



Workshop

Drug lifecycle control in Sub-Saharan Africa

**From production to responsible safe disposal and elimination in
wastewater treatment plants**

(Med4Africa)

Expired Drugs- Reflections on Ecosystems

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Expired Drugs in soils, air (incineration), waterways (surface, groundwater, wastewater) →

impacts on **human health** (antimicrobial resistance, carcinogenic, reproductive health impacts, toxicity), **ecosystems** (wildlife, biodiversity, env. load, economic cost).

Legislative/Regulatory enablers, essential. Where is the **data- FAIR?** Guidelines?

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Overview of the waste question

A country case-study approach:
Botswana.

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The Waste Question – what & how to sustain

The realities of expired pharmaceutical drugs and seeking sustainable solutions (Freitas & Radis-Baptista 2021; Marwa et al 2021).

Over time, the environment is being loaded with tonnes per year of expired drugs. Seeks nature-based solutions; effective policy tools, globally competitive personnel.

Imprints of this on the social, economic & biogeochemical systems, yet our drive is for a sustainable planet, in the long run (Nepal et al. 2020)

How to ensure inter-generational equity in the face of pollution and waste – as they are passed on as a legacy/inheritance for the future.

Disposal Methods: household garbage bins, pit latrines – no buy back options, low awareness levels of stakeholders.



Expired Drugs – and quest for sustainability

- Ecosystem (ecological system) as part of environmentally benign system.
 - Natural environment with ‘spheres’ – geosphere, hydrosphere, atmosphere – working in equilibrium.
 - Nature works with cycles – carbon, water/hydrological, N, rock cycle.
 - Across geological timescales, have been changes; the human imprint of Anthropocene touted. Man is a geological force.
 - Environment is everything that isn’t me- Albert Einstein.
 - Sustainability (social, economic, environmental): constant stock of goods and services, across time. Sustaining Dev; Deep Ecology (ecocentric); Technocentric.
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Sustainability – our common future

The Brundtland Definition (1987)

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

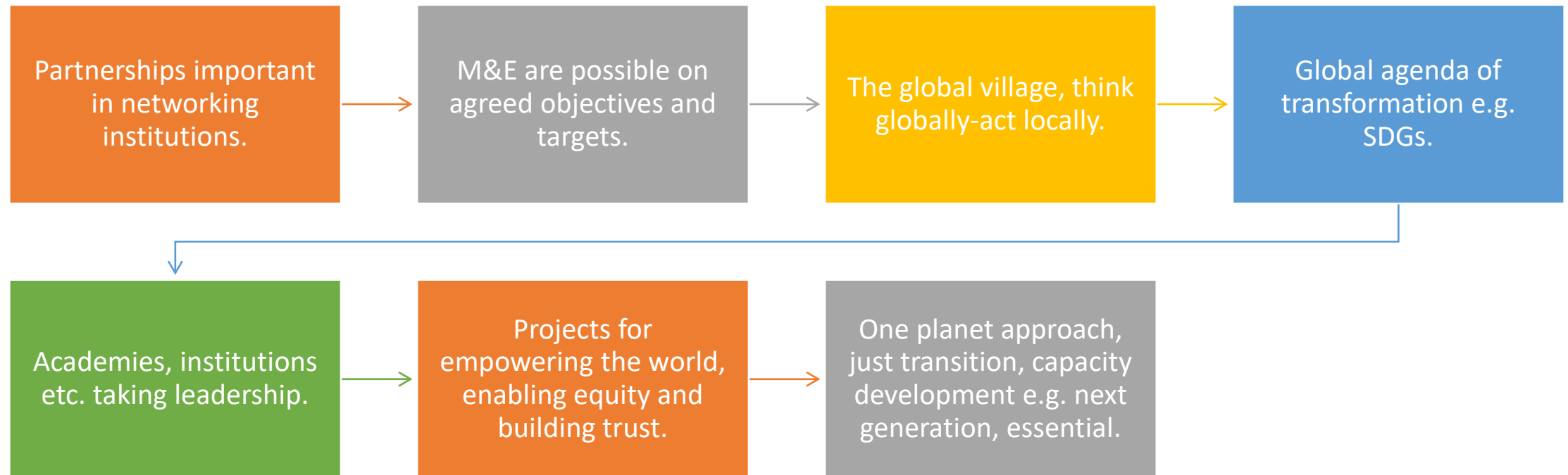
Expired drugs in the ecosystem- some limits

- Expired drugs constitute ecosystem pollution, based on equipment detection levels.
- Expired drugs/medicine definition: “medicine or drug that is unused, expired, contaminated, damaged, or is no longer needed.” (L. Wakelam, 2021). Substandard/failed quality/standards?
- Our planet is finite (can only take so much waste), thus need to work within planetary boundaries.
- The knowledge system is critical for understanding what is being tested for.
- Education key in our discovery/innovations, new methods, substances, knowledge and applications.
- Thermodynamics – conservation of energy; and entropy: first law of thermodynamics: energy can change form, it can be neither be created nor destroyed. Second Law: entropy of an isolated system not in equilibrium will tend to increase over time, approaching a maximum value at equilibrium.

