



NATIONAL KIDNEY REGISTRY®
FACILITATING LIVING DONOR TRANSPLANTS

100-Year Voucher Simulation

2/27/2025

V2.19

State of the Voucher Program

The National Kidney Registry's Voucher Program gives living kidney donors the opportunity to donate in advance of their intended recipient's transplant by providing their intended recipient with a voucher that can be redeemed for a living donor kidney at a future date.

This 100-year simulation demonstrates that the projected number of outstanding voucher redemptions can be met over the long term in all simulation scenarios.



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Voucher Program Overview

Voucher donation gives living kidney donors the option to donate now to help a stranger in need of a transplant while providing vouchers to family or friends that can be redeemed in the future. There are two types of vouchers: **Standard Vouchers** and **Family Vouchers**.

Standard Voucher (SV)

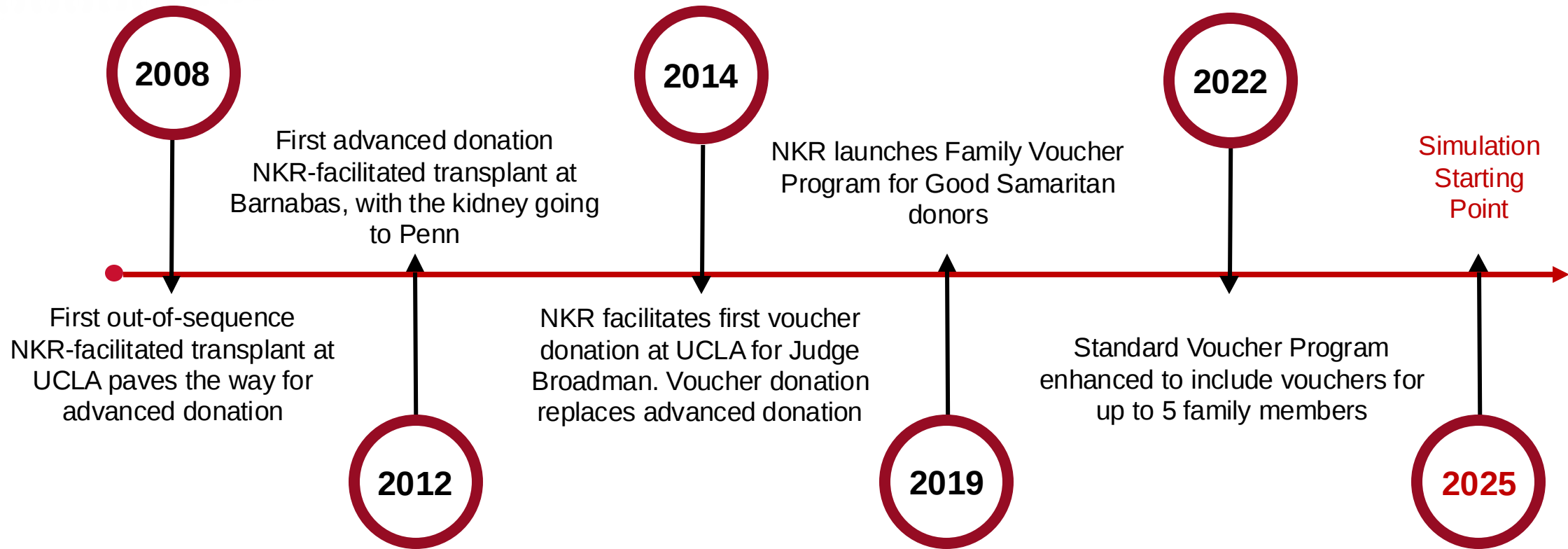
- 1 SV holder who expects to need transplant within 1 year (imminent need) is named
- SV donors can name up to 5 additional FV holders (family members NOT in imminent need) as backups to the SV holder
- Only 1 voucher can be redeemed per voucher donation (unless the SV donor needs a kidney transplant)

Family Voucher (FV)

- Up to 5 FV holders (family members NOT in imminent need) are named
- Voucher holders are not expected to need a transplant within 1 year, if ever
- Only 1 voucher can be redeemed per voucher donation (unless the FV donor needs a kidney transplant)

