Access to antiretroviral treatment in the developing world: a framework, review and health systems research agenda

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Of the estimated 7 million people who needed antiretroviral treatment (ART) in developing countries in December 2006, 2 million were receiving it. International organizations are committed to achieving universal access to ART. This article develops a conceptual framework to analyze access to ART – need is translated into latent demand by knowledge and willingness to access ART; latent demand is translated into expressed demand by ability to access; and expressed demand results in ART use, if it can be satisfied with ART supply. The article reviews evidence and ideas, and identifies future research needs, on a number of key issues in access to ART: ART need (how to measure and predict it), latent demand (how to achieve universal knowledge of HIV status and ART; how to ensure that ART services are acceptable and accommodating), expressed demand (how to ensure that ART services are accessible and affordable) and ART supply (how to achieve equitable access to ART in the short term and universal access in the long term).

At the 10th International Conference on AIDS and Sexually Transmitted Diseases in Africa, held in Abidjan in November 1997, President Jacques Chirac of France and his Secretary of Health, Bernard Kouchner, called on the developed world to provide funding for antiretroviral treatment (ART) in sub-Saharan Africa. A commentary in the *Lancet* dismissed the idea: "Given the competing healthcare priorities in developing countries, the high costs of antiretroviral agents, poor infrastructure, and inability to sustain such a programme, the French initiative is ill-advised and foolish public health practice" [1]. Some 10 years later, ART programs in developing countries provide treatment for approximately 2 million people out of 7 million in need of ART [201]. This coverage has been achieved through the commitment of national governments, which provide finance and infrastructure for ART [202], and the support of international organizations and initiatives such as the WHO's 3 by 5 initiative [202], the Global Fund for fighting HIV/AIDS, Tuberculosis and Malaria [203], Médecins Sans Frontièrs [204], the Presidential Emergency Fund for AIDS Relief (PEPFAR) [205] and the Clinton Foundation [206]. Nevertheless, 5 million HIV-positive people who currently need ART are not receiving it, leading to avoidable deaths [2]. In June 2006, the General Assembly of the UN committed itself to the goal of achieving universal coverage with HIV care by 2010 [207].

In this article, a conceptual framework of access to ART and HIV care will be developed. The framework will be used to review the current literature on access to HIV care in developing countries and to outline directions for future research on access to ART. Because of space limitations, the research themes discussed are necessarily only an incomplete selection of all themes related to ART access. However, all research themes selected are likely to be of major importance in achieving universal access to ART in the coming decade.

Access to HIV care: a conceptual framework

In the history of health systems research, a number of conceptual frameworks of access to care have been developed [3–5], prominently Andersen's "behavioral model of health services use" (a linear model that leads from demographic, social and attitudinal "predisposing characteristics" to "enabling resources" at the individual, family and community level to "perceived need" and healthcare use) [6,7] and Penchansky and Thomas' "dimensions of access", which describe the "degree of fit" between the patients and the system across five dimensions ("availability", "accessibility", "affordability", "acceptability" and "accommodation" ["the manner in which the supply resources are organized to accept clients"]) [8].

Most of these frameworks were developed more than 20 years ago with the goal to structure health systems research in the USA. Their applicability to the study of access to HIV care in developing countries is limited. Some, such as Andersen's "behavioral model", implicitly assume that the

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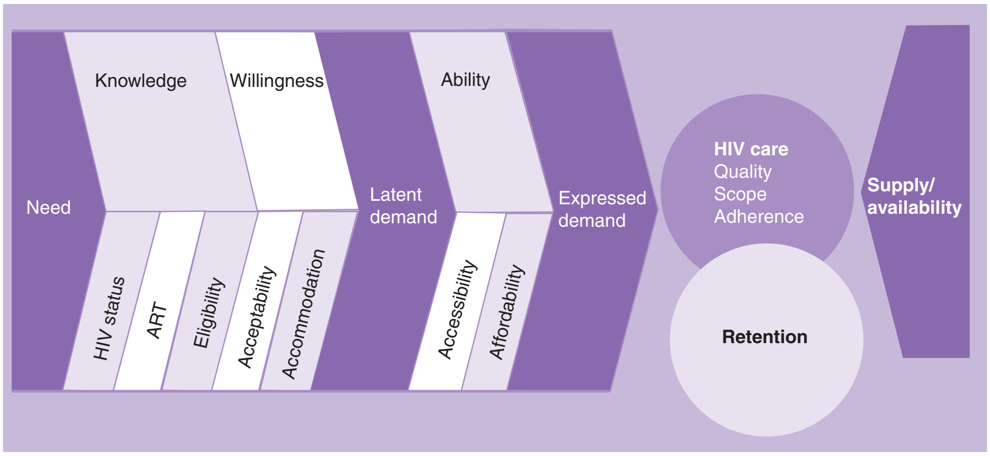
Figure 1. Framework to analyze access to antiretroviral treatment.