Partnerships/Networking

- Science collaborations/partnerships –as valuable in development sustainable agendas.
- To impact various sectors, and the methodologies standardised/validated.
- Different parts of the world, bringing diverse expertise, hence inclusive in approach.
- Build a diversity of knowledge approaches, which are applicable at scales.
- Potential for solutions - pharmaceutical, industrial, environmental, research insights and for ills emanating from contemporary developments/advancements.
- At national levels, key priorities for sustainable development, need new research frontiers.
- Human development capacity critical, in ensuring the future generations are equipped and participate in building a sustainable future.

Partnerships, the 5Ps of the SDGs



Expired drugs and ecosystems – global to local dimensions

Leave no one behind (People) protect planet and ensure sustainable systems.

The SDGs and role of Science

Leave no one behind – use Science to solve mankind challenges. The products/services being inclusive.

Recently, the world turned to Science when Covid19 struck. All other systems were paralysed. Science continues to lead in availing solutions.

Climate change was discovered and continues to be monitored through Science. The solutions continue to be informed, by Science.

The Sustainable Development Goals (SDGs) stand for equity, shared benefits.

The UNESCO Science report (Open Science, 2021) chronicled successes and challenges, of global scope. Science has to offer direction

Management systems for optimal land use – expired drugs

- Solid and liquid wastes are part of recognised land uses e.g. infrastructure for waste water, sanitary landfills for solid waste.
- Regulatory, legislative tools.
- Strategies for reducing the waste footprint, with enabled economic opportunities.
- Private sector participation? Businesses?
- Trade-offs, facilitation and ICTs/Digital and Geospatial for services/products efficiencies.
- Coordination and value chains in expired drugs (M&E) – implementation execution, integration, budget implications.



National Priorities and Pollution - Botswana

- What is going to be different about expired drugs handling? How do we Reset (RESET Agenda).
- Areas of promise, for growth (middle to high income status). Delivery mechanisms?
- Vision 2036 (achieving prosperity for all). Population and economic growth as key drivers of pollution, including expired drugs.
- *“Botswana will be a clean country with solid waste viewed as a resource and its economic value integrated in natural resource planning and management.”*

Anticipated Solutions – pollution mitigation in Botswana Vision 2036

Green growth strategies

Efficient use of resources

Reduce pollution

Promote re-use and recycling

Separation of waste at source

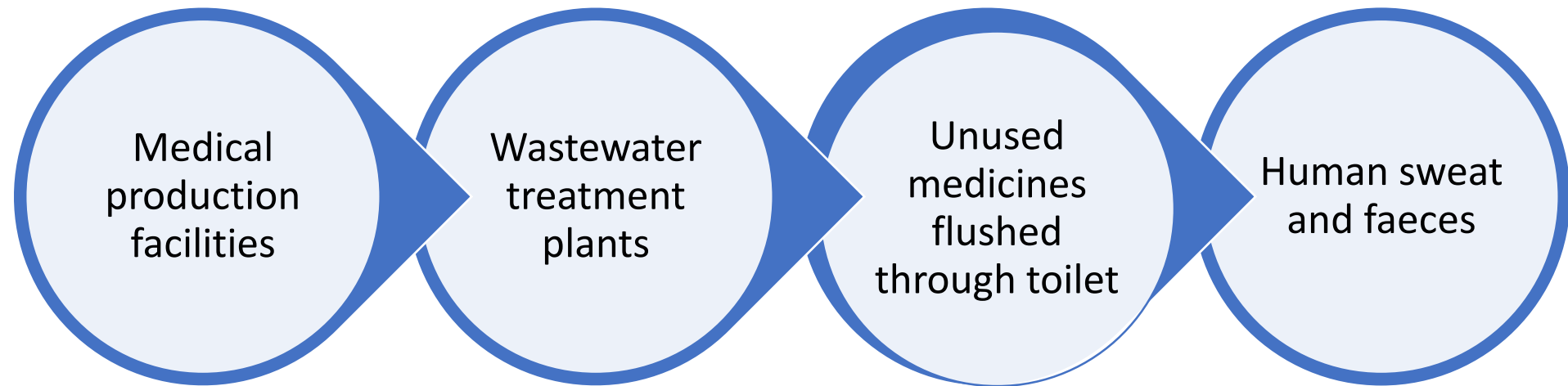
Intensify public education

Policy and legislative approaches, applied.

Improved WASH.

Wastewater and pharmaceutical waste

- Entry pathways into wastewater (Chohan, 2020: Wastewater Treatment: Pharmaceutical Waste Removal From Your Water)
- Ozonation (breakdown of micropollutants) and granular activated C (filter)



Possible Approaches to the Botswana Study

- 1. Environmental Management Plan – for environmental assessment of expired drugs (as part of EIA, SEA etc.)
 - a) Integrated resource planning approaches.
 - b) Pollution and waste impact matrices.
 - c) Mediums of deposition (soil and water).
 - d) Effect on biodiversity and food/fish i.e. on the food security.
- 2. Expired drugs and sustainable human settlements
 - The human settlements are to be clean and safe, hence need for:
 - a) Legislation/policy on safeguards relating to expired drugs
 - b) Perception audit on settlements sustainability with regard to expired drugs (social, economic, environmental).
 - c) Opportunities in sustainable national development (strategic – green growth, efficiencies; standards; public education-potency of drugs, low awareness e.g. expiry date vs. safe use/stability testing; drug waste logistics & digital initiatives.)

