

The AIDS Epidemic: Integrating System Dynamics and Gaming for Strategic Simulation

William Edgar, Aparna Higgins and Lance Durham
Booz Allen Hamilton, Inc
8283 Greensboro Drive
McLean, VA 22102, USA
703.377.5509, 301.998.6699, and 703.377.1464
edgar_william@bah.com, higgins_aparna@bah.com and
durham_christopher@bah.com

Abstract

The rapid spread of HIV/AIDS is a global crisis – one that is particularly devastating to the economies of nations where the disease is most prevalent. Booz Allen Hamilton, in conjunction with the Global Business Coalition on HIV/AIDS (GBC) and the Confederation of Indian Industry (CII), developed an innovative approach for The AIDS Epidemic in India: A Strategic Simulation. Their approach captures the complex interdependencies that drive the HIV/AIDS epidemic and its economic consequences. At the core of this strategic simulation is an analytic framework that leverages epidemiological and economic System Dynamics modeling, partnerships with leading academic centers, and simulation-driven gaming.

Introduction

UNAIDS estimates more than 60 million people have contracted HIV/AIDS worldwide in the past two decades and 25 million have died as a result - it is the fourth-leading cause of death in the world (Hein and Wilson, 2002).

Currently, Sub-Saharan Africa is the most seriously impacted region in the world – with 9% of all its inhabitants between the ages of 15 – 49 infected with HIV. Eurasia, however, is expected to be the next major area of infection, and the region includes three of the world's largest nations, China, Russia and India. The toll, in terms of human suffering will be tremendous, but, combined with the potential economic, social and political impacts, the epidemic will have staggering implications inside and outside the region (Hein and Wilson, 2002).

Booz Allen Hamilton, in collaboration with the Global Business Coalition on HIV/AIDS (GBC) and the Confederation of Indian Industry (CII), developed a strategic simulation designed to explore how public and private sector

collaboration could help develop a more comprehensive response to the HIV/AIDS epidemic in India. The strategic simulation, held in India in October 2003, was built on System Dynamics (SD) and gaming. The SD model supported a two-day game that brought together, for the first time, more than 200 leaders from industry, government, healthcare, community organizations and Non-Government Organizations (NGOs). Combining SD modeling and gaming into a strategic simulation allowed participants to better understand the social and economic implications associated with public and private strategies in the fight against HIV/AIDS. Additionally, strategic simulation facilitated the major goal of this effort, which was to encourage the business community in India to leverage its unique skill set in the fight against AIDS. To that extent, the strategic simulation supported five key objectives:

- Developing a better understanding of the long-term economic, political and social impacts of HIV/AIDS
- Understanding the impact of potential interventions
- Identifying areas for collaboration between public and private sectors
- Determining how best to mobilize both business and public sector resources
- Identifying strategies for all sectors in developing a national HIV/AIDS response

Modeling Context

According to the IMF's *The Macroeconomics of HIV/AIDS*, the HIV/AIDS epidemic has attained a scale at which the policies to prevent the spread of the virus have direct implications for key economic indicators such as economic growth and income per capita, and for economic development in many countries (Haacker, 2004, 1). It is currently estimated that the potential economic impact of the AIDS epidemic could cause an otherwise growing economy to contract to about one-third its size in three generations (Haacker, 2004, 1).

The System Dynamics model developed by Booz Allen was designed to cultivate an understanding of both the epidemiological and economic dynamics of HIV/AIDS in India. Additionally, the strategic simulation acted as a catalyst, bringing together the most appropriate national and international government, non-government and business stakeholders for India's social, political and economic future.

The challenges associated with understanding and mitigating the economic, social and political impacts of this epidemic are significant and growing as well. Policymakers, businessmen and analysts who seek to provide solutions to the spread of HIV and AIDS in India are faced with a host of challenges and issues:

- Lack of trust and understanding among the sectors proved to be barriers to successful partnership
- Social and cultural stigma associated with HIV/AIDS proved detrimental to prevention, testing, and treatment.
- Voluntary counseling and testing (VCT) services were underutilized without available care and treatment.
- Healthcare infrastructure, both in terms of facilities and human resources, is not sufficiently scaled to deal with the potential size of the epidemic.
- Long-term provision of treatment transforms HIV from a fatal disease to a chronic illness, increasing demands on health care infrastructure and available resources

Modeling Approach

Booz Allen, in partnership with leading academics from Brown, Emory, and Wayne State Universities, developed an integrated System Dynamics (SD) model that combined disease epidemiology and economics together with a variety of policy and program options. The model was based on peer-reviewed scientific literature and its predictions were validated against prevalence and economic data from India between 1987 and 2003.

