# Alliance for Health Policy and Systems Research
# Flagship Report 2014

## Medicines in Health Systems: Advancing access, affordability and appropriate use

### Chapter 1 Annex

# Examples of complexity approaches to access to medicines in the existing literature

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***Health system perspective in current evidence on medicines access, affordability and use***

Access to essential medicines has been an important subset of health literature; however, there is a dearth of evidence when it comes to analysing access using a health systems perspective. The evidence generally falls short of delving into health systems components contributing to priority policy areas impeding safe and affordable access to quality medicines. There is a growing recognition that many aspects of health care are connected to each other, and that without consideration of these interrelated parts and how they affect one another, policies cannot act effectively in improving health outcomes because they will be unable to face barriers imposed across levels of the health system. There is a need to take a systems perspective to better understand how to intervene and the effects of intervening in the area of access to medicines.

With growing focus on universal health coverage, there is an opportunity to better link medicines and broader aspects of health system financing and service delivery. Sustainable, equitable and effective approaches cannot be designed or evaluated without consideration of other aspects of the health system, including how dynamic and complex ways in which they are connected (1). Understanding the health system as a complex adaptive system is critical for advancing the agenda of enhancing access to medicines. Medicines and medical technologies are considered as one of the six WHO health system building blocks, but the drug supply system is woven throughout the other building blocks as well (2). Service delivery affects how medicines can reach patients and whether sufficient support is provided to promote rational use of medicines. Well-trained human resources are required for improved prescribing and dispensing practices as well as for supporting adherence to drug regimens where home-based care is necessary. Information systems can play a critical role in drug supply management and avoidance of stock-outs—a central tenet to poor access.  Financing systems are a major bottleneck to access due to low affordability of drugs; without national policies to give universal access to essential medicines, those living below the poverty threshold are unlikely to access medicines when necessary. Finally, leadership and governance play an important role in preventing

corruption and sale of drugs in black markets; furthermore, regulation serves to mitigate problems of counterfeits and substandard medicines. With so many factors at play, research that addresses the complexity of health systems is needed to be translated into good policy that can scale-up innovative and effective interventions for improving access to medicines (3).

In stark contrast to the thousands of research articles in the area of access to medicines, there are few studies that take a complex adaptive systems approach to the field. Our scoping review of Pubmed, Embase and Google Scholar found about 10 studies that approached access to medicines from a broader complex systems perspective. These will be explored later in the chapter. The medicines supply chain is nested within the health system and interacts with the divergent behaviours present in this system. This open and dynamic relationship is a characteristic of a complex adaptive system and should be analysed as such in order to best understand how innovations and interventions will affect the system (4; 5).

Tools exist for exploring complexity. In fact, the complex adaptive systems approach has been used to explore and evaluate health system interventions effectively (4-16). Network analysis, agent-based modelling, scenario modelling, and causal loop diagrams are some of the tools used to explore complexity (9; 12; 17;18).

The goal of this chapter's annex is to highlight the need for a complex adaptive systems approach to exploring access to medicines, to offer examples of how this has been applied and to set the scene for the case studies discussed in this report—these use the health systems perspective to access to medicines framework described in this chapter to understand how medicines are impacted by the system and how they affect and change the system themselves.