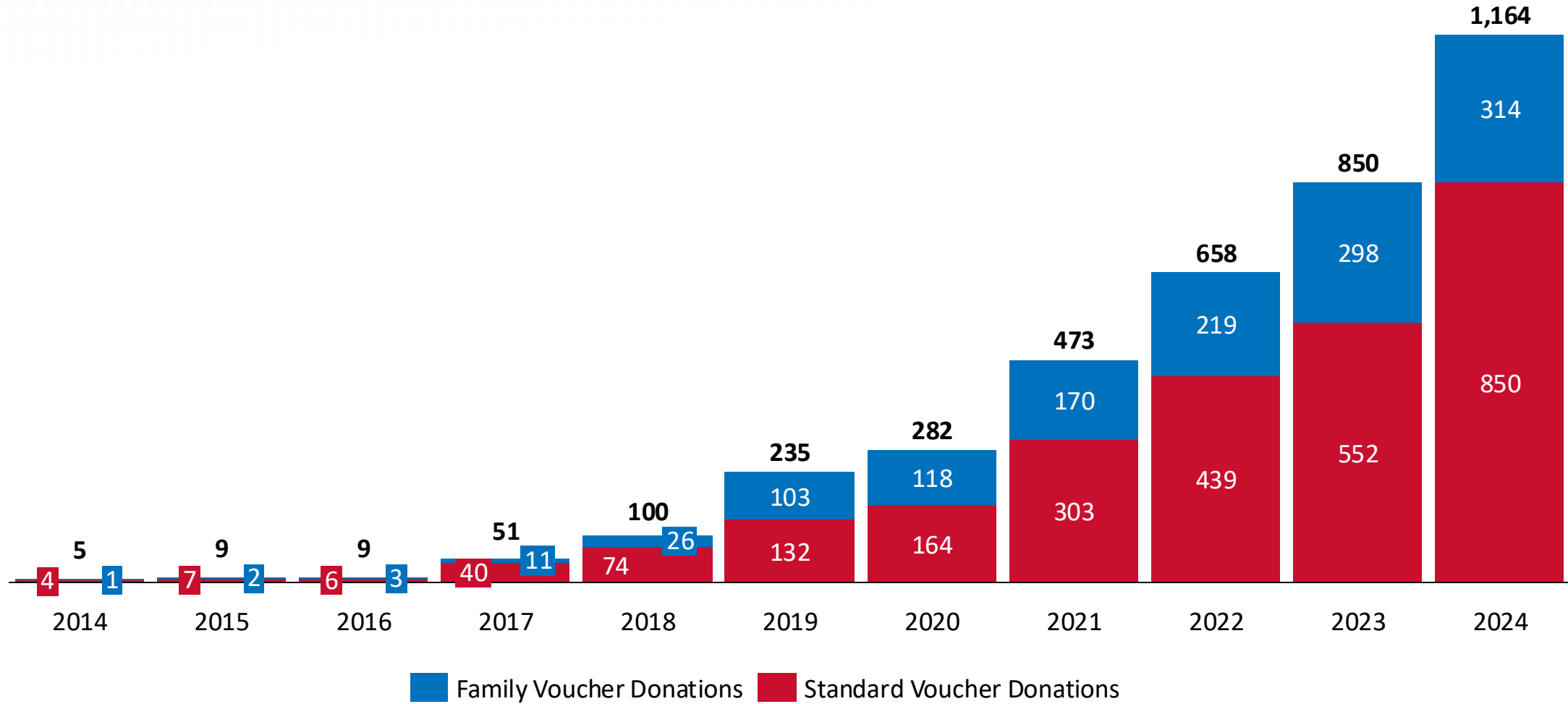


Voucher Program History



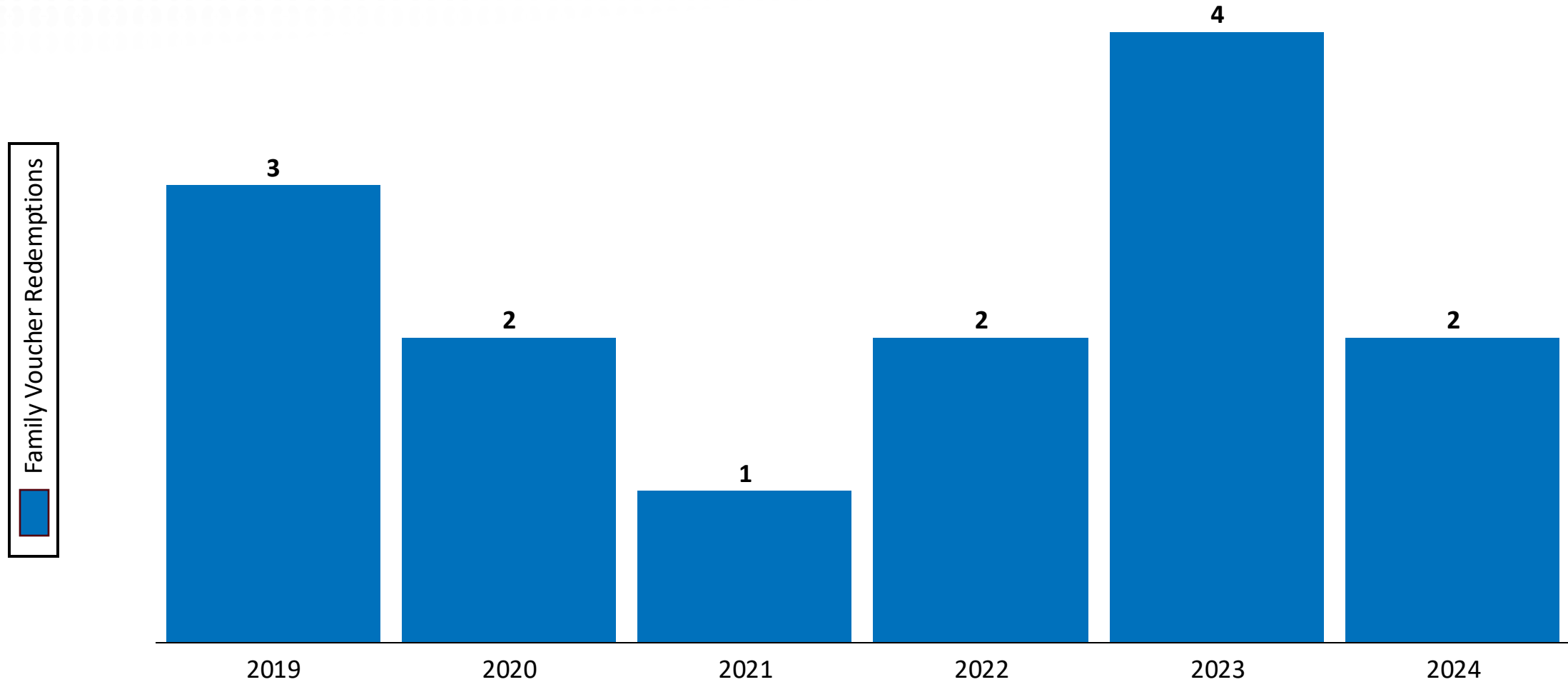
Voucher Activity History

The Program is Popular with Living Kidney Donors & ESRD Patients



Family Voucher Redemptions

