mortality in patients with HIV, such that deaths in these patients are more often than not non-AIDS related. In this context, low CD4 to CD8 ratios in individuals previously treated with ART and with undetectable plasma viral loads were independently associated with T-cell activation and with markers of age-associated diseases, such as carotid intima–media thickness, arterial stiffness, estimated glomerular filtration rate, muscle wasting, and sarcopenia.[7] However, the possible role of the CD4 to CD8 ratio in predicting hard endpoints, such as mortality, in patients with virological suppression who have previously been treated is still debated.

Although many cohort studies[8] have shown an association between this marker and either AIDS or non-AIDS events, an analysis from the ART-CC Collaboration in 2017 did not report such findings.[9] Cohort studies are probably not the perfect setting for investigation of this association. Evidence suggests that, at least in some cases, continuous quantitative, qualitative, and functional defects in the CD8 cell population could be reversed with early treatment.[9] Therefore, given that START is a prospective trial of early treatment and the results are not affected by selection bias, continued observation of the cohort is fundamental to establish whether persistence of a ratio below 1 (with elevated CD8 cell counts) is an immunologically high-risk phenotype that warrants a different therapeutic and clinical approach.

Results from trials such as START and HPTN052 have definitively changed the paradigm of when to start combination ART in patients with HIV.[10,11] The benefits of combination ART, including prevention of events in individuals and protection from transmission, has led WHO to recommend that combination ART be initiated in all HIV-positive people, regardless of CD4 count.[12] This fundamental change in guidelines is challenged by the problem of poor access to ART, especially in middle-income and low-income countries. However, Molina and colleagues' subanalysis of the START trial has helped to identify subgroups of patients who should be prioritised for treatment, especially in low-resource settings.

Cristina Mussini, Andrea Cossarizza
Clinic of Infectious Diseases (CM), University of Modena and Reggio Emilia School of Medicine (AC), Modena 41124, Italy
cristina.mussini@unimore.it

We declare no competing interests.

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Migration patterns and HIV prevention in Uganda

Published Online
February 25, 2018
http://dx.doi.org/10.1016/S2352-3018(18)30023-7

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The number of international migrants worldwide has grown rapidly in recent years, reaching 258 million in 2017.[1] Migration is inextricably linked to HIV risk (ie, individual factors) and vulnerability (ie, structural factors), particularly in sub-Saharan Africa. Migration increases HIV risk by disrupting social and sexual networks. Migrants are often separated from their spouses and families, and they may struggle with language barriers, different social and cultural norms, difficult housing conditions, reduced social and work protection, and restricted access to HIV prevention, treatment, and care services.[2] Although combination

prevention has been effective in reducing HIV infections globally,[3] findings from the Rakai Community Cohort Study (RCCS) by Olawore and colleagues,[4] published in *The Lancet HIV*, show that some groups of migrants may be excluded from combination prevention strategies.

The RCCS took place in Uganda, one of the countries worldwide with the most refugees and displaced people.[1] It is the first study to use population-based data longitudinally to assess the time at which migrants have the highest risk of acquiring HIV. The study's strengths lie in its scale (ie, more than 15 000 in-migrants and out-migrants were surveyed in 30 communities) and its longitudinal design (ie, from 1999 to 2015). The study design allowed the timing of HIV acquisition in the migration trajectory and the effects of combination prevention on HIV acquisition to be identified. The design did not, however, allow full explanation of the causal pathways between migration and HIV acquisition and its underlying mechanisms.

Olawore and colleagues found that HIV incidence was highest in the first 2 years after migrating into the study area, irrespective of sex. Compared with permanent residents, recent migrants also had a higher prevalence of sexual risk behaviours. HIV incidence remained persistently high among recent in-migrants, whereas it declined significantly among residents (both sexes) and settled migrant men. These findings suggests that during the first 2 years after migration, migrants did not benefit from the scale-up of combination HIV prevention.

The RCCS adds to the increasing body of evidence on HIV acquisition after migration.[5,6] This knowledge is highly relevant for public health, because it shifts our focus back to primary prevention. Importantly, the study also tested the hypothesis that individuals who migrate have higher risks of HIV because of destabilised social networks affecting individuals' HIV risk environments. The study provides partial evidence for this hypothesis. Research on refugees' mental health also highlighted the role of displacement-related stressors in migrants' social ecology, corroborating this result.[7] From a policy and human rights perspective, the findings provide important evidence-based arguments against stigmatising and xenophobic discourses implying that the primary reason HIV-positive individuals migrate is to seek HIV treatment.