### What is Complexity?

Complexity involves multiple, dynamic parts that work in a system towards some

purpose(s). It shows an ability to learn or create new structures, as well as a number of other non-linear patterns (Figure 1). These patterns occur because of the relationships between different parts of a system, characterized by: 1) the diversity of parts; 2) how closely they are connected; 3) their inter-dependence, or how they react to each other; and 4) their ability to learn.
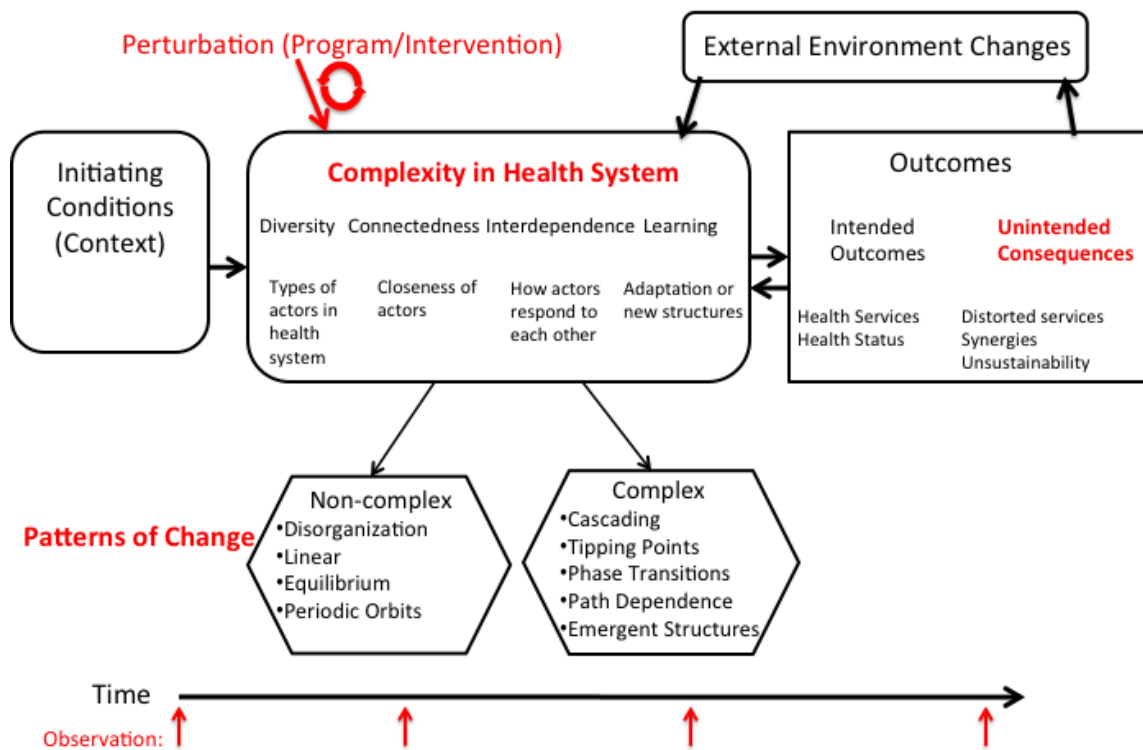


Figure 1. Components of Complex Adaptive Systems (from D. Peters)

*Complex adaptive systems and ATM*

Using CAS in understanding issues of access to medicines is particularly relevant because of the diversity of players involved in the supply chain of medicines as well as the involvement of both private and public sectors as well as patients. Furthermore, medicines concern systems outside of the health system and at international level; therefore, predicting patterns of emergent behaviour from various sources will serve to enhance understanding and to better plan and evaluate interventions that can lead to improved access to medicines and in turn, better health outcomes.

To apply a complexity lens to understanding ATM involves more than trying to examine the linear relationships between variables. Firstly, studying effects over time is critical as adaptation and dynamism are key components of CAS and to understand change, the time factor needs to be included. Another key ingredient is the inclusion of multiple players, their perspectives, their connections and the way in which they interact with one another leading to outcomes of the system (9). Predictions should be made on potential unintended consequences and the ways in which they may impact the system and its players, changing the networks, important players and the rate of change. CAS methodology can be more intuitively used in planning interventions; however, the importance of CAS in evaluation methodologies has also been highlighted calling for more efforts to include CAS in evaluations. This would allow for a better understand of gaps in the system that may be affecting quality or limiting potential (1). Furthermore, it may identify unintended negative outcomes before they adversely impact uptake of interventions and before they become a problem for the system (9). The next section identifies examples of CAS methods applied to medicines research in existing literature.

### Applying CAS methodology for research and policy-making

To explore the literature, a search was conducted in Pubmed, Embase, and Google Scholar, combining terms for medicines, low and middle income countries and CAS tools and approaches. Studies were included if: 1) the piece was focused on ATM, 2) set in LMICs, 3) considered several components of the health system and 4) followed observations at more than one point in time to capture the adaptive and dynamic nature of the system. Publications in ATM that use a CAS approach consider several components of the health system and their connections with medicines; they follow observations at more than one point in time to capture the adaptive and dynamic nature of the system. To identify studies that take a full CAS approach, the following questions are relevant:

- *Does it describe an intervention and how it changes?*
- *Does it describe initiating conditions?*

- *Does it describe multiple players and their diversity in health system?*
- *Does it demonstrate how close health systems players are to each other?*
- *Does it show how parts of the system (e.g. players) respond to each other?*
- *Does it show learning and new structures that emerge?*
- *Does it describe unintended consequences (in addition to intended outcomes)?*
- *Does it examine non-linear patterns of change?*

The following section explores how several studies have taken a systems perspective to exploring access to medicines and its complex nature.

