4-8].

In this study, sesquiterpene lactones (**1-5**) were isolated from the methanol crude extract of the shade dried and ground leaves of *I. confertiflora* using the following scheme (Fig 2).

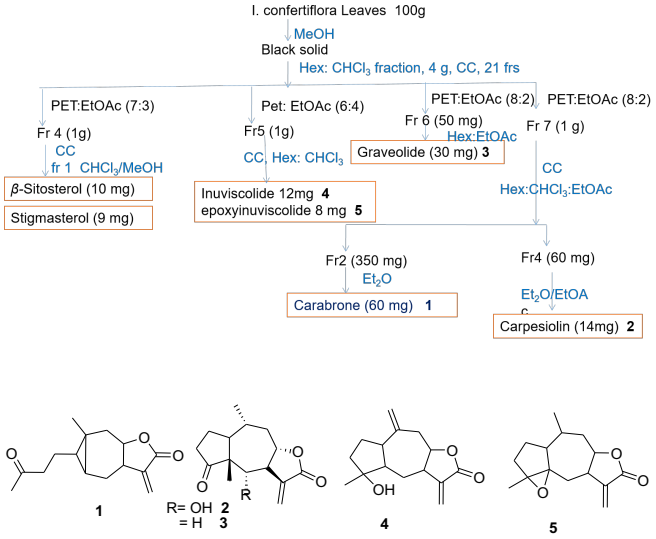

Fig 2. Isolation scheme and Sesquiterpene lactones isolated from *I. confertiflora* leaf

The structures of carabrone (**1**), carpesiolin (**2**), graveolide (**3**), inuviscolide (**4**) and 4α,5α-epoxyinuviscolide (**5**) were elucidated by spectroscopic data (FTIR, NMR, UV-Vis, MS) generated during the study at Addis Ababa University, Department of Chemistry. Phytosterols such as β-sitosterol and stigmasterol are also obtained from the plant extract [9].

Carabrone, a xanthanolide sesquiterpene lactone, is isolated from the fruits of *Carpesium abrotanoides,* leaves of *I. grandis*, ***I. viscosa***, *I. falconeri*, *I. cappa*, *I. hookeri*, *I. royleana*, *I. hupehensis* and *I. helenium.* Carabrone has cytotoxic, antibacterial and antitumor activities [4-8]. It also exhibits antifungal activities against plant pathogens such as *Botrytis cinerea*, *Colletotrichum lagenarium* and *Erysiphe graminis*. The ketonic carbonyl at C-4 was

reported to have a role in the activity of carabrone besides the α-methylene-γ-lactone functional group [10]. Guaianolides such as graveolide isolated from *I. graveolens*, *I. hupehensis*, *I. sericophylla*, *I. hookeri,* and *I. falconeri*; and carpesiolin isolated from Carpesium abrotanoides, *I. hupehensis*, *I. falconeri*, *I. sericophylla* and *I. hookeri* display cytotoxic activity [4-8].

Antitumor Epifriedelanol and dammara-20,24-dien-3-yl acetate from *Inula confertiflora*

Chemical study of the gummy ethanol crude extract of the shade dried root of *Inula confertiflora* root (Fig 1) contained rare triterpenoids such as epifriedelanol (**6**) and dammara-20,24-dien-3-yl acetate (**7**) (Fig 3) besides the ubiquitous metabolites of the plant parts **1**, **2** and **3**. Both **6** and **7** were recrystallized from ethyl acetate. In the course, thymol was also isolated from the plant [11].