Booz Allen's HIV/AIDS model like all models is not designed to predict the future with certainty. It can help decision-makers reduce risk and uncertainty in decision-making when confronting complex interdependent environments like healthcare. Models reduce the probability that decision-makers will be surprised by unanticipated delays or other "unanticipated" events and permit more adequate preparation. In addition a simulation model enables decision makers to test different assumptions, explore potential scenarios, and examine impact of their decisions in a cost effective way.

The HIV/AIDS model has two key modules: the disease progression module and the economic module, but the approach consists of a collection of integrated analytic solutions.

The disease module is primarily a model of heterosexual transmission that incorporates multiple risk groups. In the economic module models specific industrial segments: information technology, financial services, and automotive. Economic impact of HIV/AIDS was captured through worker morbidity and mortality. There were a variety of program and policy options that were incorporated into our model. Programs included both prevention and treatment options. Prevention programs were modeled both at the industry and national levels and consisted of: general education and wellness, voluntary counseling

and testing, condom distribution, and mother to child transmission prevention programs. Treatment options included both anti-retroviral therapy (ARV) and non-ARV care. Both options existed at the industry and national levels. All programs can be limited by financial and infrastructure constraints. Program funding can be time phased and costs are appropriately discounted. Due to data limitations on health infrastructure, indexed program effectiveness scores were used. These scores reflect the ability to reach the segments of a targeted population and were developed in conjunction with leading HIV/AIDS clinicians from India and the U.S.

There are a variety of public health and economic metrics computed in the model. A sample of these metrics includes: HIV/AIDS prevalence, AIDS mortality, AIDS impact on GDP, AIDS impact on industrial productivity, health care expenditures, and discretionary spending. The model allows the policy maker to set funding levels and effectiveness scores for various programs and evaluate the impact of alternative options on prevalence, mortality, and economic output. The model also has the capability to identify what the leading metrics are and what are the drivers of those metrics. It serves as a tool that can assist policy makers in simulating a variety of alternative scenarios and performing rapid trade-off analysis.

The HIV/AIDS Strategic Simulation

The strategic simulation held in India was not intended to be a predictor of the future of the AIDS epidemic in India, but an analysis of potential scenarios that could occur based on actions taken in the present. The goal was to provide a better understanding of the potential consequences and impacts of those actions. The experience enabled more informed decision-making and policy assessments.

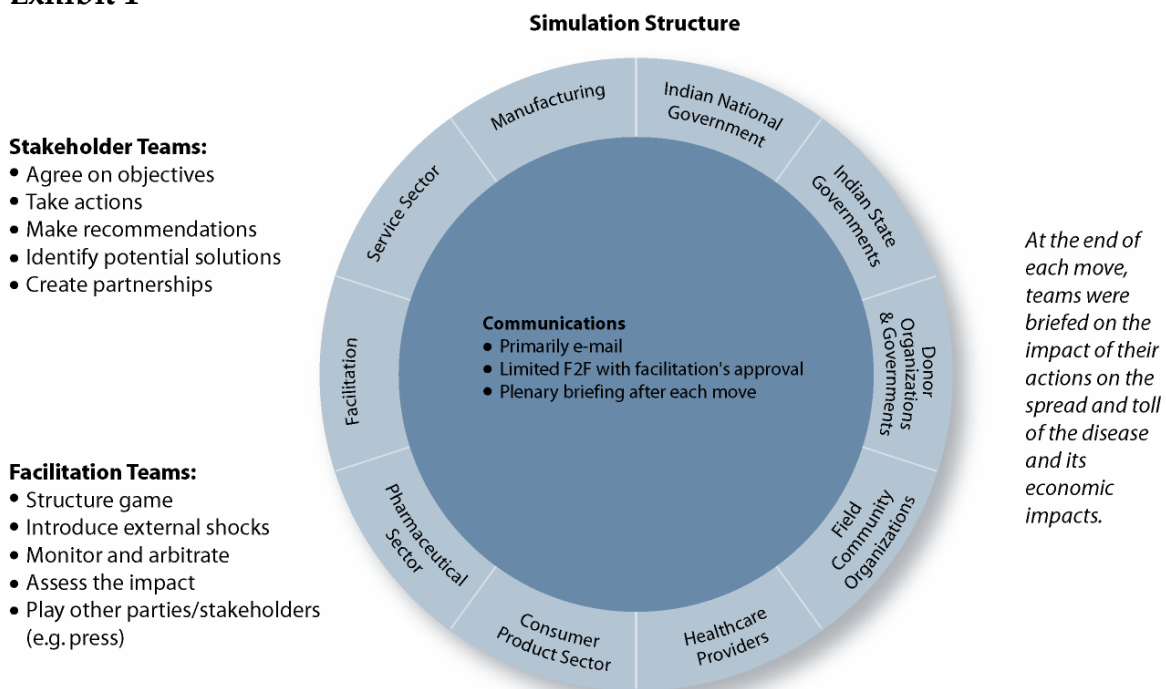
During the strategic simulation teams representing key stakeholders worked together to innovate, articulate, and execute 53 partnerships and 100 initiatives to curb the spread of the disease and mitigate its impacts. These spanned from business initiatives to raise awareness and increase access to testing and treatment, to national government prevention efforts that provided outreach to high risk and marginalized populations.

