

DYNAMIC MODELLING OF THE HIV CARE CASCADE IN THE UNITED STATES: WHERE ARE PEOPLE LEAVING THE CASCADE AND WHERE SHOULD WE INTERVENE?

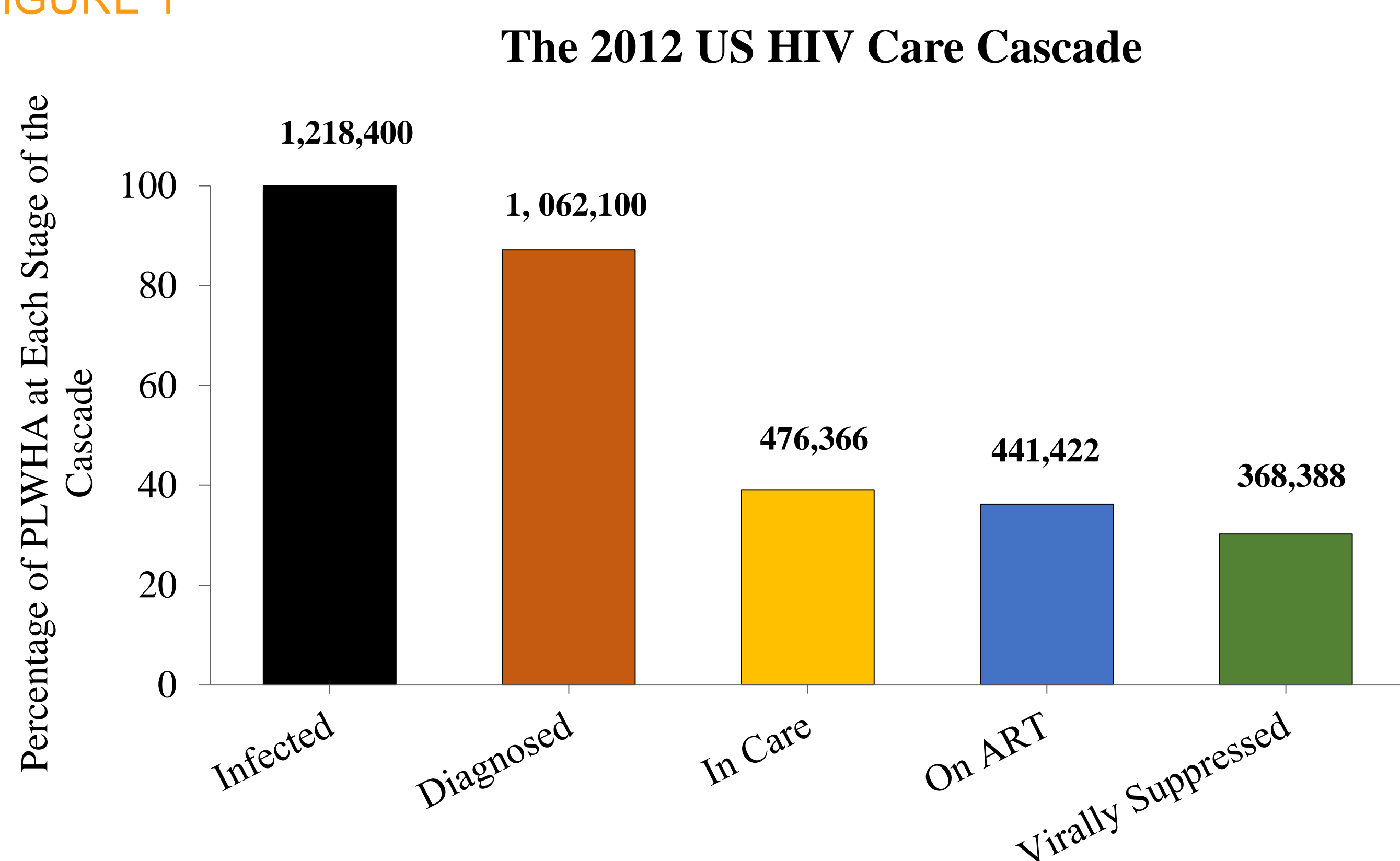
Feyi Fadero¹, Marie-Claude Boily^{1,2}, Kate M Mitchell^{1,2}