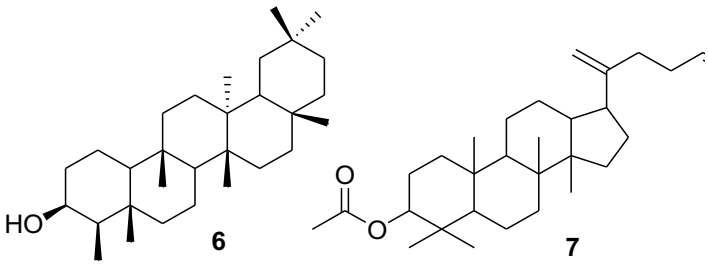

Fig 3. Triterpenoids isolated from *Inula confertiflora* root

Epifriedelanol is previously isolated from different plants including the root bark of *Vitis trifolia* [12] and *Quercus variabilis* [13]. *V. trifolia* has antitumor activity [12]. *Anoectochilus chapaensis* also shows protein tyrosine phosphatase 1B inhibiting activity [14]. *Ulmus davidiana* reduces cellular senescence in human primary cells [15]. Anticancer activity of epifriedelanol was also reported [16]. According to the reports, **e**pifriedelanol and dammara-20,24-dien-3-yl acetate are not ubiquitous in all species of the genus. Previously compound **6** was only reported from *I. cappa* [5,17]. Compound **7** is also isolated from *Olea madagascariensis* [18], *Pileostegia viburnoides* [19], *I. cappa* [5,17], *I. viscosa, I. candida subsp. Candida, I. pseudolimonella* [20], and its anti-inflammatory and anti-neuroinflammatory activities [19] are reported.

Conclusion

Inula confertiflora contains bioactive sesquiterpene lactones, unusual triterpenoids and sterols that could potentially be used as therapeutically important lead metabolites.

Data availability statement

Data analyzed during this study are available at http://etd.aau.edu.et/handle/123456789/19320).

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References

1. Dagne, E. New Biologically Active Compounds from African Plants. In 2000 Years of Natural Products Research Past, Present and Future (Luijendijk, T.J.C., ed.), Congress Proceedings (**2000**), Phytoconsult, Netherlands, pp. 1–13.

2. Mesfin, T. Asteraceae (Compositae): Flora of Ethiopia and Eritrea **2004**, 4 (2), 122.

3. Gebre-Mariam, T.; Neubert, R., Schmidt; P.C., Wutzler, P.; Schmidtke, M. Antiviral activities of some Ethiopian medicinal plants used for the treatment of dermatological disorders. *Journal of Ethnopharmacology* **2006**, 104, 182. DOI: 10.1016/j.jep.2005.08.071.

4. Zhao, Y-M; Zhanga, M-L; Shi, Q-W; Kiyota, H. Chemical Constituents of Plants from the Genus *Inula*. *Chemistry and Biodiversity* ***2006***, 3, 371-384; DOI: 10.1002/cbdv.200690041.

5. Seca, A. M.; Pinto, D.C.; Silva, A. M. Metabolomic Profile of the Genus *Inula*. *Chemistry and biodiversity* 2015, 12, 859-906**;** DOI:10.1002/cbdv.201400080.

6. Bessada, S. M. F.; Barreira, J. C. M.; Oliveira, M. B. P. Asteraceae species with most prominent bioactivity and their potential applications: A review. *Industrial Crops and Products* **2015,** 76, 604–615; DOI: 10.1016/j.indcrop.2015.07.073.

7. Sun, C-P.; Jia, Z-L.; Huo, X-K.; Tian, X-G.; Feng, L.; Wang, C.; Zhang, B-J.; Zhao, W-Y.; Ma, X-C. Medicinal *Inula* Species: Phytochemistry, Biosynthesis, and Bioactivities. *American Journal of Chinese Medicine* **2021**, 49, 315-358. DOI: org/10.1142/S0192415X21500166.

8. Seca, A. M.L.; Grigore, A.; Pinto, D. C.G.A.; Silva, A. M. Review: The genus *Inula* and their metabolites: From ethnopharmacological to medicinal uses. *Journal of Ethnopharmacology* **2014**, 154, 286–310; DOI: 10.1016/j.jep.2014.04.010.

9. Gashu, M.; Wolde, E.; Awoke, S. Sesquiterpene lactones from Inula confertiflora A. Rich (Asteraceae) Leaf. Letters in Applied NanoBioScience 2023, 12(4**).** https://doi.org/10.33263/LIANBS124.095.

10. Chadwick, M.; Trewin, H.; Gawthrop, F.; Wagstaff, C. Sesquiterpenoids Lactones: Benefits to Plants and People. *International Journal of Molecular Science* **2013**, 14, 12780-12805; DOI: 10.3390/ijms140612780.

11. Gashu, M., 2022. Epifriedelanol and Dammara-20, 24-dien-3-yl Acetate from Ethiopian Inula confertiflora Root Extract. *Journal of Chemistry* **2022.** Article ID 2114595. https://doi.org/10.1155/2022/2114595.