The Family Voucher Program Has Few Redemptions

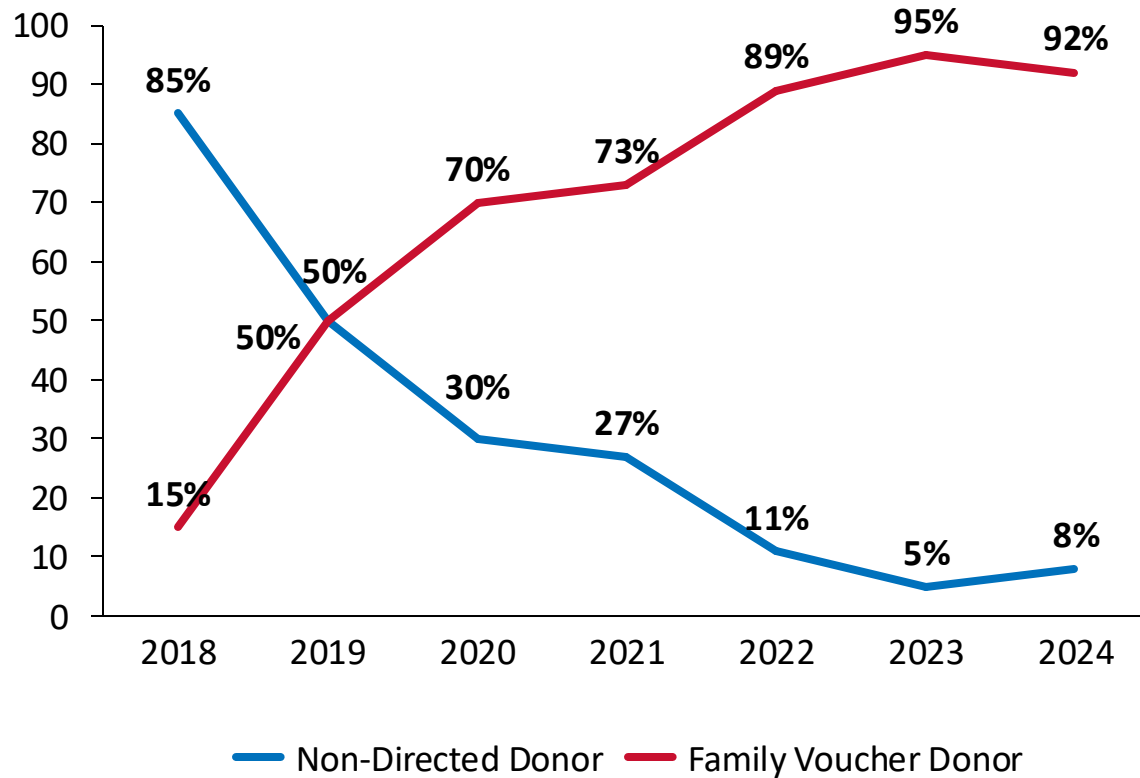


As of 1/6/2025

Conversion To Voucher Donation

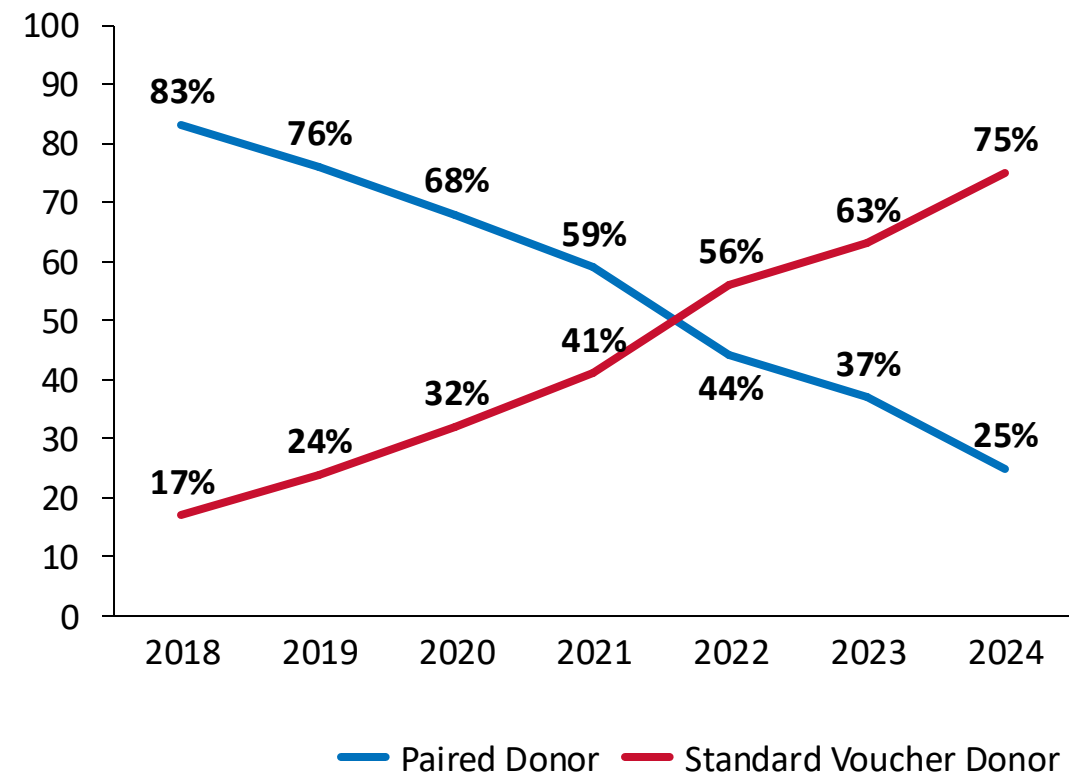
Standard and Family Vouchers Have Changed Paired Exchange Donation