Objectives contd...

- Risks documentation and interventions on expired drugs
- a) Baseline data on expired drugs (WHO indispensable medications, antibiotics, garbage & sewer disposal methods vs other more strategic methods).
- b) Monitoring & Evaluation protocols – re-use, recycle/waste-to-wealth, active pharmaceutical ingredients (APIs possible re-use in generic medicine developments; burning and heavy metals challenges – e.g. for supplements with heavy metals like Cu, Zn).
- c) Design parameters of storage/disposal sites (LCA) – circular economy implications.

Conceptual/Theoretical Frameworks

Theoretical frameworks – how to inform, frame and approach the study based on existing body of language, how the methods, analysis, interpretations align or contrast existing body of knowledge.

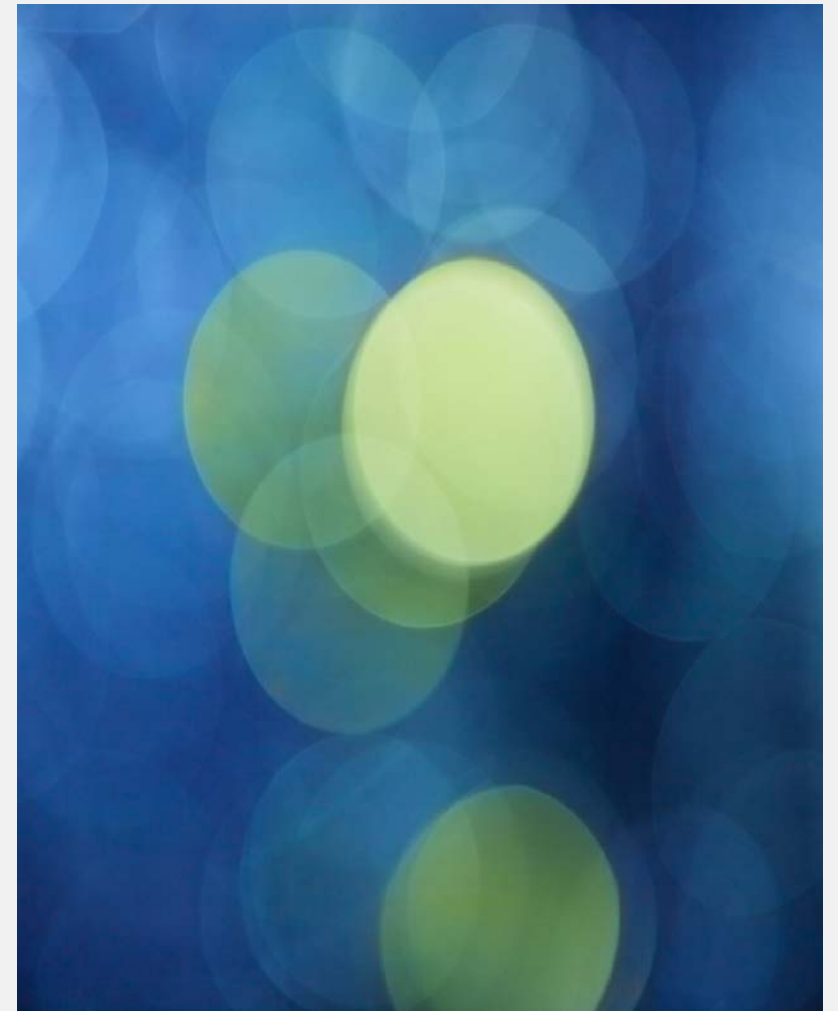
Conceptually – possible to apply:

KAP – what are the Knowledge, Attitudes and Practices (outlines Knowledge, as to what informs the choices and practices – and expected outcomes).

PSIR – the Pressure, State, Impact, Response to deal with the medical waste challenges. Impact indicators and scenarios behind the expired drugs reality.

Theory of change – to lead to transformative paths, circular/ green economy for just transition, to be assessed for the study.

Policy, technological, analytical tools for data.



Some Refs

- Freitas LAA, Radis-Baptista G. Pharmaceutical Pollution and Disposal of Expired, Unused, and Unwanted Medicines in the Brazilian Context. *J Xenobiot*. 2021 May 18;11(2):61-76. doi: 10.3390/jox11020005. PMID: 34069823; PMCID: PMC8162542.
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- Anam Chohan (2020) <https://savethewater.org/wastewater-treatment-pharmaceutical-waste-removal-from-your-water/>.
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- Wakelam, L. (2021) Pharmaceutical Waste Disposal Guidelines. <https://www.sharpsmart.co.uk/knowledge-centre/pharmaceutical-waste-disposal-guidelines>.