12. Kundu, J.K.; Rouf, A.S.; Hossain, M. N.; Hasan, C. M.; Rashid, M A. Antitumor activity of epifriedelanol from *Vitis trifolia. Fitoterapia.* **2000** 71(5), 577-9; DOI: 10.1016/s0367-326x(00)00191-x.

13. Jia, L-Y; Wang, J; Lv C-N ; Xu, T-Y; Jia, B-Z; Lu, J-C**.** A new cycloartane nortriterpenoid from stem and leaf of *Quercus variabilis. Journal of Asian Natural Products Research* **2013**, 15, 1050-1054; https://doi.org/10.1080/10286020.2012.762911.

14. Cai, J.; Zhao, L.; Tao, W. Potent protein tyrosine phosphatase 1B (PTP1B) inhibiting constituents from *Anoectochilus chapaensis* and molecular docking studies *Pharmaceutical Biology* **2015**, 53(7), 1030-1034; DOI: 10.3109/13880209.2014.957781.

15. Yang, H. H.; Son, J-K.; Jung, B.; Zheng, M. S.; Kim, J-R. Epifriedelanol from the Root Bark of *Ulmus davidiana* Inhibits Cellular Senescence in Human Primary Cells. *Planta Medica* **2010**, 77,441–449; DOI: 10.1055/s-0030-1250458.

16. Perumal, P.C.; Sowmya, S.; Velmurugan, D.; Sivaraman, T.; Gopalakrishnan, V.K. Assessment of dual inhibitory activity of epifriedelanol isolated from *Cayratia trifolia* against ovarian cancer. *Bangladesh Journal of Pharmacology* **2016**, 11, 545-51; DOI: 10.3329/bjp.v11i2.24933.

17. Wu, Z-J.; Shan, L.; Lu, M.; Shen, Y-H; Tang, J.; Zhang, W-D. Chemical constituents from *Inula cappa*. *Chemistry of Natural Compounds* **2010**, 46, 298-300; https://doi.org/10.1007/s10600-010-9595-4.

18. Bianchini, J-P; Gaydou, E. M.; Rafaralahitsimba, G.; Waegell B.; Zahra, J. Dammarane Derivatives in the Fruit Lipids of *Olea madagascariensis. Phytochemistry* **1998**, 27, 2301-2304; https://doi.org/10.1016/0031-9422(88)80147-X.

19. Li, X.J.; Kim, K.W.; Zou, Q.P.; Liu, Z.Z.; Oh, H.C.; Kim, Y.C.; Liu, X.Q. Chemical Constituents from Stems of *Pileostegia viburnoides*. *Natural Product Communications* **2019**, 14(1), p.1934578X1901400127.

20. Panoutsopoulos, G; Aligiannis, N.; Chinou, I.B. Chemical constituents from three Inula species. Biological activities. *Planta Medica* **2007**, 73, 204. DOI: 10.1055/s-2007-986985.

QUALITY IMPROVEMENT (QI) PROJECT TO REDUCE NON-LEFTOVER MEDICATION WASTAGE IN HARAMAYA UNIVERSITY HIWOT FANA CHOMPRENSIVE SPECIALIZED HOSPITAL (HFCSH), PEDIATRICS WARD, HARAR, ETHIOPIA

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ABSTRACT

BACKGROUND: Medication wastage refers to any pharmaceutical product that remains unused or is not fully consumed throughout the pharmaceutical supply and use chain. Budget constraints in financing the health care system together with huge amount of wastage costs create a serious risk to the patient and health care system. This project aims to reduce non-leftover medication wastage due to unrestricted access in Haramaya University Hiwot-Fana Comprehensive Specialized Hospital (HrU-HFCSH) pediatric ward.

LOCAL PROBLEM: Baseline assessment of randomly selected prescription and their corresponding patient chart showed that 23 % of medications dispensed from pediatrics pharmacy were not administered to the patient as they were not in the treatment regimen. This implies that, in terms of financial 29 % of cost of medications dispensed from a single dispensary was wasted.

METHODS: A-before-and-after study, which utilized data collected through both prospective and retrospective methods, was conducted. Three key areas which are vulnerable to medication wastage or theft were evaluated. All data were converted into monitory value and presented as % wastage and % discrepancy. Dispensed medications that were not administered to patients were considered as wasted medications if they were not in the treatment regimen.