Transition to Family Voucher Donation



% of NKR Good Samaritan donors choosing family voucher donation

Transition to Standard Voucher Donation



% of NKR KPD donors choosing standard voucher donation



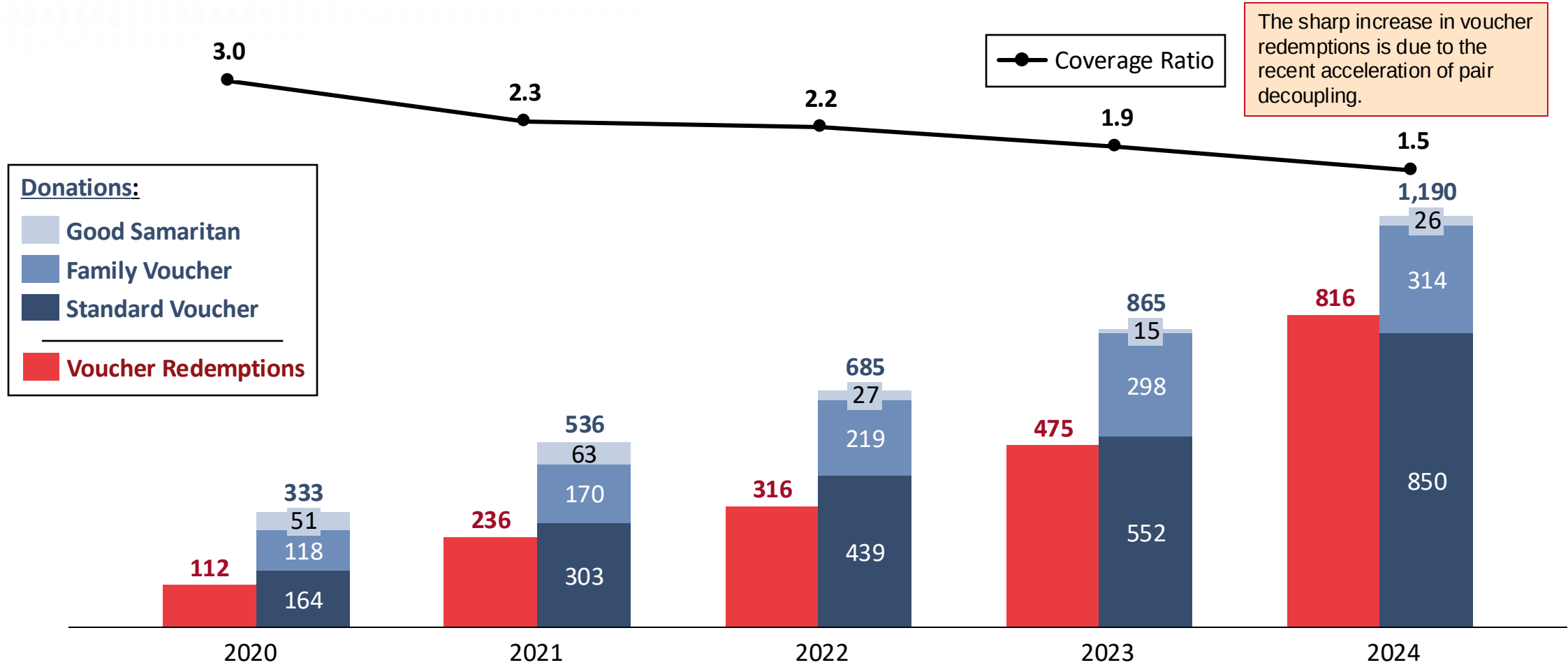
Key Measure - The Coverage Ratio

$$\text{Coverage Ratio (CR)} = \frac{\text{Number of NKR Chain-Starting Donors}}{\text{Number of Expected Redemptions}}$$

CR Values > 1.00 mean that the number of chain-starting donors exceeds the number of expected voucher redemptions

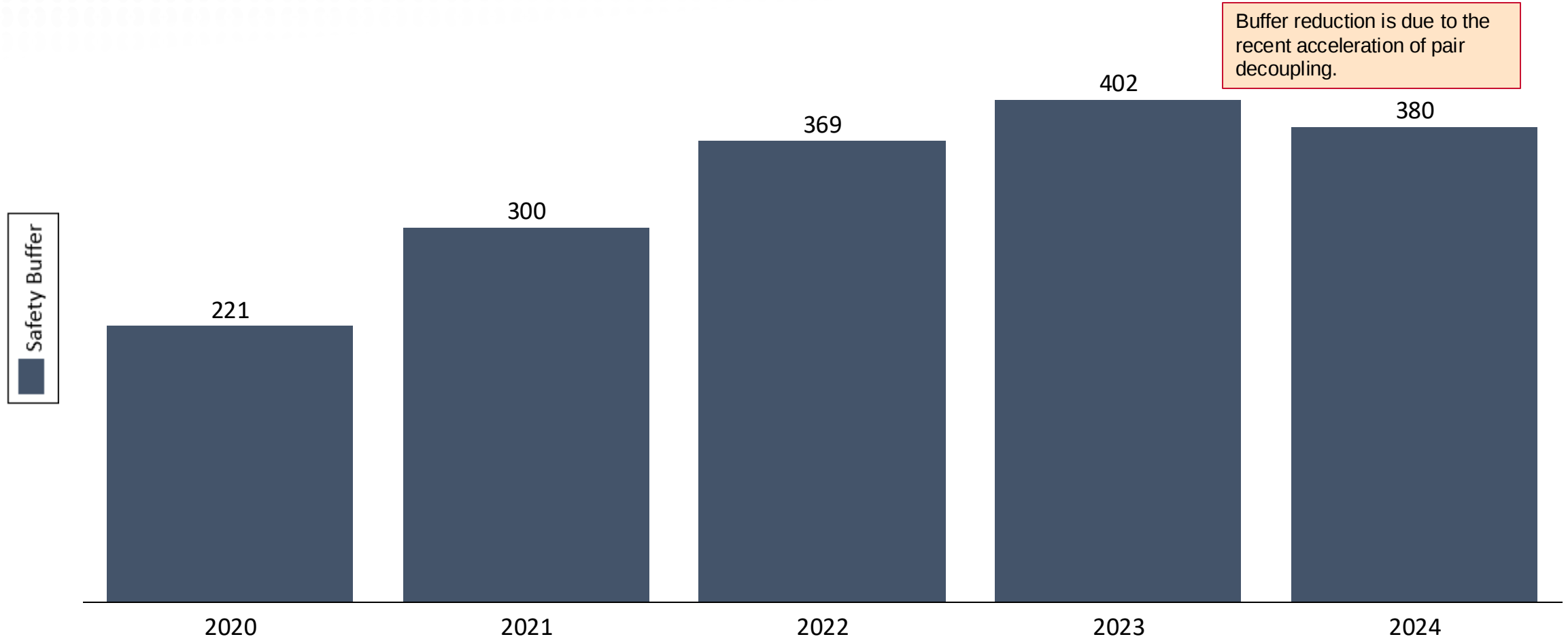
Voucher Program History

Coverage Ratio = Chain Starts / Voucher Redemptions



Voucher Redemption Safety Buffer

Safety Buffer = Chain Starts Less Voucher Redemptions



As of 1/6/2025

Voucher 100-Year Simulation Model

To ensure a coverage ratio greater than 1, the NKR employed a Monte Carlo simulation model to estimate the annual number of expected voucher redemptions and chain starts over a 100-year time horizon. Four scenarios were modeled. In all scenarios, the number of chain starts exceeded expected voucher redemptions in each of the 100 years simulated.