ART: Antiretroviral treatment

overall capacity of the health system to meet healthcare needs is sufficient; however, most developing countries are currently not able to supply sufficient resources to provide ART to all individuals in need. Others, such as Penchansky and Thomas' analysis of "degree of fit", view different dimensions of access as independent of each other. However, the different conditions that need to be in place in order for an individual to access ART can be usefully viewed in an hierarchical way: a person first needs to know that she needs ART, then needs to be willing and, finally, be able to access ART. In order to emphasize both the supply of resources to provide care and the hierarchical relationship between knowledge, willingness and ability to access ART, Penchansky and Thomas' five dimensions of access are integrated into an expanded economic framework of supply and demand, where ART need is translated into latent demand, if an individual knows about his or her ART need and is willing to receive treatment. Latent demand, in turn, is translated into expressed demand, if an individual is able to access care. Expressed demand will be met if supply is sufficient, leading to ART use (or 'realized access' [7]) (**Figure 1**). As ART needs to be lifelong, access needs to be continuous (as emphasized by 'retention' in **Figure 1**).

ART need

How can ART need (unmet & met) be measured and predicted?

The WHO estimates of ART need cited above are based on a model of the HIV epidemic developed by the Joint United Nations Program on HIV/AIDS (UNAIDS) and the WHO [9–11]. Inputs into the model include adult HIV prevalence, the age of the HIV epidemic and assumptions regarding the length of time from HIV infection to ART eligibility and survival probabilities of people receiving ART [9]. While the model has served the important purpose of providing a measure of ART need for most developing countries, its findings will need to be validated in different settings by comparing them with results of other models [12,13], and the accuracy of its inputs (such as time from infection to ART eligibility) will need to be improved [9,14]. In addition, it may be possible to directly measure ART need in general populations under HIV surveillance, for example, by measuring CD4 count in dried blood spots collected in HIV surveillance systems [15].

The WHO estimates of the number of people on treatment "are based on the most recent reports received from either the ministries of health or the WHO or UNAIDS offices in the countries concerned, or from other reliable sources in the countries, such as bilateral partners, foundations and nongovernmental agencies that are major providers of treatment services" [16]. The reported numbers may overestimate the true numbers of people on ART (many countries report the number of people who ever received treatment, which includes people who have discontinued treatment or died) or they may underestimate the true numbers (in many countries the reported estimates do not include people receiving ART in the private sector). Future efforts may improve the accuracy of the nationally reported numbers by improving systems to monitor the flow of patients through

ART programs. In addition, it may be possible to directly measure ART use in general populations by screening biological samples from sentinel surveillance systems, such as dried blood spots, for the presence of antiretroviral drugs [15].

As ART programs age, the number of people in need of second-line therapy will increase. Second-line therapy is currently far more expensive than first-line therapy [17,18]. Thus, it will be increasingly important that models of ART need (both at the national and the program level) are able to distinguish between the needs for first- and second-line therapy. Such models may be informed by information regarding switching rates from ART programs in developing countries [19] and by population-based surveillance systems that are able to measure drug resistance [20].

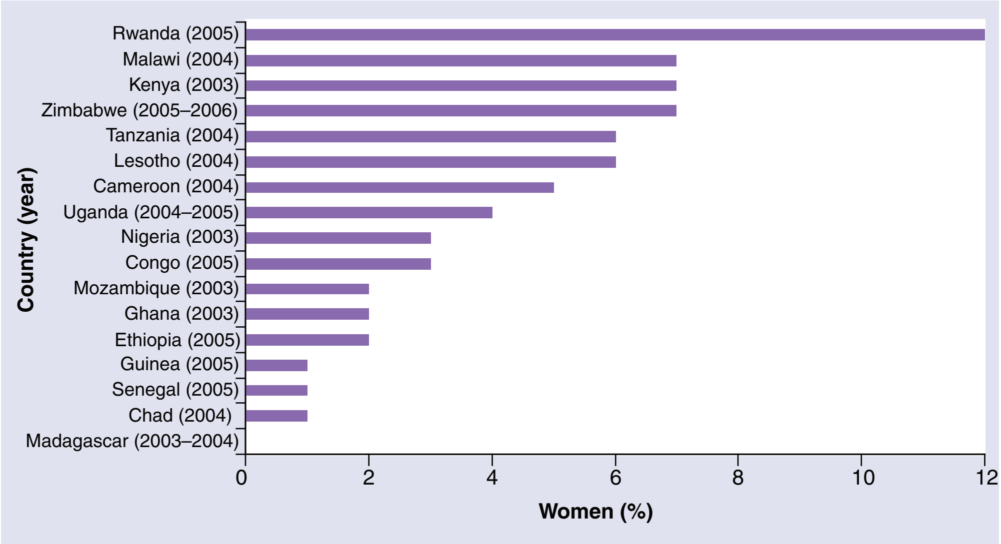
Generating latent demand for ART: knowledge

