Testing Healthcare System Resilience Using Microsimulation Modeling Under Various Shocking Scenarios

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BACKGROUND

- People living with HIV (PLWH) have faced significant challenges from the COVID-19 pandemic and the illicit drug toxicity crisis.
- The resilience of healthcare systems—their capacity to anticipate, absorb, adapt to, and recover from those crises, is essential to support PLWH and promote healthy aging in this population.
- We used an individual-based microsimulation model to assess the resilience of healthcare system for PLWH in British Columbia (BC), facing those crises, compounded by migration and displacement due to war, political violence, and stigma.

METHODS

- We developed a microsimulation model to simulate transitions of PLWH in BC among different states: Active antiretroviral therapy (ART), Short-term/Long-term ART dispensing Interruption (18-months threshold), Outmigration, Drug Toxicity Death and Death due to Other Causes (Figure 1).
- The transition rates between states, stratified by age and sex, were estimated based on data collected from the Drug Treatment Program (DTP) in BC.
- The model simulated the trajectories of DTP participants alive by the end of 2014, and new DTP participants added by the end of each month, for the period of 2015-2033.

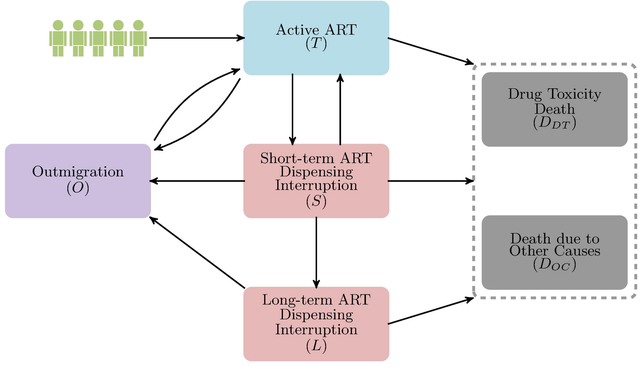


Figure 1. Model description.

It is imperative to integrate HIV care with other critical services like substance use support to prevent illegal drug toxicity deaths, particularly for aging populations.

Expansion of services to migrants, including tailored adherence support and seamless continuity of care, should be prioritized to stabilize ART retention in settings with significant population mobility.

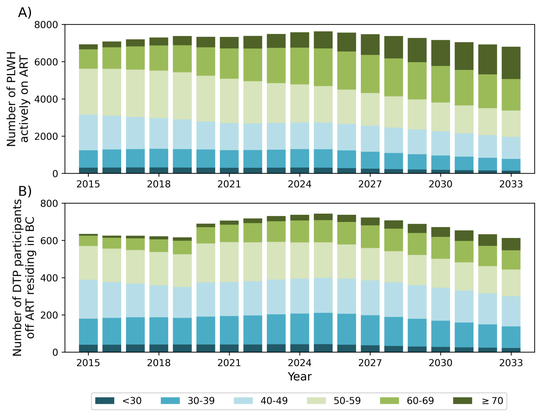


Figure 2. Number of PLWH actively on ART(A) and DTP participants off ART residing in BC (B) (2015-2033).

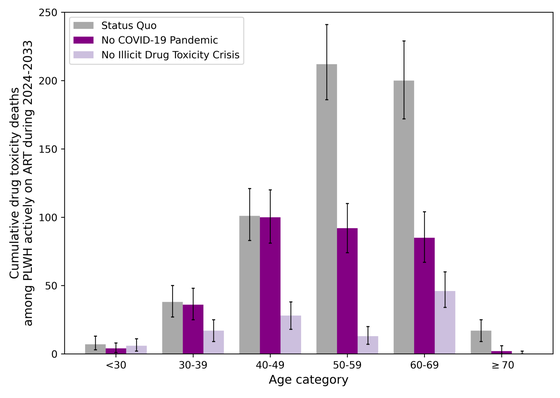


Figure 3. Cumulative drug toxicity deaths by age (2015-2033).

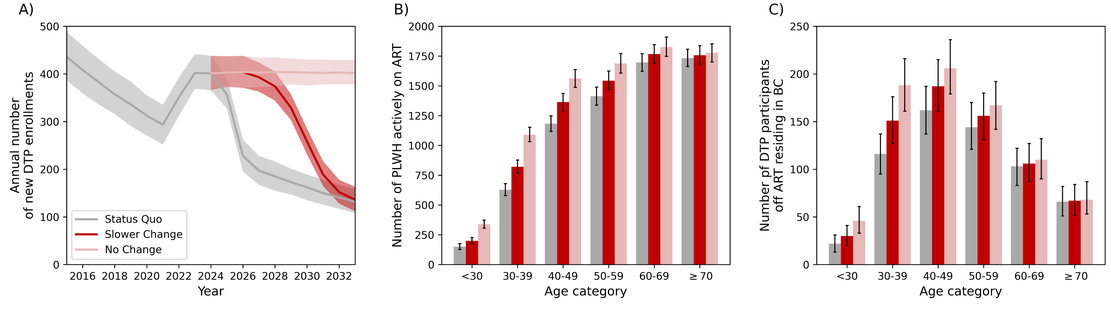


Figure 4. Impact of migration on DTP enrollment: annual new enrollments (A), PLWH actively on ART by 2033 (B), and DTP participants off ART residing in BC by 2033 (C).

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METHODS (continued)

- We assessed the effects of different scenarios compared with the Status Quo scenario where all parameters remained the same as those in 2023:
  - Diminishing/Sustained Impact of the COVID-19 Pandemic and Prolonged/Moderate Illicit Drug Toxicity Crisis;
  - Return to Pre-pandemic Levels;
  - Slower or No Change in Immigration Policies;
  - No COVID-19 Pandemic (since 2020)
  - No Illicit Drug Toxicity Crisis (since 2015)

RESULTS

- By 2033, individuals aged ≥70 were projected to increase to 1800 (1729–1878) from 774 (725–824) in 2023, accounted for about 24% of the DTP population (Figure 2).
- The cumulative number of drug toxicity deaths under the Status Quo scenario between 2024 and 2033 was projected at 574 (530–622) cases, representing a 79.7% (64.0–99.0%) increase over the scenario No COVID-19 Pandemic, 71.6% (67.8–75.3%) of which were among . older PLWH aged 50–69 (Figure 3).
- The model projected a 10–22% increase in the DTP population over the next decade under high-migration scenarios, with younger PLWH (ages <50) accounting for the majority of new enrollments (Figure 4).

CONCLUSIONS

- Integrating services to prevent drug toxicity deaths and age-appropriate healthcare into HIV care is crucial to build healthcare resilience for aging PLWH.
- Migration to BC emerged as a major factor influencing the PLWH population. Addressing the unique needs of migrant population should be prioritized to minimize treatment churn and sustain long-term ART retention.