¹Department of Infectious Disease Epidemiology, St Mary's campus, ²HIV Prevention Trials Network Modelling Centre, St Mary's campus, Faculty of Medicine, Imperial College London, London, United Kingdom

BACKGROUND

- Only 30% of people living with HIV/AIDS (PLWHA) in the US are virally suppressed
- The US HIV care cascade shows that large numbers of PLWHA are not retained in care (Figure 1)
- However, the cascade assumes unidirectional progression and fails to capture cascade dis-engagement or re-engagement
- We used a dynamic model of the US care cascade to:
 - Identify weak points where most PLWHA disengage from the cascade
 - Evaluate the effects of targeted interventions

FIGURE 1

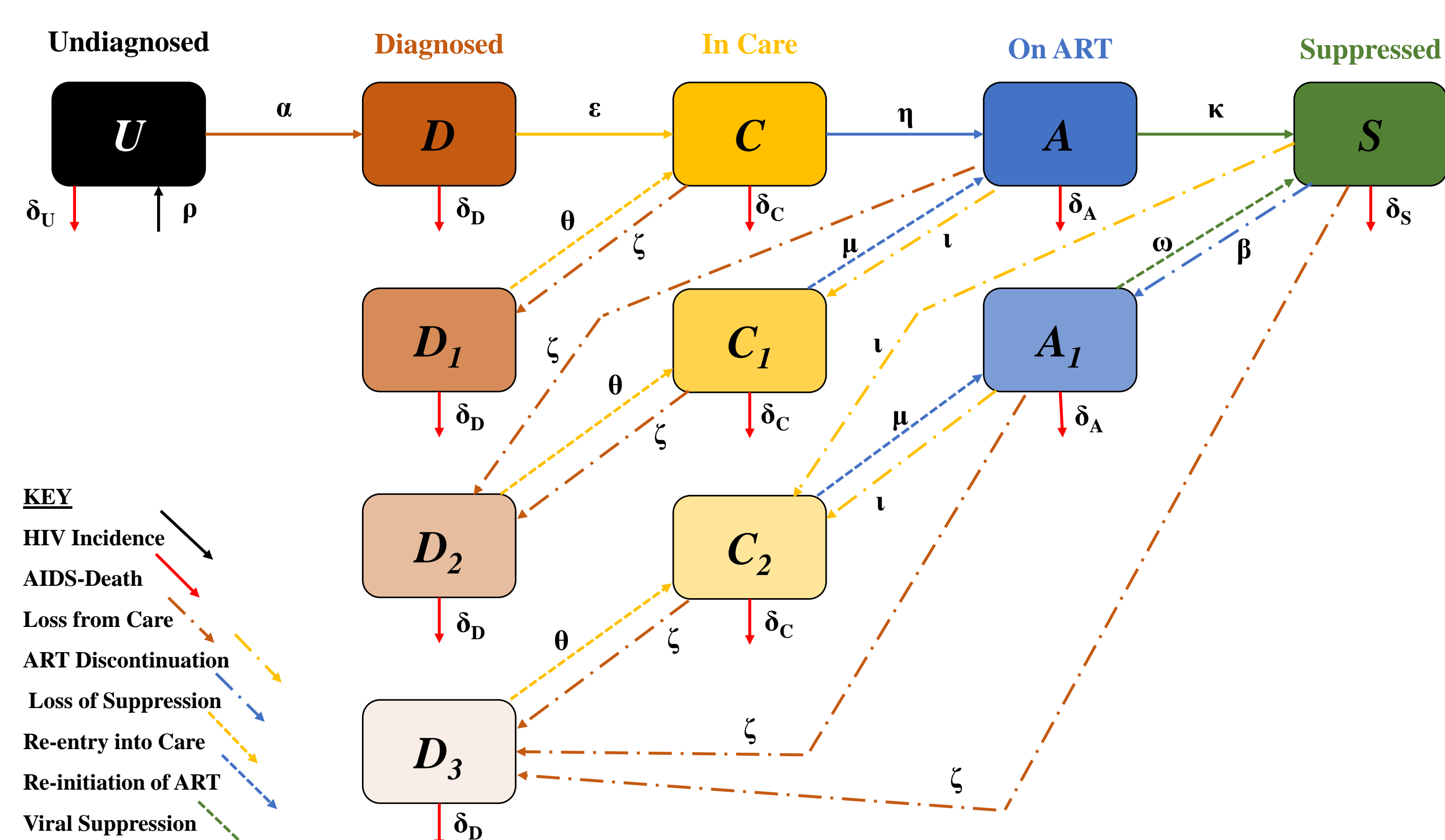


2012 US HIV care cascade, showing the percentage of PLWHA in the country at each step of the treatment cascade. Data from CDC¹

METHODS