The study also delivers local epidemiological information about mobile individuals, which is needed for prevention planning on the basis of recent migrants' mobility patterns, their partner characteristics, and transmission hotspots.[8]

As Olawore and colleagues rightly state, their findings may not be generalisable to other migration settings and mobile groups. With only 1% of the study population immigrating from outside Uganda, and 32% of the participating women and 42% of the men having migrated from more than 30 km from their places of origin, the described differences in HIV-related outcomes might be surprising. However, even short-distance migration confers additional risk of HIV acquisition.[9]

This finding warrants further investigation to better understand the specific migration-related dynamics that occur as part of broader social processes, which seem to diminish the effects of combination prevention. The study design, although longitudinal, does not allow for exploration of the underlying mechanisms. Qualitative research methods are still underused and possibly devalued in epidemiological public health research, particularly if a community-based participatory approach is used.[10] Complementing longitudinal epidemiological data with longitudinal qualitative data could provide useful insights into the socially and culturally constructed meaning of multi-level factors driving HIV risk in the context of migration. Mixing both research methods would allow us to not only establish the degree of risk, as done in this study, but also explore the underlying reasons.[11] Lessons from studying HIV acquisition after migration among sub-Saharan African migrants in Europe[12,13] could guide this process, while researchers in Europe could learn from the African experience. Insights into why such changes occur would give prevention planners information to develop interventions tailored to the needs of all groups of migrants, ensuring that nobody is left behind in the area of combination prevention.

Christiana Nöstlinger, Jasna Loos
Department of Public Health, Institute of Tropical Medicine, Antwerp 2000, Belgium
cnoestlinger@itg.be

We declare no competing interests.

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Ending AIDS by 2030: catchy slogan or sincere goal?

Published Online
March 11, 2018
http://dx.doi.org/10.1016/S2352-3018(18)30041-9

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The target of reducing HIV incidence by 90% by 2030, the designated benchmark for Ending AIDS by 2030, will not be reached. The road we are heading on does not go there. This is the inevitable conclusion one must draw from the findings by Sherrie Kelly and colleagues[1] in *The Lancet HIV*, if their results are valid.

But are their results valid? Judged by standard criteria,[2] they seem to be. The structure of their model has face validity, the inputs are accurate manifestations of existing evidence, and the model's output matches other observations a large portion of the time and across a wide range of countries and epidemiological contexts. No simple statistical test of a model's overall validity exists, so the relevant question is whether decisions made by use of the model would lead to better outcomes than those made otherwise.[3] We can be confident that the answer is yes. Furthermore, the results converge with the observation that few countries are on track to achieve the 90-90-90 target by 2020[4] and are broadly consistent with those from other entirely separate modelling work.[5–7] If the results are valid, spending would need to be tripled (from US$12·8 billion to $40 billion per year) and optimised. Indeed, without optimisation, the necessary spending to achieve this goal would probably top $52 billion per year, an even heavier lift.

Optimisation means figuring out how resources can be allocated most efficiently so as to deliver the most health. Accordingly, Kelly and colleagues sought to identify a scenario in which reallocating funds from one programme to another would no longer improve health, as indexed by HIV incidence. Their results suggest that intra-country optimisation would decrease HIV infections by 26% (uncertainty range 13–50%), corresponding to about 7·4 million infections averted, and would be startlingly simple. More than 90% of that health benefit would be achieved by reallocating funds towards only two or three types of programmes: antiretroviral therapy, prevention of mother-to-child transmission, and HIV testing, only if budgets increase. Reallocating funds between countries makes a comparatively small difference. The authors note that a short-term boost in voluntary medical male circumcision might have also been part of optimisation if their approach had allowed consideration of time-varying expenditures. Their optimisation results are a quantitative embodiment of a straightforward idea: do more of what we know works, and do less of what we are less sure about. Spend more on treating and testing, and by extrapolation, more on improving adherence and tightening the care continuum, particularly in key populations. Although not explicitly stated by the authors, these funds must be spent on cost-effective interventions, meaning that they would deliver more health than if those funds were spent on simultaneously resource-constrained alternative interventions.

Increasing spending is never easy because competing priorities always exist. The authors suggest that