Business participants included senior executives from industries including consumer products, financial services, heavy manufacturing, information technology, pharmaceuticals, automotive and energy. Representing government were national and state officials from India, as well as officials from the United States, United Kingdom, Germany and Australia. Civil society leaders from international organizations including UNAIDS, Global Fund, Oxfam, Gates Foundation, Gere Foundation, World Bank, World Economic Forum, and

domestic organizations such as Action India AIDS Project, Family Planning Association of India, India HIV/AIDS Alliance and Sahara, were also in attendance.

Participants were divided into nine teams representing industry, government and civil society stakeholders [Exhibit 1], with a mix of sector representatives assigned to each team. This allowed individuals to share their unique insights, knowledge and challenges, providing all participants with a broader perspective on the impacts of the disease and the consequences of HIV/AIDS interventions and policies.

Exhibit 1



At the start of the simulation, participants were faced with the current state of the HIV/AIDS epidemic in India. Teams worked together to respond to the epidemic, mitigate its impact and identify innovative approaches to preventing and managing the disease.

The highly interactive exercise allowed teams to communicate with each other via email to seek information, assistance and funding, and form partnerships. The epidemic evolved based on the actions taken by the teams. Ten-years time was simulated in System Dynamics over a series of three moves, forcing participants to address real-world dilemmas and choices, and manage the short- and long-term consequences of their actions.

Over the course of the simulation, the System Dynamics model allowed teams to experience first-hand the consequences of relying on broad prevention and education programs as the disease spread rapidly to the middle class. They grappled with the challenges of funding constraints, as they rushed to develop programs that, in the end, were not implemented due to lack of resources. However, based on these experiences, participants took away a fundamental understanding of the challenges inherent in managing an emerging public health crisis with widespread political, social and economic consequences.

Findings

Through the course of the simulation, participants were faced with pressures and constraints similar to those encountered in the real world. Teams had to not only propose effective interventions, but also develop strategies that could actually be implemented. They quickly discovered that no single sector would be able to tackle HIV/AIDS without leveraging the knowledge, talents and resources of others. The issues inherent in developing effective partnerships among a diverse group of stakeholders, and confronting a topic as controversial as HIV/AIDS, presented several challenges.

- Lack of trust and understanding among the sectors proved to be barriers to successful partnership. Initially, organizations' natural focus was on their own constituency, and individual sector decisions did not always address the broader group of stakeholders. Early in the simulation, the business sector teams developed programs that focused on their own employees and customers. However, all participants realized that failure to address the needs of high risk and marginalized communities, such as commercial sex workers (CSW's), injection drug users (IDU's) and the mobile population, reduced the effectiveness of the response.
- Social and cultural stigma associated with HIV/AIDS proved detrimental to prevention, testing, and treatment. Individuals had little incentive to learn their HIV status for fear of being ostracized by their families and communities. Healthcare workers often did not want to be recognized as treating the disease, for fear of losing other patients. Further, the social and cultural mores of the nation prevented the open discussion of many of the risk behaviors, making it difficult to educate the population about even the most basic methods of prevention.
- Voluntary counseling and testing (VCT) services were underutilized without available care and treatment. People were reluctant to undergo testing not only because of stigma, but because it was not supported by

adequate care and support services for those found to be positive. Participants found that uptake of VCT increased when coupled with Anti Retroviral Therapy (ART). ART served as an incentive for individuals to learn their status because it enhances quality of life for people living with HIV/AIDS (PLWHA). In addition, the stigma of having HIV/AIDS can often be avoided when PLWHA undergo treatment.