- We developed a deterministic compartmental model of the HIV care cascade (Figure 2), based on the HIV States and Transitions framework put forward by Powers and Miller², which allows PLWHA to:
 - enter and leave care
 - initiate and discontinue antiretroviral therapy (ART)
 - achieve and lose viral suppression
- We modelled movement of PLWHA through the US HIV care cascade from 1995 until 2015
- The model was parameterised using published estimates of transition rates between different care cascade stages and calibrated to data from 1995-2012 on the number of people at each cascade stage
- We used the calibrated model to identify where most people are lost, and to assess the impact upon viral suppression of strengthening different parts of the cascade

FIGURE 2



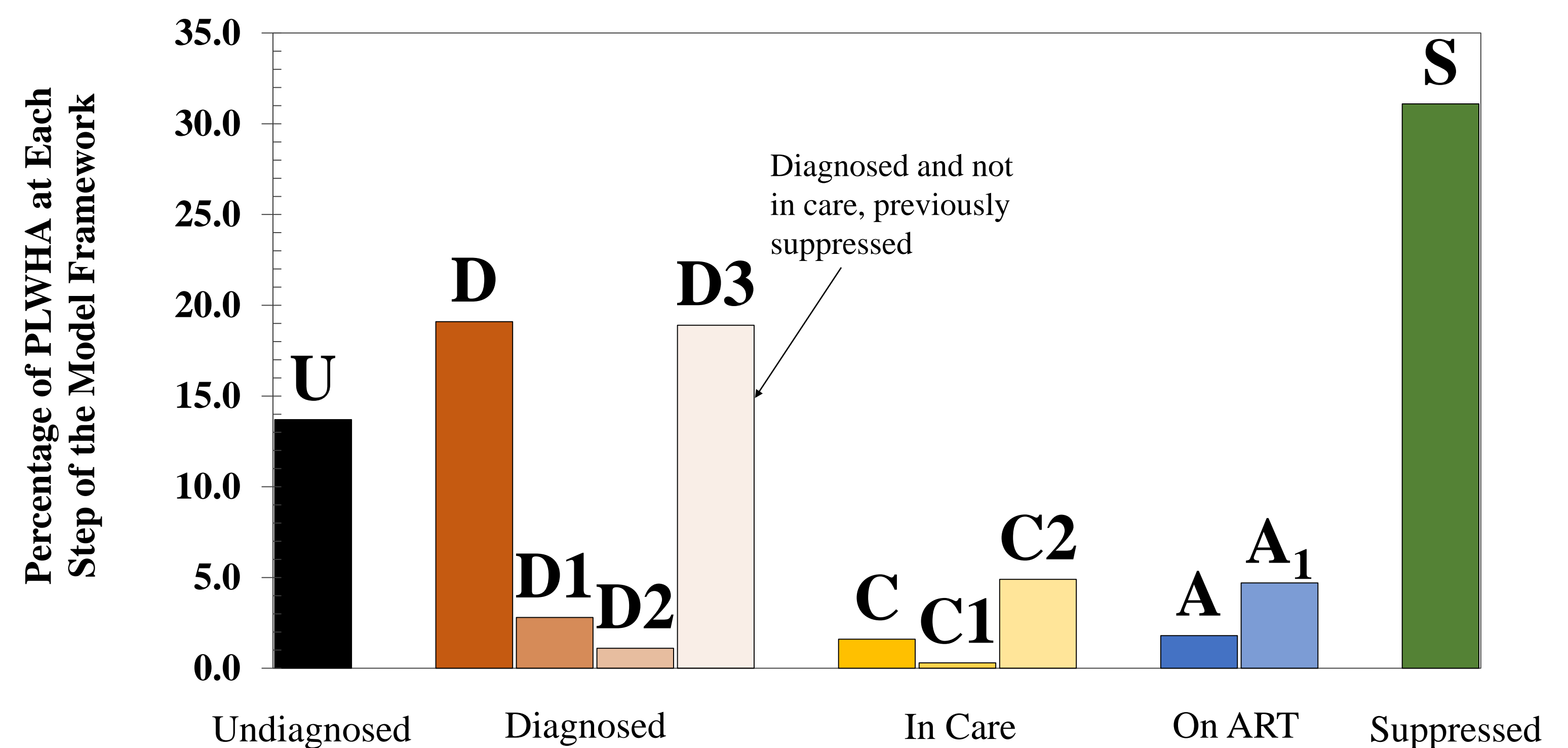
Structure of the compartmental model adapted from the "HIV States and Transitions" framework² to simulate the movement of PLWHA through the Care Cascade