How to achieve universal knowledge of HIV status?

In order to translate ART need into latent demand for ART, people need to know their HIV status. While it is theoretically possible to infer a probability of being HIV positive without an HIV test (by assessing past risk behavior or observing symptoms of disease), an HIV test is a necessary condition to be screened for ART eligibility and thus to gain access to treatment. In many developing countries, including those with very high HIV prevalence, only small proportions of the population have ever received an HIV test result [21]. Among people who have received a negative HIV test result but continue to engage – at least occasionally – in risk behavior, HIV-status information, once received, becomes increasingly uncertain as time passes. In this situation, repeat HIV testing is necessary for accurate HIV-status knowledge. **Figures 2 & 3** show the proportion of women and men aged 15–49 years, respectively, who received an HIV test result within the past 12 months for all country-years in sub-Saharan African countries for which information on this indicator was available from a Demographic and Health Survey, a Multiple Indicator Cluster Survey, a Reproductive Health Survey, a Sexual Behavior Survey, a Behavioral Surveillance Survey, or an AIDS Impact Survey [208]. The percentages who have received an HIV test result in the past 12 months range from 0 to 12% in women and from 0 to 11% in men.

The dominant model of HIV testing in the past 25 years, voluntary counseling and testing (VCT) [22], has been blamed for the low level of HIV-status knowledge in developing countries [23–25]. VCT may limit opportunities to gain knowledge regarding HIV status because it has to be initiated by the client. In addition, its main characteristics – counseling and information regarding HIV before and after the HIV test; informed, specific and voluntary consent to the test; and anonymity of the test result [209] – make it difficult to scale-up because they require a specialized workforce and counseling centers.

Figure 2. Percentage of women aged 15–49 years who received an HIV test result within the past 12 months in sub-Saharan African countries.



In the past few years, the VCT approach has been challenged in a number of developing countries. The government of Botswana introduced an HIV-testing policy in 2004 whereby patients are routinely tested during a medical visit unless they explicitly refuse [26]. In South Africa, the Department of Health in its HIV and AIDS and STI Strategic Plan for South Africa, 2007–2011, calls for "a paradigm shift in health care provision where HIV testing is routinely offered to people attending health services" [27]. In Lesotho, the Ministry of Health and WHO announced, in 2005, plans to test all residents aged 12 years or older in a village-to-village campaign by the end of 2007 [28,210].

A population-based study in Botswana found that 81% of 1268 study participants were "very much or extremely in favor of routine testing" during medical visits [29]. However, the acceptability of routine testing reported in this study was stated rather than observed. Future research needs to evaluate how far different alternative testing strategies, such as the "opt-out" approach (i.e., testing is initiated by the provider of some health service and the client is tested unless she actively refuses to be tested) and the "opt-in" approach (i.e., testing is initiated by the provider, but the client must specifically agree to the test) [30], differ from VCT and amongst themselves in their acceptability and performance in protecting HIV-positive individuals against abuse as well as in their effectiveness and cost–effectiveness in scaling-up HIV testing. In addition, it will be of interest to analyze whether, as has been suggested [31], provider-initiated HIV testing will reduce HIV-related stigma because it normalizes 'HIV exceptionalism' [32,33].

How to ensure that people are aware that ART is available & effective in prolonging the lives of HIV-positive people?