A study on supply chain management in Uganda by Windisch et al (19) identifies gaps that would not have been evident without systematic consideration of interactions within and across building blocks of the supply management system. Path dependence is considered where initiating conditions and the history of supply chain management in Uganda were explored. Multiple players in different building blocks of the health system were incorporated and through a mixed methods approach and their perspectives were captured through key informant interviews. The network involved was also laid out for improved understanding of how the different pieces of the system fit together. Consequences of one part of the system on the other were also outlined, and feedback loops were shown, pointing out unintended effects. All together, the use of the WHO building blocks to systematically explore the various components of the drug supply chain and the multi method approach with a focus on CAS elements such as accounting for history, mapping out interactions, predicting unintended consequences, outlining the causal effects of change in one part of the system on another and highlighting emergent patterns, make this study a comprehensive study of access to ARTs in Uganda. It provides an understanding of what is missing from the system and where an intervention would be helpful.

There is a case made by Buckup (20) for taking an approach that addresses the complexity of systems within market structures of medicine purchasing and financing. Economic

theory and the role of markets in access to medicines are an important component that should be addressed; with neoclassical economics, the assumption is that all players are informed and there are no transaction costs. It makes a case for exploring market relationships and focusing instead on partnerships. The power, position and needs of each stakeholder are better met when the interconnected nature of the system is addressed and its responsiveness to these needs is analysed.

Guo and Zhao (21) explore the complexity of drug discovery and innovation. The collaborative government-enterprise-academia system is seen as being successful in the competitive market of drug development. Considering the drug research contributions, supply chain management, political environment and human resource and capital requirements are critical to success in drug innovation; therefore, looking at the drug supply chain as a complex adaptive system has its advantages from a competitive edge.

Policy implementation and its effect on the multiplicity of actors involved in the inputs, process and outcomes, can be better evaluated through a complex adaptive systems lens. A study in rural China by Xiao et al (22) evaluated a national drug policy's implementation in terms of its intended outcomes and unintended consequences through identifying the actors involved, their roles, relationships and feedbacks created by their actions and responses to the policy and system. As stated above, the assumption that actors are well-informed and predictable is not sufficient, which is why an approach that takes into account the dynamic and adaptive nature of the system and how the drug policy would affect the system is necessary. Behaviour patterns by different actors emerge as a result of the policy and other actors' behaviours—these emergent patterns lead to self organization, leading to a system that is greater than the sum of its parts. To best understand the impact of such a system, one must then understand the behaviours of these actors and their influence on each other through a multi-methods approach. This study in China expands on traditional economic evaluation to account for the changes brought on the system through emergent patterns and self organization by the actors. In depth key informant interviews were used to understand the motivations of the actors.

A study by Hontelez et al. (23) explores the role of universal test and treat (UTT) and anti-retroviral therapy (ART) in eliminating HIV/AIDS in South Africa. Microsimulation mathematic modeling was used to map out emergent patterns of sexual behaviour and risk taking behaviour using social network analysis. This study compares nine modeling techniques for their accuracy in predicting the complex network of HIV/AIDS and its treatment. Probability distributions were used in the more advanced models to predict rates of infection as random processes. The most complex model includes demography, sexual behaviour, transmission, natural history, and intervention considerations. This model is the STDSIM (dynamic, stochastic, microsimulation model). Although all 9 models included in the study predicted elimination of HIV/AIDS using UTT, the time component is significantly different across models as are the baseline predictions. The authors used a step-wise addition approach to adding components to the models being tested and found that the predictions and time to elimination were changing significantly based on each component; therefore, the model with the most comprehensive set of components and the most room for capturing the dynamic and self organizing nature of sexual networks and ART treatment, was found to be the most accurate.

