Where are the deficiencies in care?

***Aim:***

*What is the contribution of each stage of care on overall DALYs / mortality?*

*The interventions we have designed to intervene along HIV care may have an attentuated impact due to upstream / downstream weaknesses in care. For example, we have a powerful ART Outreach intervention that brings back 100% of people lost from care, yet it doesn’t have a huge impact on DALYs averted in the model, this is due to the small proportion of individuals that ever initiate ART due to upstream leaks in care at baseline. I want to understand how important each “stage” of care is, by making care “perfect” and then systematically walking through each stage and “weakening” it (using the baseline values from AMPATH), while keeping all other aspects of care perfect to visualise the impact on DALYs and mortality.*

**Method:**

1. *Create a “perfect care” scenario, in which everyone, upon getting infected, immediately gets tested, linked, retained in pre-ART care and initiates ART as soon as they become eligible, all adhere to ART and there is zero dropout.*
2. *In the absence of interventions, test the contribution of each “stage” of care on DALYs accrued and mortality. For example, for testing pre-ART retention: set pre-ART retention parameters to “baseline” levels, allow care upstream and downstream to be perfect.*
3. *Test the impact of our interventions on each “stage” of care on DALYs accrued and mortality. For example, again for testing pre-ART retention: with pre-ART retention parameters at “baseline” levels (care upstream and downtream perfect), test the impact of the pre-ART outreach intervention on reducing DALYs accrued and mortality.*

# Results

***“Perfect Care”***

Baseline= 1,874,647 DALYs accrued between 2010 and 2030.

*This scenario was created by doing the following:*

* Individuals get an HIV-test the very day they become infected (if time >= 2004, when testing starts)
* The mean time to seeking care through VCT / PICT is 1 day, so people seek care all the time.
* All tested individuals are linked to care.
* Once linked, all individuals receive a CD4 test, none are lost from care
* Receive the CD4 test result the very next day (on average).
* If not eligible, the follow-up test is the next day. (PICT / VCT rates are competing here so everyone is seeking care all the time).
* If eligible, start ART the next day.
* 100% adherence to ART
* 0% dropout from ART.

This scenario was created in an attempt to understand “if HIV care is perfect, no leaks, immediate testing and treatment, whats the cost in terms of DALYs accrued and mortality?”

**Contribution of each stage of care to DALYs accrued and mortality**

Starting with our “perfect care” scenario, I split care into 5 discrete stages:

***Normal HIV-Testing*** *–* all care downstream is perfect but HIV-testing rates are set to baseline levels.

***Normal Linkage*** *–* HIV-testing is perfect, linkage is set to baseline levels and all care downstream is perfect

***Normal Pre-ART Retention*** *–* HIV-testing and linkage is perfect, pre-ART retention levels are set to baseline with ART retention and adherence perfect

***Normal ART Retention*** *–* HIV-testing, linkage and pre-ART retention are perfect, ART adherence is perfect too but patients can dropout of ART care.

***Normal ART Adherence*** *–* HIV-testing, linkage, pre-ART and ART retention are perfect but adherence to ART is set to baseline levels.

I first look at impact in terms of DALYs, by subtracting the DALYs that accrue between 2010 and 2030 in the “perfect care” scenario from the DALYs that accrue when I test each of the 5 stages, I arrive at the “additional DALYs that accrue due to imperfect care between 2010 and 2030” for each stage. The results are shown in the black bars on figure 1. The longer the bar, the more detrimental the impact a particular stage has on care.

We instantly see that baseline linkage has little effect on additional DALYs that accrue over 20 years. I think this might be slightly misleading as “perfect HIV-testing” implies that people are seeking care very quickly / all the time. So while linkage rates may be low, people just keep re-appearing and attempting to link to care so the overall impact of a low linkage rate here is reduced.

By testing the impact of our interventions on each stage of care, I was able to show how the interventions reduce the amount of additional DALYs that accrue compared to “perfect care”. We see that the “realistic” scenario for our interventions reduce additional DALYs less than the “best possible” scenario – as we would expect.

A larger distance between the baseline bar and an intervention is indicative of a larger impact and more DALYs averted. We see that by far the intervention averting the most DALYs in a particular stage (while upstream/downstream care is perfect) is the ART Outreach intervention in the “Normal ART Retention” stage. With perfect upstream care, the ART Outreach intervention was able to avert 3,523,289 DALYs (baseline vs. best possible ART Outreach intervention). Further indicating that in a mature ART-programme with robust pre-ART care, interventions can be focused further downstream.

**Impact on mortality**

Looking at the impact of these scenarios on mortality, inparticular HIV-related deaths between 2010 and 2030 (figure 2). Looking at the HIV-related mortality in the “perfect care” scenario, we see that HIV-related deaths are very infrequent, 10% of those who die from HIV never initiate ART. This is entirely due to people dying before becoming eligible for treatment (I tested this by allowing everyone to be eligible and this fraction disappeared). The remainder of HIV-related deaths then occurs from individuals dying while on ART. Quite a few individuals are initiating ART late still (<200), at least initially this is due to eligibility criteria preventing treatment until CD4 <200 prior to 2011. Mortality pretty much tells the same story as figure 1, the largest gains in reducing mortality from a particular stage of care are from the ART Outreach intervention assuming upstream / downstream care is perfect.

jjo11:cascade:CareCascadeV2:December:18th:LeaksNew:plots:additionalDalysDueToImperfectCare.pdfjjo11:cascade:CareCascadeV2:December:18th:LeaksNew:plots:mortalityDueToImperfectCare.pdf

Figure 2.

Figure 1.