ACKNOWLEDGEMENTS

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RESULTS

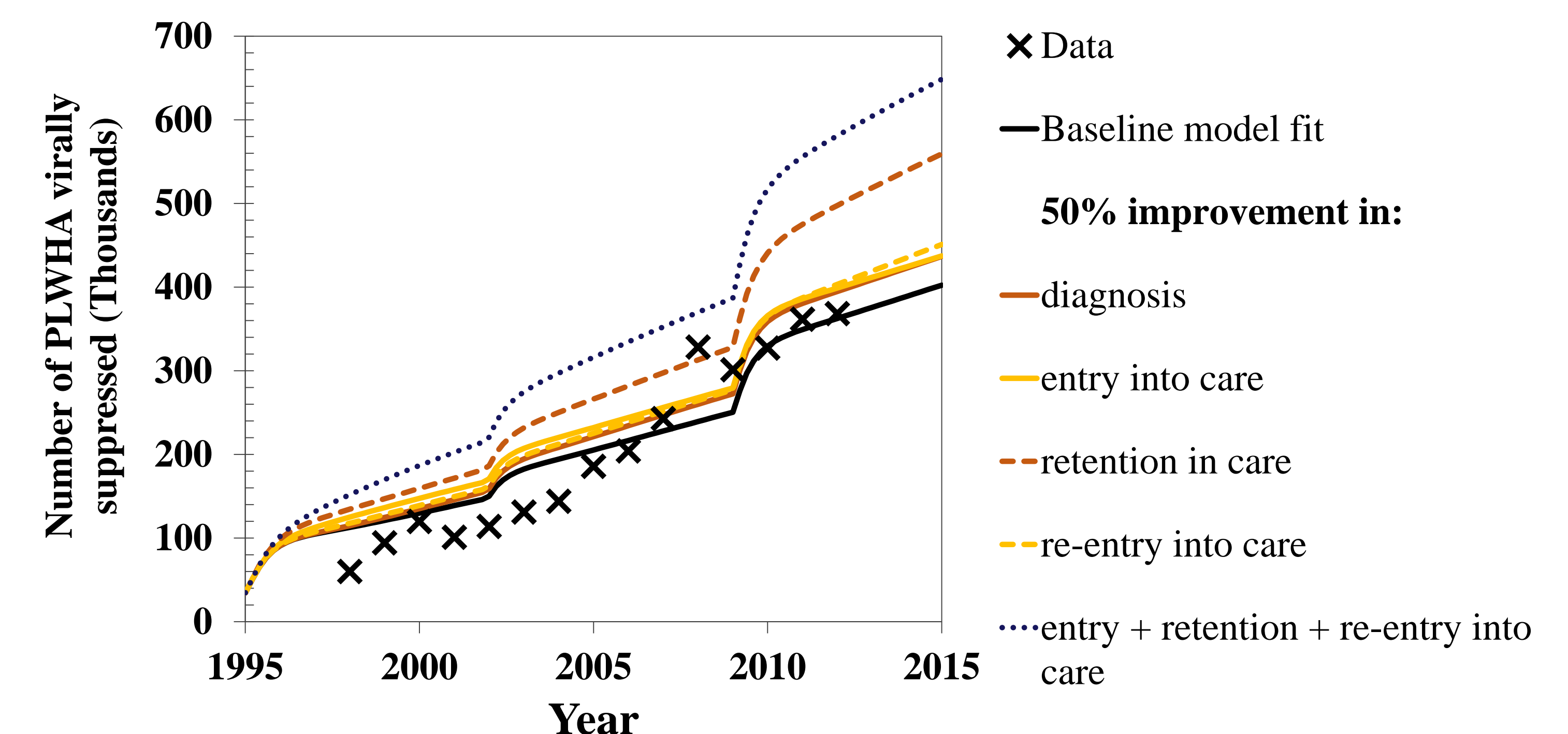
FIGURE 3



The distribution of PLWHA across the different compartments for the year 2012. [U] Undiagnosed, [D] Diagnosed, [D₁] Diagnosed previously in care, [D₂] Diagnosed previously on ART, [D₃] Diagnosed previously suppressed, [C] Care, [C₁] Care previously on ART, [C₂] Care previously suppressed, [A] on ART, [A₁] on ART previously suppressed & [S] Suppressed.

- The calibrated dynamic cascade model suggested that failure to retain PLWHA in care after linkage significantly contributes to the low numbers achieving viral suppression in the US, consistent with the static cascade
- The dynamic model additionally suggested that a substantial proportion of PLWHA who are not in care have previously achieved viral suppression (Figure 3)

FIGURE 4



Number of suppressed individuals in the US 1995-2015 with different interventions implemented. Markers represent the dataset. The solid black line shows the baseline model fit. Other lines show the result of changing different rates: 50% increase in HIV diagnosis rate, 50% increase in rate of entry into care, 50% reduction in rate of loss from care (increase in retention), 50% increase in rate of re-entry into care, or joint targeting of entry, retention and re-entry into care (50% increase in rate of entry + 50% reduction in loss from care + 50% increase in re-entry into care)

- Improvement of patient retention in care (reduction in rate of loss from care) gave the largest improvement in viral suppression: 50% greater retention rates since 2005 would have improved the proportion of PLWHA with suppressed viral load in 2012 by 11 percentage points (from 31% to 42%; Figure 4)
- Increasing rates of HIV diagnosis, entry into care or re-entry into care by 50% only increased suppression in 2012 by 2-3 percentage points each
- Simultaneous 50% improvements in care entry, retention and re-entry rates were additive, giving an 18 percentage point increase in the proportion virally suppressed in 2012 (from 31% to 49%; Figure 4)

CONCLUSIONS

- The dynamic model of the US HIV care cascade gives additional information over the static cascade about how PLWHA transition through care, suggesting that a substantial proportion of people not in care have previously been virally suppressed
- The dynamic model confirms that improving retention in care is crucial to optimise the US HIV care cascade

REFERENCES

1. Centers for Disease Control and Prevention (CDC) (2015). HIV Surveillance Supplemental Report 2015. Report No.2 Vol. 20.
2. Powers K.A, Miller W.C. Journal of Acquired Immune Deficiency Syndromes. 2015 Jul. 1; 69(3):341-7.