Access to pain management services and medicines should be included in essential clinical services, as per the WHO's recommendations. Uganda was the first African country to address this need in its national health plan by making morphine freely available and mobilizing a specialist palliative care workforce. Logie and Harding's (24) report on the outcomes of Uganda's morphine access programme which handles chronic pain for cancer, HIV/AIDS and pain from sickle cell crisis. The policy is evaluated from the legislative, clinical and community perspectives. A multi method approach was used to capture the complexity of the pain care delivery system using structured interviews, direct observation, and two sets of audits. The quality audits were designed using local prescribing guidelines as well as best practice from the literature. Due to the black market potential of morphine purchasing, considering the unintended outcomes of this policy is important to prevent misuse of morphine. Politicians, police and senior physicians had been wary of this

potential consequence and had stringent rules in the supply chain to account for all drugs. Through interviews exploring the viewpoints across actors in the system, the politicians' and physicians' reluctance was translated to fear in nurses responsible for accounting for the morphine supply. This fear made nurses less likely to prescribe morphine near death as accounting for unused medicines could be difficult. The effects of laws such as those requiring locked cupboards and various levels of authorization, are also explored in this study as barriers to availability of the medicine to nurses and therefore, patients. The authors assert that there has not been sufficient evidence of the diversion of therapeutic morphine to illegal use and this, together with expert opinion on regulation of the drug, suggests that regulation can be relaxed to levels similar to other drugs, allowing for better availability by lifting the disincentives to prescribing pain medications where necessary. Supporting patients in pain management is also identified in the study as an important factor for rational use of morphine as well as human resource training and expanding the health workforce available for pain management through the use of home-based community health workers. This study's three pronged approach and consideration of several aspects of the health system allowed room for exploring unintended outcomes of the drug policy in Uganda as well as capturing process barriers faced by various actors. This approach captures some of the complexity of this and allows for better predictions for how the drug supply chain will affect end users and how best to improve it.

With so many programmes being implemented for managing care in HIV/AIDS, effective and accurate evaluation becomes critical in understanding how a programme affects the system and whether the financial, social and political costs are appropriate given both the intended and unintended consequences of such programme. One such evaluation is the implementation analysis approach. This approach focuses on the process of producing outcomes and holds relationships as a central tenant of how a programme interacts within its organizational context. A study in Brazil by Oliveira et al (25) on access to pharmaceutical care by people living with HIV/AIDS uses this approach to assess the success and quality of implementation. This approach allows for continuous quality improvement because it takes into account the dynamic nature of the system and considers

relationships and linkages across several components of the health system.

The different building blocks of the health system contribute to access to medicines and a health systems approach is required to capture the barriers at each level of the health system and across all components. A study by Bigdeli et al (26) using mixed methods including policy document review, key informant interviews, focus group discussions and direct observation at health facility to explore use of magnesium sulfate for sever pre eclampsia and eclampsia. Context specific health system barriers and enablers were identified and their capacity to affect access and use of magnesium suflate was used to make policy recommendation. The levels of the health system explored include individual, households and communities; health service delivery; health sector; national level beyond the health sector and international level. A fish diagram was used to identify causal pathways and in the process highlighting barriers and enablers. Further interpretation of the fish diagrams nodes were provided through interviews and focus groups to capture the multitude of factors and actors at play in blocking or propelling access to and appropriate use of magnesium sulfate. Triangulation of data sources and methods of collection are the strengths of this study in allowing for more comprehensive exploration of the different levels of the health systems as well as the various building blocks of the health system. Context specificity is also an important strength of this study in improving availability and use of medicines within the service delivery system.

Ridge et al (27) used a fishbone diagram as well to identify barriers and facilitators to the availability and use of magnesium sulfate. However, this was a smaller scale case study at the facility level and therefore did not explore factors across the health system based on interviews and focus groups. It does however provide a strong basis for demonstrating complexity in translating research to practice, and it provides an effective way to understand barriers at the regulatory/government, supply, procurement, distribution, health facility and health professional levels.