Simulation Results Explained

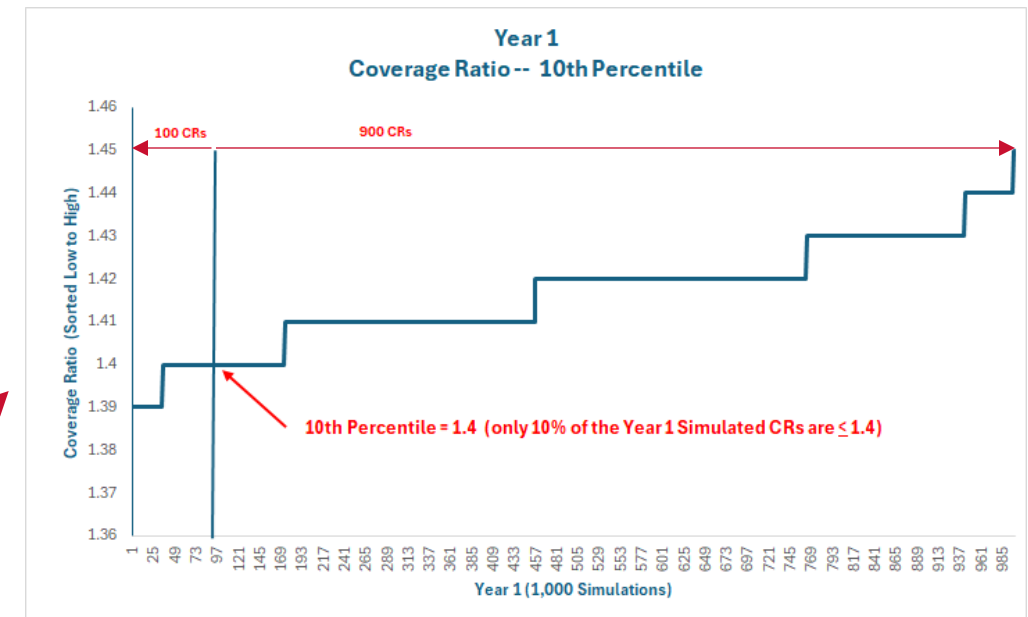
The simulation model generates 1,000 independent results for each year (1-100).

For each year (1-100), two statistics are computed:

1. The Average Coverage Ratio
2. The 10th Percentile Coverage Ratio*

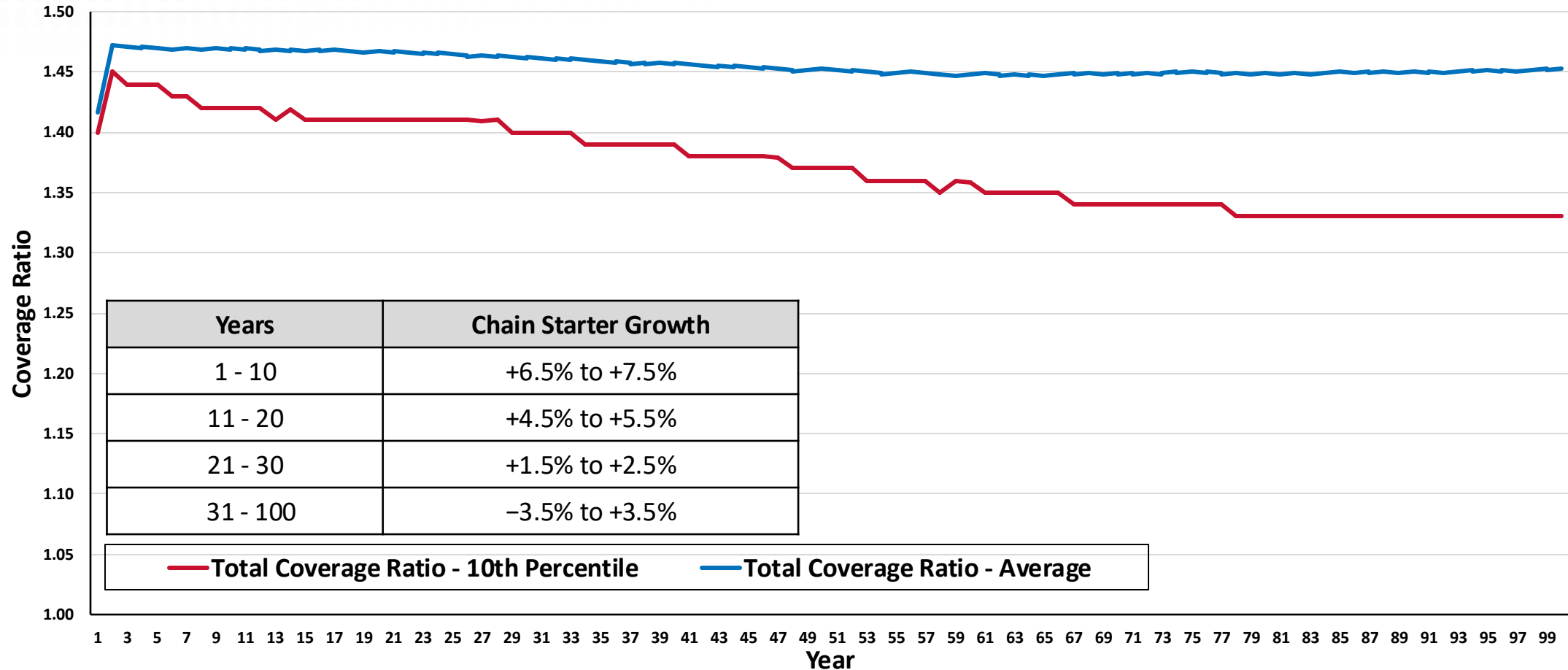
*The 10th percentile is the value at which only 10 percent (100/1,000) of coverage ratios for a given year are lower – 90 percent (900/1,000) of the year's coverage ratios are higher.