In order for people to be able to demand ART, they must know that ART exists and believe that it can be effective in prolonging and improving their lives. The few studies that have investigated people's knowledge of ART in developing countries have found widespread lack of knowledge. A study among HIV VCT clients in Tanzania between 2003 and 2005 found that only 17% were aware of ART [34]; a study from India reported that of 1667 surveyed persons seeking general healthcare in one of six public or private healthcare clinics in 2004, only 36% had heard of ART [35]. Even among HIV-infected people, ART knowledge is limited. Of 1544 individuals who tested HIV positive in a population-based HIV surveillance in a high-HIV-prevalence community in rural KwaZulu-Natal in 2006, 32% had never heard of ART, 29% had heard of ART but did not know where to access it, while 39% had heard of ART and knew where to access it [36]. In developing countries, where highly active ART (HAART) has been available for more than 10 years [37], considerable proportions of people may not know of ART. For example, a study in the USA of 16,962 people who participated in the 2001 Behavioral Risk Factor Surveillance System found that 14% of respondents did not know that treatment exists that can prolong the lives of people with HIV [38]. Further research is needed to investigate the determinants of ART knowledge in order to inform the design of information and education campaigns to achieve universal knowledge of existence, effectiveness and availability of ART.

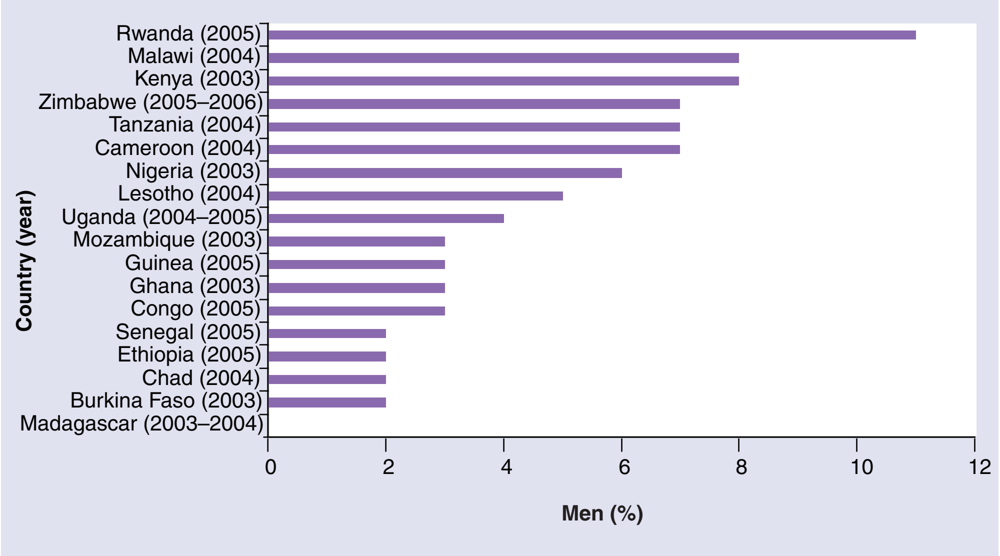
Generating latent & expressed demand for ART: willingness & ability

How to ensure that ART services are acceptable, accommodating, accessible & affordable?

Once a patient knows that she would be eligible for and benefit from ART, she needs to be willing to access ART (leading to latent demand) and able to access it (leading to expressed demand). Willingness to access will be determined by "acceptability" [8] of ART services – *inter alia* a function of attitudes towards ART providers [39,40], fellow patients and ART facilities, and beliefs regarding the use of alternative therapies, including traditional medicine [41–48] – and "accommodation" [8] – *inter alia* a function of how far services are perceived to be able to help patients attain self-efficacy in taking ART, avoid the consequences of stigma, discrimination and abuse [42,48–52], and provide ART when patients are able to attend a clinic [35].

Ability to access, in turn, will be determined by "accessibility" [8] – a function of the distance between a patient's home and a clinic and the availability of transport [53,54] – and "affordability" [8] – a function of legal and illegal user fees [16,55,56] and health-insurance coverage [57,58]. Future research needs to identify interventions that are effective in reducing the main barriers to willingness and ability to access ART [50,59]. In addition, it will be an important research agenda for social scientists to investigate in different communities the long-term effect of ART on

Figure 3. Percentage of men aged 15–49 years who received an HIV test result within the past 12 months in sub-Saharan African countries.



beliefs regarding the HIV epidemic [60] and ART itself, risk behavior [61], HIV-related stigma and the political power of people living with HIV [62].

ART supply

How to ensure equitable access to ART in the short term?