INTERVENTIONS: Three main interventions evaluated in this project were: (1) Implementation of a new prescribing and dispensing protocol for medications dispensed for free/credit, (2) Monthly financial audit of pediatric pharmacy and (3) Control of stock flow in the dispensary.

RESULTS: Overall, the finding of this project reveals that, strict control of medication supply and administration data revealed a-24.65 % reduction in % wastage (financial), a-18.65 % reduction in % wastage (product) and a-14% reduction in % discrepancy from the baseline.

CONCLUSION: The findings of this project indicate the importance of monitoring discrepancies in medication supply and administration data for reducing non-leftover medication wastage.

KEY WORDS: Medication wastage, non-leftover, Discrepancy, Harar, Eastern Ethiopia.

BACKGROUND: Medication wastage refers to any pharmaceutical product that remains unused or not fully consumed throughout the pharmaceutical supply and use chain. It is an act or instance of using or expending medications carelessly, extravagantly, inefficiently, ineffectively or for no purpose. It can be classified as leftovers and non-leftover wastage. Leftover wastage refers to medicines dispensed to patients and remaining unused. Non-leftover medications wastage refers to medications that are dispensed, but not used by patients as they are not in treatment regimens. Budget constraints in financing the health care system together with huge amount of wastage costs create a serious risk to the patient and health care system. In Ethiopia, none of previous studies aimed to assess non-leftover wastage. This project aims to reduce non-leftover medication wastage due to unrestricted access in pediatric ward of Haramaya University Hiwot-Fana Comprehensive Specialized Hospital (HrU-HFCSH) from 29 % to < 5 %, in the period February 1st, 2023, to July 30th, 2023, in Harar, Eastern Ethiopia.

LOCAL PROBLEM: It is true that the hospital cannot accurately account for all medications. But there must be safeguards to account for drug losses or ways to identify discrepancies between medications supplied and medications administered to patients. But in our institution, there were no safeguards to fully account for drug losses, and no mechanisms to identify discrepancies in the medication use process. To facilitate the detection of medication discrepancies, a system of electronic

medication record (EMR) has not been implemented in our institution. Even if EMR were applied, some losses may escape the EMR system. Due to these additional factors, medication wastage, theft and financial discrepancy have been high.

Baseline assessment of randomly selected prescription and their corresponding patient chart showed that 23 % of dispensed medications from the pediatrics pharmacy were not administered patients, since they were not in the treatment regimens. This implies that, in terms of money, 29% of the cost of medications dispensed from a single dispensary was wasted. In addition to this, baseline % discrepancy in the dispensary was conducted. Data from one month reference period were taken, accordingly, there was a 19% discrepancy between medication supply and administration recorded data.

The facility estimates the purchase of pharmaceuticals by calculating past consumption, but this estimation does not account for wasted and undocumented medications that will compromise accuracy of estimation and leads to stockout of essential medicines before the next purchase period. This problem is not only limited to the facility, but patients are also pressured to buy pharmaceuticals from private pharmacy at high cost due to medication wastage and associated stock out of essential medicines in the facility. So, this project is aimed to reduce non-leftover medication wastage due to unrestricted or uncontrolled access and associated stock out of essential medicines in the HrU-HFCSH pediatric ward.

METHODS: A before-and-after study which utilized data collected prospectively was conducted. Three key areas which are vulnerable for mediation wastage and theft were evaluated including: (1) medication issued to the dispensary, (2) medications dispensed to various patients, (3) medications administered to the patient. All data were converted into monetary value and presented as % wastage and % discrepancy. Medications which are dispensed but not administered to the patient were considered as wasted medications if they are not part of the treatment regimen.

INTERVENTIONS: Three main interventions evaluated in this project were: (1) Development and implementation of a new prescribing and dispensing protocol, (2) Conduct monthly financial audit of pediatric pharmacy to evaluate discrepancy between what it is and (3) Control of stocks flow in the dispensary

1) DEVELOPMENT AND IMPLEMENTATION OF NEW PRESCRIBING AND DISPENSING PROTOCOL

The purpose of implementing this prescribing and dispensing protocol was to assure that medications are reaching the right patients and those who need them the most. An additional purpose was to avoid dispensing medication doses more than the daily requirement and to provide an easy way to identify whether the required medications are already dispensed or not. In this prescribing and dispensing protocol**,** a list of all current medications that a patient takes and maximum daily doses to be dispensed for each medication were calculated and documented by Healthcare Professionals (HCP) available at ward. The pharmacy personnel at dispensing unit check documentation of the patient's current medications on this chart, record doses of medications dispensed with each encounter and make sure that maximum daily amount to be dispensed is not exceeded. Medications which are not documented on the chart would not be dispensed to the patients at the dispensary. Medications would be documented in the smallest unit of measurement. (i.e., the number of tablets or capsules, ampules or vials, bottles, or tubes). Oral medications can be dispensed for the prescribed duration of therapy.