10th Percentile
Example



100-Year Simulation

Scenario: 1 (Most Likely)

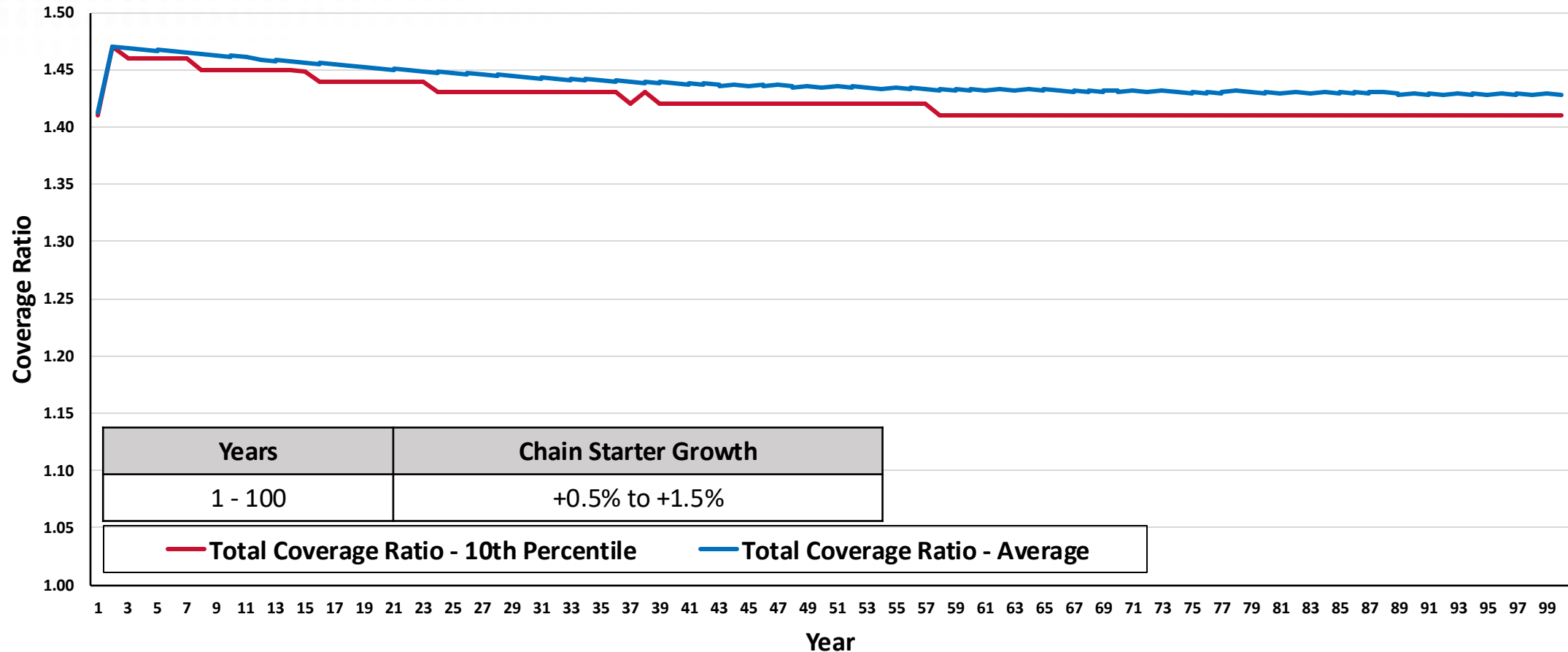


Average CR = Average CR of 1,000 replications for each year

10th Percentile CR = CR that cuts off the lowest 10 percent of the 1,000 replications each year

100-Year Simulation

Scenario: 2 (Slow Growth)