As long as resources are insufficient to achieve universal ART coverage, health systems will need to prioritize the treatment of certain people over the treatment of others. Different countries have taken very different routes to prioritizing patients for treatment. For example, Malawi organized public hearings and radio phone-ins in order to elicit public perceptions on the social eligibility for free ART. Participants identified certain population groups as more deserving of free ART (e.g., members of HIV advocacy groups, people who had publicly disclosed their HIV-positive status, physicians and teachers) or less deserving (e.g., commercial sex workers), but eventually the central government decided on a first-come, first-serve process to select patients for ART [63,64].

The question of whether access to ART is currently equitable and how it can be made more equitable in the future can be approached from two perspectives. First, the procedural fairness of the decision-making process that led to the current prioritization mechanism can be assessed. Norman Daniels identifies four conditions of fairness of process in deciding who should receive ART – publicity, relevance of the reasons considered, revisability and enforcement of the decision [65,66]. Have those or similar conditions been met in current ART programs? How can a fair process of deciding who to prioritize for ART be ensured in the future?

Second, the distributive goals and consequences of ART programs can be examined according to substantive principles of justice [67]. Do ART programs aim to maximize the total health gain from ART (a utilitarian goal), prioritize those who are sickest (a maximin goal [68]), prioritize those who have contributed to our knowledge of HIV/AIDS and ART, such as people who have participated in ART, AIDS vaccine or microbicide trials (justice as compensation [69]), or try to ensure that all groups of people in need of ART have equal access (an egalitarian goal)? Decisions that will have distributive consequences include medical eligibility criteria, decisions where to initiate patients on ART and where to monitor their treatment [70], as well as explicit rules for who should be first to receive ART [67]. Future research needs to assess the distributive consequences of decisions that are taken by policy makers, ART program managers and health workers on an ongoing basis and help set up systems to aid them in assessing the implications of their decisions for equity of access. Will access to ART become more equitable if those with CD4 counts below 50 cells/ml receive ART more quickly than those with higher CD4 counts? What are the distributive consequences of moving the CD4-count threshold for ART initiation from 200 to 350 cells/ml? Which community health centers should be selected as down-referral sites from a hospital in order to ensure equity of access? Should ART programs prioritize access to certain social groups, for example, based on a maximin goal to ensure care for the most vulnerable (e.g., orphans), a utilitarian goal to minimize the number of AIDS orphans (mothers with HIV), a utilitarian goal to maximize health (e.g., health workers), or a utilitarian goal to maximize social welfare (e.g., teachers)?

How to achieve universal access to ART in the long term?

The provision of ART needs a number of functions – finance, planning (strategic and operational) and management (of human resources, supplies, facilities, infrastructure, data) – and inputs (human resources, facilities, cars, drugs, laboratory tests). The experiences of the first years of scaling-up ART has shown that some of the necessary functions to provide access to ART are more easily fulfilled and some inputs are more easily obtained than others [16,71,72,202]. The following four lessons learned are starting points for a health systems research agenda for coming years.

First, human resources are the binding constraint to scaling-up ART in many developing countries [71–78]. By one estimate, in order to treat the approximately 3.6 million people in sub-Saharan Africa who in December 2006 needed ART, but did not receive it, the stock of health workers in sub-Saharan Africa would have had to be increased by 3600 to 7200 doctors, 7200 to 25,200 nurses, and 3600 to 10,800 pharmacists [79]. As there is positive feedback between the number of health workers needed to achieve universal ART coverage and the number of health workers who currently work in ART programs – because through ART provision health workers prolong the lives of people needing ART – it may be difficult to completely fill the gap in the long run [80].

There are two approaches to address the current HIV/AIDS health workers shortage. On the one hand, the density of health workers could be increased by increasing education rates or decreasing emigration rates from developing to developed countries [81–83]. Research into options to increase the number of HIV/AIDS health workers includes studies investigating scholarships that commit health workers in training to service in public ART programs after graduation [79] and studies investigating reasons for emigration [84,85]. On the other hand, changes in the organization of HIV care could reduce the need for highly skilled health workers to provide ART to a fixed number of patients. No standard human resources model for HIV care in developing countries has emerged. In fact, the composition and number of health workers caring for 1000 ART patients differ widely across settings [86]. It has been suggested that tasks traditionally performed by doctors in delivering ART could be shifted to nurses [87], and tasks traditionally performed by nurses could be delegated to community health workers, nursing assistants or treatment counselors [88–90]. Future clinical trials and evaluations need to investigate the effectiveness, cost–effectiveness, acceptability and impact on equity of different strategies to decrease the need for highly skilled health workers in the delivery of ART, including task-shifting, technological advances (such as telemedicine [91,92] and teleconferencing [93]), treatment support systems, and simplification and standardization of care using treatment algorithms, guidelines and clinical pathways [94].