- Healthcare infrastructure, both in terms of facilities and human resources, is not sufficiently scaled to deal with the potential size of the epidemic. As the simulation progressed, teams became more prolific in the introduction of programs to combat the spread of the disease. However, teams quickly discovered that existing infrastructure and HIV/AIDS education and training was inadequate to support interventions. For example, many of the business teams proposed VCT programs for their employees, but did not have the trained staff available for implementation. Compounding this problem was the fact that many healthcare providers did not want to deal with HIV/AIDS patients because of the associated stigma. Teams worked to find innovative solutions and set priorities, in an attempt to optimize the use of existing resources.
- Long-term provision of treatment transforms HIV from a fatal disease to a chronic illness, increasing demands on health care infrastructure and available resources. Teams' success in developing effective interventions led to a new set of issues and challenges. AIDS-related mortality was reduced, but overall prevalence and healthcare costs were predicted to increase, because PLWHA lived longer and required higher cost treatments throughout their lives. In addition, some feared that the availability of ART might also lead to complacency on prevention, increasing the number of individuals in need of treatment over time.

Exhibit 2



As teams responded to the above challenges, four critical success factors emerged for national HIV/AIDS strategies [Exhibit 2].

Leadership: Leadership from the top is vital, whether it be government officials, CEOs or community leaders. A strong public stance on HIV/AIDS lays the groundwork for broad participation across all sectors, and

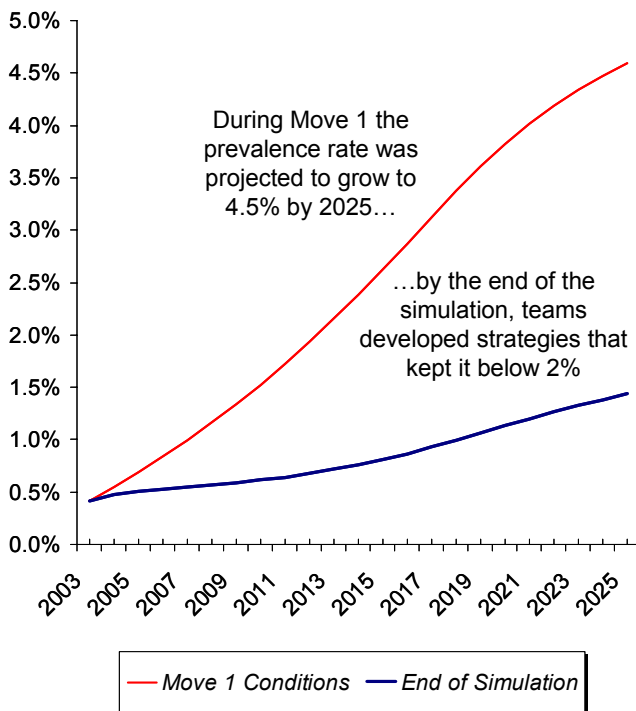
can address key barriers such as stigma and discrimination.

During the simulation, the political will exhibited by the national team provided a context in which business leaders felt motivated to act. In another example, healthcare providers led an effort that forged partnerships among the pharmaceutical industry, state governments and NGOs, to serve patients in high-risk areas. These ideas can be reinforced through real-world policy initiatives, such as the introduction of anti-discriminatory legislation for insurance and employment purposes.

Prevention, Testing, Care Continuum: Non-discrimination, awareness and prevention, VCT, care, support and treatment are interdependent and best viewed as part of a continuum. Policies must balance these interventions based on the social, cultural and economic infrastructure of the community. Communities must identify their place on the spectrum, and work across sectors to develop the strategy that most effectively addresses the needs of their stakeholders.