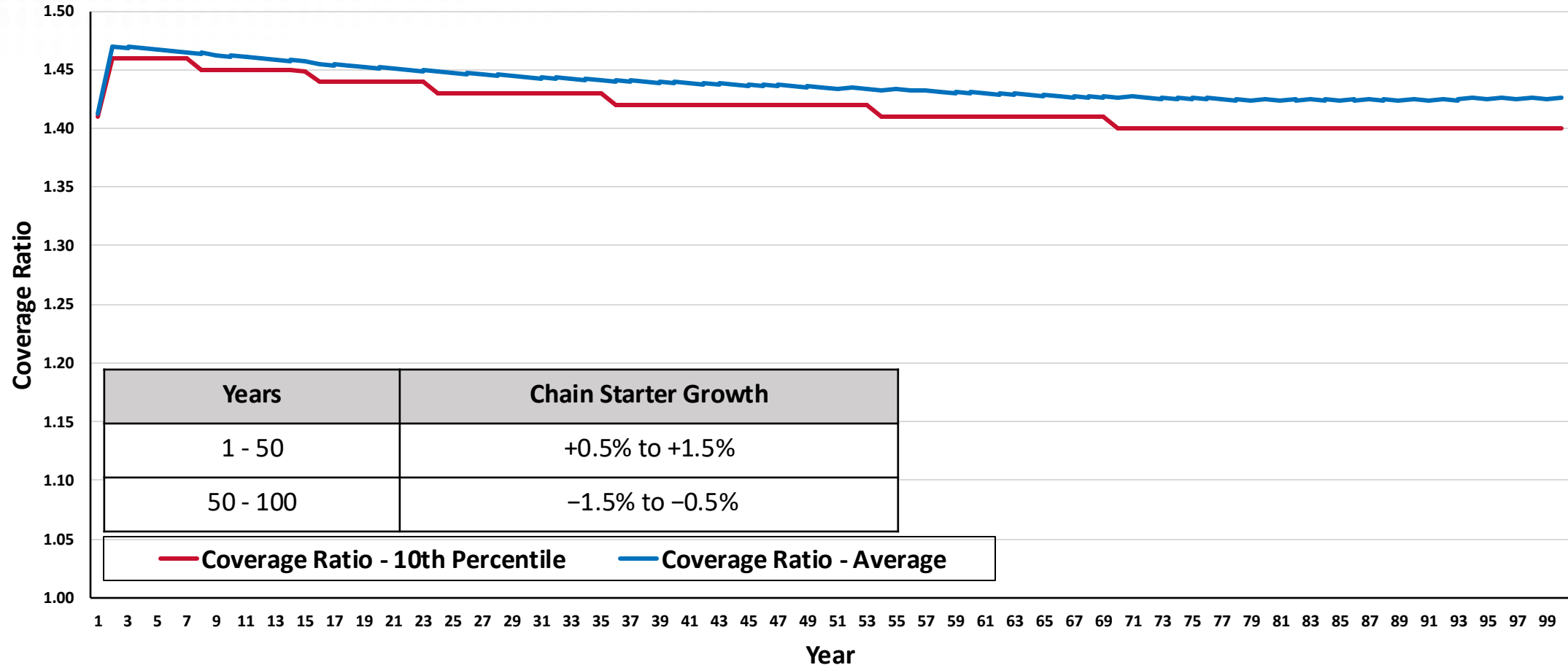


Average CR = Average CR of 1,000 replications for each year

10th Percentile CR = CR that cuts off the lowest 10 percent of the 1,000 replications each year

100-Year Simulation (All Blood Types)

Scenario: 3 (Slow Growth Followed by Slow Decline)

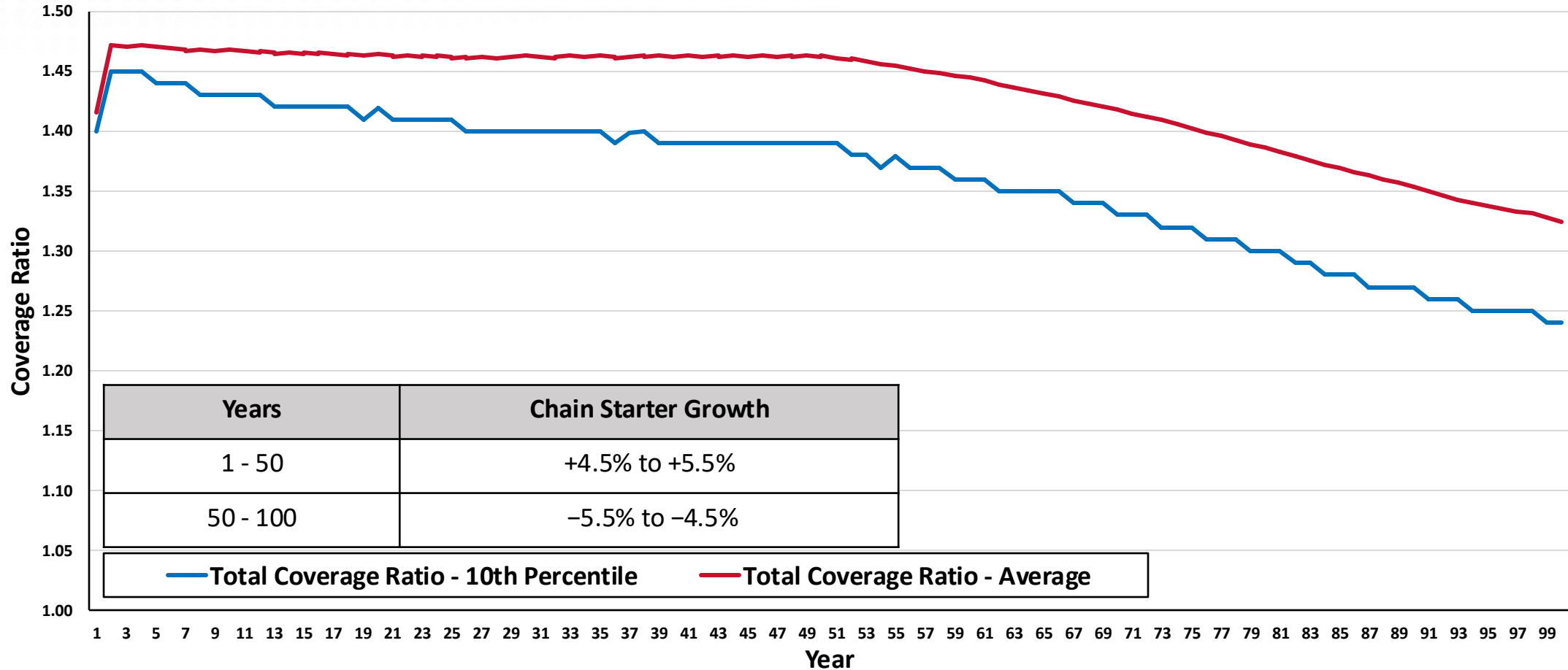


Average CR = Average CR of 1,000 replications for each year

10th Percentile CR = CR that cuts off the lowest 10 percent of the 1,000 replications each year

100-Year Simulation

Scenario: 4 (Rapid Growth Followed By Rapid Decline)



Average CR = Average CR of 1,000 replications for each year

10th Percentile CR = CR that cuts off the lowest 10 percent of the 1,000 replications each year

Conclusion

- Regardless of the scenario, the average and 10th percentile coverage ratios are greater than 1.0.
- This indicates that the number of available chain starts in any year is projected to exceed the number of vouchers redeemed.
- Additional modeling must be undertaken to estimate the O voucher holder wait times under the various scenarios.

Appendix A

Monte Carlo Methodology

A Monte Carlo simulation model was constructed to estimate the annual number of voucher redemptions relative to the number of kidneys available for transplant over a 100-year time horizon under several projected scenarios. Monte Carlo computer simulation models are commonly used in a wide range of fields, including finance, insurance, and transportation, to perform risk analyses in complex situations where it is not possible to mathematically calculate future values for important outcome variables. They have been used to project the availability of donor livers and the impact of organ allocation strategies. Our model tracks simulated donors and voucher holders until either a voucher is redeemed, the voucher holder dies, or the voucher “expires” (voucher holder reaches age 85 or another voucher holder from the same voucher donation redeems the voucher).