Second, many ART programs in developing countries have been struggling to establish and maintain systems to collect, store, retrieve and update patient data over repeated visits [95]. These difficulties need to be overcome quickly to ensure the success of ART at the individual, the programmatic and the political level. At the individual level, the “longitudinality” [96] of ART requires longitudinal information to ensure treatment success. In order for patients to realize the full mortality and morbidity benefits of ART, treatment adherence needs to be near-perfect and retention in care needs to be lifelong [97–99]. The rate of virological failure increases steeply with slight decreases in adherence (e.g., in one study, from 22 to 61 cases per 100 person-years when adherence falls from 95–100% to 80–94.9% of all prescribed pills taken [100]), and adherence is an important predictor of progression to both AIDS and death among ART patients [101–103].

Studies of adherence in sub-Saharan Africa have found better levels than in the USA [104]. Initial studies of retention in ART programs in developing countries have reported varying but often substantial losses to follow-up [105] (e.g., fewer than 3, 17 and 43 losses to follow-up in 100 person-years in programs in Mozambique [106], French Guiana [107] and Kenya [108], respectively). However, most patients included in studies of retention and adherence in developing countries to date have been on ART for only a few years at most, and the sites where the studies have taken place are usually sites with a high degree of external involvement, for example from the Sant'Egidio (an Italian faith-based organization) [106], the French Ministry of Health [107], the German Agency for Technical Cooperation and Development [108] or PEPFAR [109]. Healthcare providers who work with patients who have been on treatment for many years in programs with little external support need to be able to routinely monitor retention and adherence amongst their patients in order to identify patients in need of special support. Longitudinal clinical information systems need to be in place for such monitoring.

At the programmatic level, information systems that are able to track patient flows over time and space can provide health systems researchers and planners the information necessary to design effective interventions to ensure retention and adherence. For example, in communities with high levels of out-migration, retention on ART may improve if patients are allowed to keep copies of their patient records and are able to select providers in migration destinations. In communities with high levels of circular migration, on the other hand, retention in care may be improved if providers know about migration plans ahead of time and can adjust the scheduling of drug supply and follow-up visits to accommodate longer periods of absence.

Finally, at the political level, the willingness of international donors to continue their substantial support for ART programs worldwide will depend in part on programs demonstrating success in intermediate outcomes (such as enrolment and retention) and final outcomes (such as reductions in morbidity and mortality) [16] – a task that cannot be achieved without effective systems to collect patient data over time. In the coming years, information technology experts and clinicians need to continue to develop medical information systems that can be easily implemented in resource-limited settings [95,110], and best practices of already existing systems need to be disseminated and adapted to different contexts [111,112].

Third, it is especially difficult to improve ART access for children. In many developing countries, ART coverage among children is currently lower than ART coverage among adults [113]. Since most children are infected through mother-to-child transmission (MTCT) during pregnancy, delivery or breastfeeding, the HIV epidemic among children is a reflection of the lack of access of pregnant women to effective prevention services. Access to MTCT prevention interventions in developing countries has been reviewed elsewhere [114–117]. Infected children depend on adult carers, usually their mothers, to bring them to a site of ART delivery, and thus face similar demand-side barriers to ART access as their carers. However, children face additional barriers to access ART because appropriate technologies for their care are not as widely available as for adults [118].

A first problem is that children under the age of 18 months can carry transplacentally transferred maternal HIV antibodies in their blood, so that standard serological assays cannot be used for definitive diagnosis of HIV in this age group. Instead, nucleic acid tests need to be used to detect viral RNA or DNA [119]. These tests are not available for routine use in many developing countries because they are expensive and depend on extensive laboratory infrastructure [120,121].

A second problem is that pediatric formulations are not available for a number of antiretroviral agents, requiring caretakers to break or crush adult-size tablets, leading to erratic dosing. Liquid formulations, on the other hand, which make incremental dosing easy, commonly have a bad taste and may be very voluminous or require cold storage, rendering their use impractical [118].

A third problem is that health workers in ART programs are commonly not as well trained in pediatric HIV care as they are in adult care [122]. Health-services researchers need to work closely with clinicians and laboratory scientists to find technical solutions to the barriers to pediatric HIV diagnosis and treatment that cannot be rapidly scaled-up in developing countries. In addition, they need to transfer the knowledge gained from teaching adult HIV care to health workers in resource-constrained settings to pediatric HIV care in order to create effective and efficient training programs.