However, the simulation illustrated that targeted early actions are often the least expensive interventions, and can prevent the longer-term costs of delivering

Exhibit 3



treatment and care to PLWHA and their families. In addition, proactive action targeting high-risk groups can prevent the disease from spreading to the general population. Social stigmas often make it difficult to reach out to these groups, however they are the bridge populations that spread the disease to the rest of the population. Model results show distinct improvements [Exhibit 3] in the prevalence of HIV/AIDS from the beginning of the simulation (Move 1) to the end.

Collaborative Partnerships: Collaboration is critical to maximizing impact, but requires careful management, clear communication and understanding.

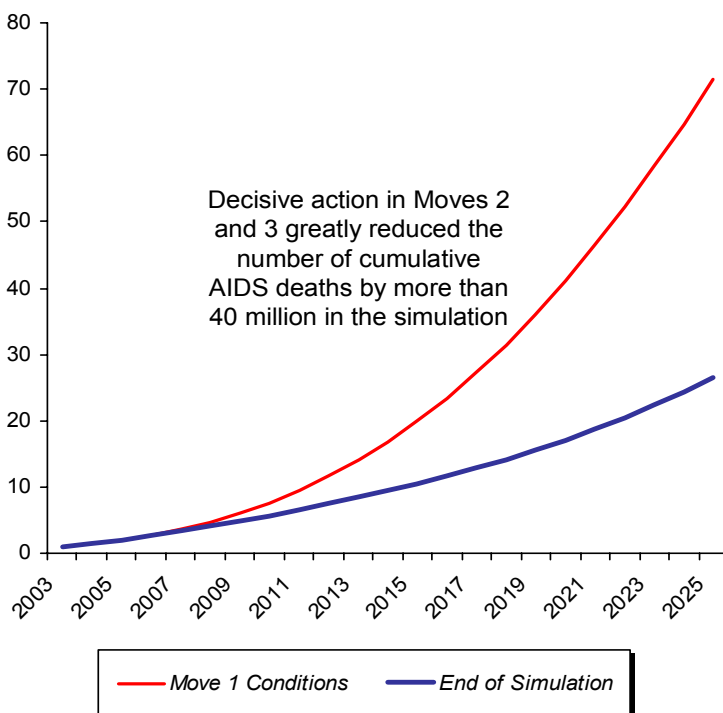
Partnership can occur at all levels – among players in a single sector, or between sectors. However, ownership of the broad spectrum of issues and constituencies is required. Communities must assess the extent to which each sector can take responsibility, and determine who will represent the informal sector.

When establishing partnerships, each stakeholder should have a clear understanding of what advantages it offers, and what others can do more effectively or efficiently. Successful strategies leverage the unique capabilities, resources and skills of each sector. For example, industry assistance in strategic and long-term planning will help to enhance overall management and effectiveness of HIV/AIDS strategies. The business sector can also help to generate innovative programs using its communications and marketing, information technology and logistics and distribution skills. Further, existing infrastructure and resources in all sectors can be leveraged for a broader audience.

Communication and common language are also critical to effective partnerships. Each party must understand the motivations of their partner(s) and what they have to gain or lose.

Results-Based Funding: Clear prioritization of programs and innovative funding approaches are critical given resource and infrastructure constraints. This prioritization should not only focus on HIV/AIDS programs – HIV/AIDS

Exhibit 4



competes with business costs, other diseases and other development issues. Finding linkages among these issues is key to ensuring widespread support.

A coordinated approach to funding at a national level will ensure that programs support the national strategy and objectives. For example, a centralized body could monitor funding and programs at a national level. Its responsibilities would include identification of criteria for program selection and development

of performance measures. Teams also noted the need for decentralizing funding to deliver cash to the end user as quickly as possible.

The impact of innovative approaches to funding initiatives are paramount, and, as Exhibit 4 demonstrates, can save lives. These are effective tools for expanding the level of resources available to fight HIV/AIDS. Several specific examples emerged during the simulation including in-kind donations of resources, facilities, expertise, time and services, and providing incentives, such as tax breaks, to industry for their HIV/AIDS programs.

Conclusion

Our team developed a sophisticated model that provided a new means to quantify global health risk and the impact of responses for both the public and private sector stakeholders. The System Dynamics model integrated partial equilibrium economics and world-class epidemiological expertise, with options for public health policies and programs. This dual-approach – combining interactive simulation with dynamic modeling – provided participants with real-time feedback on the impacts of their actions, and provided a context in which to measure their success.

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