2) CONDUCT MONTHLY FINANCIAL AUDIT OF DISCREPANCY

Discrepancy between cost of stock available for sale during a specified one-month period and documented cost of stocks dispensed to various patients, issued to other dispensing units, expired/ damaged stock in dispensary were audited. The finding from the auditing process was communicated to pharmacists working in the dispensary. They were given orientation to make them aware of their poor documentation and associated high discrepancy rate in medication supply and administration data. Roles and responsibilities were assigned for the dispensing staff. They were encouraged to work in a responsible manner, and they were made aware of the direct and indirect impact of their negligence on both the institution and patient/community.

Discrepancy between cost of stock from calculated ending balance and cost of stock from physical inventory were presented as total discrepancy in monetary value, and also as % discrepancy after adjusting for inventory accuracy rate.

3) CONTROL OF STOCKS FLOW IN THE DISPENSARY

The aim of this intervention was to crate accountability and transparency of stock flow in the dispensary. List of all medications which are stocked in the dispensary were provided in alphabetical order, The pharmacy personnel at the dispensing unit were assigned responsibility. Some were assigned to record the amount of medication dispensed after each transaction, and others were tasked to provide dispensing and counseling service. Those who dispense products did not get involved in documentation of transaction. The bin owner calculates and documents daily consumption from the medication list on the bin. Weekly consumptions of medications supplied from the dispensary were calculated and documented by case team leaders. The information obtained from this record was used to compare weekly consumption of each medication with the amount at hand when updating bin card every week. Medications will be documented in the smallest unit of measurement (i.e., number of tablets or capsules, ampules or vials, bottles or tubes). If there are the same medications with different dosage form, strength, brand or batch number, each item was recorded separately.

RESULTS: The results are presented in the Run Chart shown below. Eight data points were used in four Plan-Do-Study-Act (PDSA) cycles. In the final (4th) PDSA cycle significant improvement was achieved in all of outcome measures. Both financial and product wastages were reduced to 4.35%. Discrepancy from financial auditing of dispensary was reduced to 4.8 %.

Overall, from the baseline there was a 24.65 % reduction in % wastage in terms of financials, a 18.65 % reduction in % wastage in terms of products, and a 14% reduction in financial discrepancy from financial auditing of dispensary. The findings of this project highlight the importance of monitoring discrepancies in medication supply and administration data, thus reducing non-leftover medication wastage.

CONCLUSION: The finding from our project proves the importance of interventions and strict control in three key areas which are vulnerable for wastage and theft in the chain of events from medication issued (supplied) to the dispensary, medications stored in dispensary and medications dispensed and administered to patients. This process has been shown to be effective in reducing non-leftover medication wastage.

RECOMMENDATION: The finding of this project indicates strict monitoring and control of medication supply and administration data resulted in a significant reduction in non-leftover wastage and discrepancy in medication use process in HrU-HFCSH pediatric ward. Therefore, it is recommended that HrU-HFCSH conducts regular and random audits of discrepancy in the medication use process and apply this concept in all other wards. It is also recommended for Harari RHB and FMOH to test the concept of this project in other public health facilities found in the region and the country.

- Drug and Therapeutic Committee should give regular training for HCPs on the rational use of available resources and consequences of both intentional and unintentional wastage.
- The hospital management should give special attention to monitor discrepancy in medication supply and administration data as a day-to-day activity plan to improve the rational use of available resources and also to control theft.
- The hospital management must apply strict and vigilant regulatory enforcement to limit daily maximum amount of supplies needed for each procedure especially for those who are free or credit service users as well as strict and vigilant law enforcement on prescription pad is also necessary to give priority for the use of available resource to those who needs it the most.

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