Fourth, it is especially difficult to scale-up ART coverage in rural areas. For one, in most rural areas, population density is lower and the means of transportation are more limited than in urban areas. In order to make ART accessible to rural populations, treatment must thus be offered in many small, dispersed clinics, rather than in a few large hospitals. Some of the inputs into the production of antiretroviral care (e.g., laboratories and pharmacies) can – even at their minimum size – provide a necessary service for much larger numbers of ART patients than usually attend one peripheral clinic. Services that depend on these inputs can thus not be as efficiently provided in rural areas as in cities. Either the inputs are established in many small clinics, where they will likely operate below their optimum capacity, or they are established only in a few central places, in which case the transportation costs of supplying the services to end users will be high.

In addition, health workers commonly find rural areas less attractive places to work than cities, because rural areas offer fewer opportunities for further specialization and career progression, are more likely to suffer from shortages of essential medicines and lack of access to specialist services, and are less likely to have good schools for children and work opportunities for spouses [123–125].

Finally, general infrastructure (such as water and sanitation, transportation, electricity and communication technology) that can improve the efficiency of ART delivery is often lacking in rural areas [126].

In the next years, operations researchers [16] and management scientists could aid the scale-up of ART by improving the placement of healthcare clinics [53] and the supply systems to peripheral healthcare facilities (e.g., by optimizing transportation schedules); human-resources scientists could inform policies to increase the attractiveness of rural areas for health workers (e.g., by devising attractive career paths for rural health workers); and, in the absence of broader infrastructural improvements, engineers could help overcome some of the technical problems in the delivery of ART in resource-limited areas (e.g., by developing low-cost CD4-count technologies) [127].

Further to the research questions arising from the four lessons learned regarding difficulties in scaling up ART in developing countries, future health systems research must address a number of other pressing issues, including the relationship between ART programs and the overall health system and the long-term financing of ART.

The impact of the large-scale supply of ART on the healthcare system is currently unclear. On the one hand, it seems plausible that the scale-up of ART improves the performance of the overall healthcare system. In countries with generalized epidemics, large proportions of in- and out-patient admissions in the general health services are related to HIV [128–130]. ART decreases healthcare utilization amongst HIV-positive people [131]. Thus, an expansion of ART access will free up healthcare capacity to treat diseases that are not HIV-related. Moreover, in real-life ART programs, HIV-positive patients commonly receive not only ART but also treatment for a range of HIV-related and HIV-unrelated diseases, thus freeing up further healthcare capacity in the general healthcare system [79]. On the other hand, it has been suggested that ART programs crowd out the delivery of other health services, because rather than increasing the overall capacity for care, they shift capacity, especially human resources, from the overall health system to ART delivery. Future research must investigate the impact of ART programs on health systems in developing countries and suggest ways to maximize the beneficial and minimize the harmful effects. Research must also analyze how far ART programs should be integrated into the overall health systems of developing countries [77,88,89].

Once a patient has been initiated on ART, treatment must be lifelong (except in some rare cases of second- and third-line treatment failures). Thus, finance for ART must continue for tens of years. While current commitments to finance HIV care in developing countries are relatively long, they fall far short of the long-term commitment needed to ensure that current and future patients on ART will continue receiving treatment over their lifespans. A number of financing mechanisms that have not previously been employed in international aid have been suggested for ART finance. These include a tax on airline tickets proposed by the French government [90] and the International Finance Facility proposed by the UK's Department for International Development. The International Finance Facility would leverage development aid by issuing bonds on international capital markets against long-term commitments of annual payments from developed countries to developing countries [132]. Financial economists need to establish whether such mechanisms are feasible and whether ART programs pass basic tests for public investment in developing countries [133].

Conclusion

While there is initial scientific evidence on a number of key issues in access to ART in developing countries, intensive research is needed in the coming decade if universal ART access is to be achieved. Important areas for future health systems research include ART need (to improve estimation and measurement of ART need and use), HIV status knowledge (to evaluate the performance of provider-initiated approaches to

HIV testing), ART knowledge (to increase knowledge of existence, effectiveness and availability of ART), willingness to access ART (to identify, design and evaluate interventions to decrease individual and community barriers to access, including correcting beliefs regarding alternative therapies and reducing stigma), ability to access ART (to identify, design and evaluate interventions to decrease health systems barriers to access, including travel times and user fees), ART supply (to achieve equitable access to ART in the short-term by improving the fairness of procedures and distributive consequences of prioritization for treatment and to achieve universal access in the long-term by narrowing the human-resources gap; improving data-collection systems; improving pediatric HIV care; decreasing obstacles to scaling up ART in rural areas, such as inadequate supply systems, insufficient human resources and deficient general infrastructure; optimizing the integration of ART into the overall health system; and attaining long-term financing for ART in developing countries).