Another good case of combining data sources to inform a health system framework for

access to medicines is seen in the study is done by Zaidi et al (28) to map out access to essential medicines in Pakistan and to set a research and policy prioritization agenda. A combination of key informant interviews, desk review, and stakeholders' roundtable was used to address the various components of the health systems framework for medicines described earlier in this chapter. Such an approach identifies health system barriers and highlights quality factors that are being overlooked in the supply and delivery chain, including stock outs, appropriate drug storage and management of retail outlets. The concerns of the various actors in the system were also highlighted through interviews where the gap in research on policy priorities was brought to light. Priority setting exercises using similar methodology were conducted in 16 other low and middle income countries as well with a health systems perspective as the primary framework (29- 36).

While more studies are exploring the whole system through a systems dynamics approach, specific issues should also be increasingly set to a systems dynamics lens, whether they are disease-specific or topic-specific. For example, Bhojani et al. (37) took an approach founded in the interactions of the health system's moving parts by using thematic analysis to explore semi structured interviews with stakeholders across the system, including pharmacists, to study quality of care for diabetes mellitus type 2. The recurring themes were grouped into the following: health service delivery, knowledge and information, leadership and governance, values and principles. This allowed strengths and weaknesses to be identified to improve the system.

Tomson & Vlad (38) looked at antibiotic resistance from a multi level approach exploring how containment interactions affect the different levels of the system and how global dynamics affect determinants of antibiotic resistance. Looking at the separate building blocks is not enough—levels and interactions need to be demonstrated.

A study in Iran looked at National Drug Authorities and built a system dynamics model to visualize the effects of market variables involving the 5 P's (Product, Price, Promotion, Place, People) and how they affect access, availability, affordability, quality and rationality (39). The stock flow diagrams created allowed for exploration of process and evaluation of

various policy approaches to facilitate decision making. The models simulate what the system flow and outcome would be, along with positive and negative effects, with changes made at the various levels of the system. Models can be manipulated depending on what researchers and policy makers would like to focus on as central concepts while external concepts can be used as foreign control knobs. For example, in this study, while affordability and availability were the core of the model, quality and rationality were also tested in terms of how they affect the system.

The results of a study by Agyepong et al (40) demonstrate the need for taking a complexity approach. The study was conducted in Ghana to study provider behaviour as affected by provider payment methods and incentives. Mixed methods were used to inform causal loop diagrams and causal tree diagrams; these showed that although sometimes results were intuitive, counter-intuitive effects were also common. Effects were more relevant to context and interactions with the system rather than linearly to any given provider payment method.

*Conclusion*

CAS methods require input from a wide range of stakeholders as well as follow up over time, making them a bit more challenging. However, developing global research capacity in this area is critical to moving forward with better access to medicines and improved universal health care in general. For example, involvement of the free market and private sector in health, changing the nature of health and health products to pure commodities may appear to be beneficial if explored from a purely affordability perspective, but with a health systems perspective, the effects of such interventions on other parts of the health delivery chain may be revealed as unsustainable and negative for quality and equity within the system (41). The rigor and validity of a CAS approach is also important and researchers should refer to frameworks for quality of research methods such as those for generalizability and validity as highlighted by Green & Glasgow (42) to ensure that the systems approach is one that can be representative and transferable across contexts. An important addendum to increasing the CAS approach in ATM research is the development of information systems. Efficient and functional medical informatics allows for better collection of accurate data that can be used in predictive modeling to address health concerns. With the growing disease burden of non communicable diseases (NCDs), this is even more necessary as a patient-centered, holistic approach that takes into account the social, biological, and economic determinants of health, becomes critical (43). A multi-disciplinary, integrative approach to research is the key to understanding these complex disease interplays and in better training a health workforce. Furthermore, to address the need for universal health coverage, interventions that include private-public partnerships and other cross-cutting approaches are increasing employed; with the changing dynamic of public health approaches, the same change needs to happen in how they are researched and evaluated. CAS methodologies offer a dynamic approach and should be further developed in health research. Importantly, the use of a CAS approach and health systems perspective has benefits in connecting research to practice through not only enhancing research uptake but also more efficiently and effectively informing policy makers and sensitizing them to the myriad of outcomes their decisions could have for a variety of perspectives. The comprehensive and complex awareness afforded to policy makers through a CAS approach can lead to more appropriate and timely decisions that

are evidence-based and accountable to the range of stakeholders involved.

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