Appendix B

Coverage Ratio Methodology

The primary measure of model risk is the “coverage ratio,” or the number of available chain starts per voucher redeemed each year. Coverage ratios exceeding 1.0 indicate that the number of available chain starts will exceed the number of vouchers redeemed in any given year. For each scenario, and each of the 100 simulated years, we have chosen to report the average coverage ratio value and the 10th percentile coverage ratio. The 10th percentile was purposely selected to represent an ultraconservative projection for each scenario.

Appendix C

Coverage Ratio Summary

Scenario 1: Most Likely	
Average Coverage Ratio Over 100 Years	> 1.45 Every Year (SV and FV donors)
10th Percentile Coverage Ratio Over 100 Years	> 1.30 Every Year (SV and FV donors)
Scenario 2: Slow Growth	
Average Coverage Ratio Over 100 Years	> 1.40 Every Year (SV and FV donors)
10th Percentile Coverage Ratio Over 100 Years	> 1.40 Every Year (SV and FV donors)
Scenario 3: Slow Growth Followed By Slow Decline	
Average Coverage Ratio Over 100 Years	> 1.42 Every Year (SV and FV donors)
10th Percentile Coverage Ratio Over 100 Years	≥ 1.40 Every Year (SV and FV donors)
Scenario 4: Rapid Growth Followed By Rapid Decline	
Average Coverage Ratio Over 100 Years	> 1.30 Every Year (SV and FV donors)
10th Percentile Coverage Ratio Over 100 Years	> 1.20 Every Year (SV and FV donors)

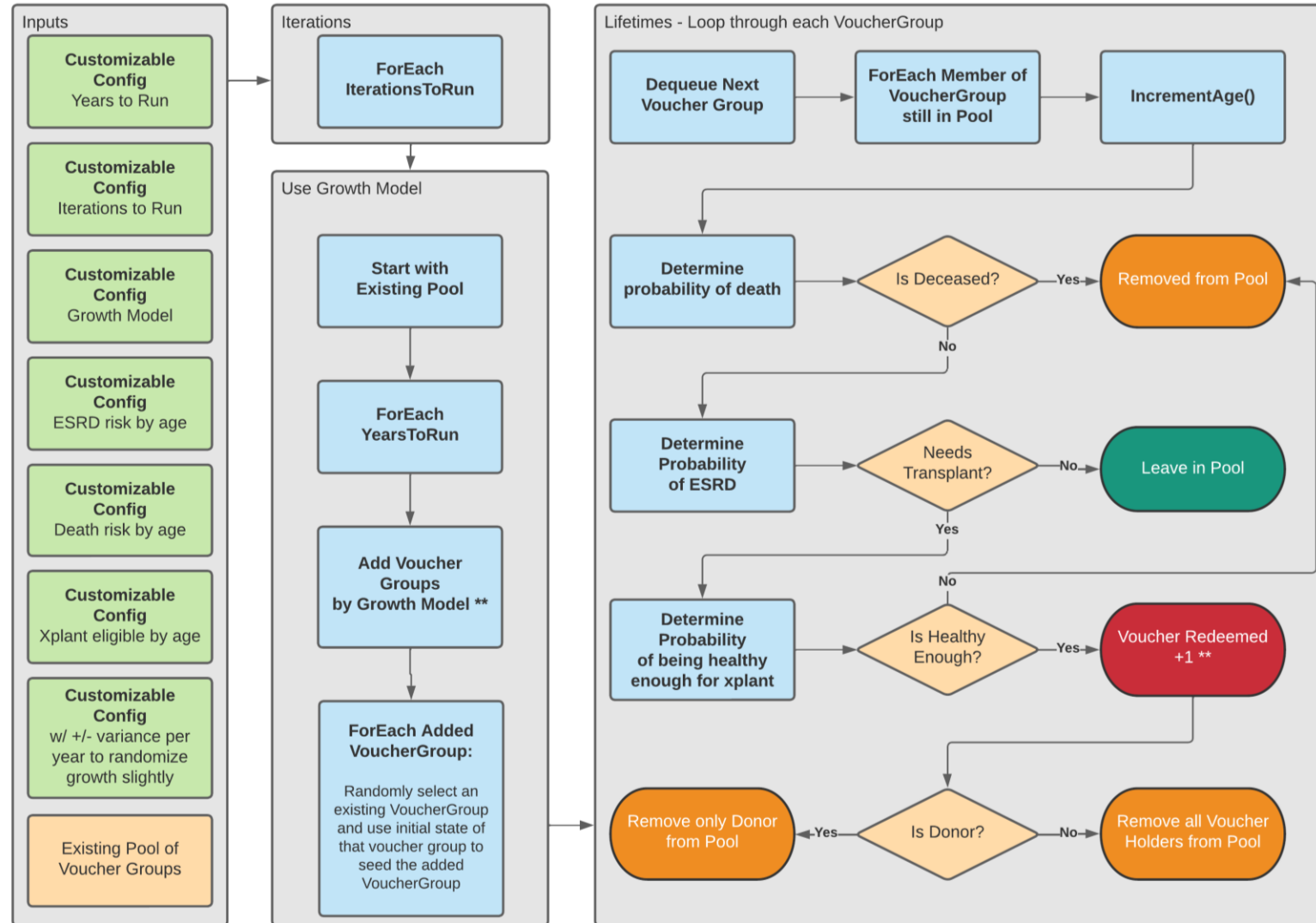


Appendix D

100-Year Simulation Details

The flow of the model is illustrated.

The simulation model was programmed and ran using .NET core 6.0.



Term: VoucherGroup is a group composed of all NKR donors, and—if a voucher donor—that donor's voucher holders.

****** Growth model is a % of expected growth or decline based on scenario with a +/- % to cause a percentage of randomization