Executive summary

- One way to analyze access to antiretroviral therapy (ART) in the developing world is to start with ART need, which is translated into latent demand by knowledge and willingness to access ART. Latent demand, in turn, is translated into expressed demand by the ability to access ART. Expressed demand results in ART use if it can be satisfied with ART supply.
- Estimates of ART need in developing countries are based on models with a limited number of input variables, the values of which are usually not accurately known. Models to measure and predict ART need must thus be validated in different settings, and the accuracy of their inputs must be improved.
- The dominant model of HIV testing in the past 25 years, voluntary counseling and testing, may be an obstacle to universal knowledge of HIV status because it has to be initiated by the client and because its main characteristics (counseling, informed consent and anonymity) make it difficult to scale-up. Future research needs to accompany the roll-out of alternative testing strategies, such as a provider-initiated 'opt-out' and 'opt-in' testing, to investigate their effectiveness, cost–effectiveness and ability to protect HIV-positive people from stigma and abuse.
- Initial studies suggest that large proportions of people in developing countries do not know that ART exists or where to access it. Further research is needed to investigate the determinants of ART knowledge in order to inform the design of information and education campaigns to achieve universal ART knowledge.
- Barriers to latent demand for ART include negative attitudes towards providers of ART, fellow patients and ART facilities, and beliefs regarding alternative therapies. Barriers to expressed demand include long travel times to ART services, user fees and lack of insurance coverage. Interventions are needed to eliminate these barriers.
- As long as resources are insufficient to achieve universal ART coverage, health systems will need to prioritize the treatment of certain people over the treatment of others. The question of whether current prioritizations are equitable can be approached from perspectives of procedural fairness and distributive consequences. Ethicists need to support policy makers in improving fairness of access to ART.
- A first lesson learned from the experiences of the large-scale roll-out of ART in developing countries in the past years is that human resources are the binding constraint to the scale-up of ART in many settings. The human resources gap may be narrowed by interventions that increase health-worker education or decrease emigration, or by decreasing the need for highly skilled health workers through task-shifting, technological advances, and simplification and standardization of care.
- A second lesson learned is that it is difficult, but necessary, to establish and maintain systems to collect and update ART patient data over repeated visits. Information technology experts and clinicians need to continue to develop medical information systems that can be easily implemented in resource-limited settings, and best practices of systems need to be disseminated and adapted to different contexts.
- A third lesson learned is that it is difficult to improve ART access for children. Health-services researchers need to work with clinicians and laboratory scientists to develop pediatric HIV-testing technologies and drug formulations that can be easily scaled-up in resource-limited settings.
- A fourth lesson learned is that obstacles to ART scale-up are especially difficult to overcome in rural areas. Operations researchers and management scientists can support the rural scale-up of ART by improving the placement of clinics and the design of rural supply systems; human-resources experts can inform policies to increase the attractiveness of rural areas for health workers; the lack of essential infrastructure for delivering ART in rural areas may be overcome by investment or technological advances. Further research questions on the way to universal ART access include how to integrate ART programs into the overall health systems of developing countries and how to secure long-term financing of ART.

Future perspective

Health systems research will play a crucial role in the international efforts to achieve universal access to ART in the developing world in the coming decade, just as clinical research played a crucial role in the first years of ART roll-out [134]. The large-scale expansion of HIV care in developing countries has happened to a large extent without strong evidence as to the relative performance of different models of ART provision in different contexts. health systems researchers are now tasked to evaluate, compare and suggest improvements to the different existing models of ART provision. The scope and speed of change in access to ART will change the field of health systems research. First, researchers will increasingly incorporate research techniques from other fields, such as action research, implementation research, operations research and case studies, to investigate alternative models of ART delivery. Second, health systems researchers will learn how to produce and disseminate results more quickly and broadly, so that the ongoing scale-up of ART can take their findings into account without long lag times. Third, in order to produce timely results, researchers will learn to better anticipate possible changes and test them on a small scale before their implementation on a larger scale. Whether or not (near) universal access will be achieved lies outside the sphere of influence of health systems researchers. However, it seems unlikely that without sound evidence generated by research and acted upon by policy makers, universal ART access can be achieved and sustained.

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