Item S1. State transition probability formulas.

A. One-year probability of death among people of age x without CKD ($Q_{noCKD,x}$):

$$Q_{noCKD,x} = M_x / [1 + P_{CKD,x} * (HR_{CKD,x} - 1)]$$

Source:

Variable	Definition	Source
M_x	One-year probability of death among the entire population of age x	Vital statistics
$P_{CKD,x}$	Prevalence of CKD at age x	NHANES
$HR_{CKD,x}$	Sex- and race-adjusted hazard ratio for mortality associated with CKD for persons of age x (compared with eGFR 90-104, ACR<10)	CKD-PC

Nomenclature:

$d_{population,x}$: number of deaths in population (total, CKD, or no CKD) of age x to age x+1
$Q_{population,x}$: one-year probability of death in population (total, CKD, or no CKD) of age x
$N_{population,x}$: number alive in population (total, CKD, or no CKD) of age x to age x+1

Algebra:

1. Define $d_{total,x} = d_{CKD,x} + d_{noCKD,x}$
   a. $d_{total,x} = Q_{total,x} * N_{total,x}$
   b. $d_{CKD,x} = Q_{CKD,x} * N_{CKD,x}$
   c. $d_{noCKD,x} = Q_{noCKD,x} * N_{noCKD,x}$
2. Substituting 1a-1c, $Q_{total,x} * N_{total,x} = Q_{CKD,x} * N_{CKD,x} + Q_{noCKD,x} * N_{noCKD,x}$
   a. $N_{CKD,x} = P_{CKD,x} * N_{total,x}$
   b. $N_{noCKD,x} = P_{noCKD,x} * N_{total,x}$
   c. $P_{CKD,x} = 1 - P_{noCKD,x}$
   d. $Q_{CKD,x} = Q_{noCKD,x} * HR_{CKD,x}$
3. Substituting 2a-2d, $Q_{total,x} * N_{total,x} = Q_{noCKD,x} * HR_{CKD,x} * P_{CKD,x} * N_{total,x} + Q_{noCKD,x} * P_{noCKD,x} * N_{total,x}$
4. Solving for $Q_{noCKD,x} = Q_{total,x} / (HR_{CKD,x} * P_{CKD,x} + P_{noCKD,x})$
   a. $P_{noCKD,x} = 1 - P_{CKD,x}$
   b. $Q_{total,x} = M_x$
5. Substituting 4a-4b, $Q_{noCKD,x} = M_x / [1 + P_{CKD,x} * (HR_{CKD,x} - 1)]$

*Intuition: if $HR_{CKD,x} = 1$, then $Q_{noCKD,x} = M_x$

**Assumption: HR is modeled appropriately by age, sex, and race (see eTable2)

***Equation is presented as a single CKD category with a single HR_{CKD}. For models with more than one category of CKD, the equations would reflect the prevalence-weighted HRs associated with CKD. For example, for a two CKD category model, #4 is calculated as:

$$Q_{noCKD,x} = Q_{total,x} / (HR_{CKD1,x} * P_{CKD1,x} + HR_{CKD2,x} * P_{CKD2,x} + P_{noCKD,x})$$

B. <u>One-year probability of developing CKD among people of age x without CKD ($I_{CKD,x}$):</u>

$$I_{CKD,x} = (P_{CKD,x+1} - P_{CKD,x})/(1 - P_{CKD,x}) + M_x*[(P_{noCKD,x+1}/P_{noCKD,x}) – (Q_{noCKD,x}/ M_x)]$$

<u>Source:</u>

Variable	Definition	Source
M_x	One-year probability of death among the entire population of age x	Vital statistics
$Q_{noCKD,,x}$	One-year probability of death among those without CKD at age x	Previous step
$P_{CKD,x}$	Prevalence of CKD at age x	NHANES

<u>Nomenclature:</u>

$Q_{population,x}$: one-year probability of death in population (total, CKD, or no CKD) of age x
$N_{population,x}$: number alive in population (total, CKD, or no CKD) of age x to age x+1

<u>Algebra:</u>

1. Define $N_{noCKD,x+1} = N_{noCKD,x} – (N_{noCKD,x}* Q_{noCKD,x}) - (N_{noCKD,x}* I_{CKD,x})$
    a. i.e., the number alive without CKD at age x+1 is the number alive without CKD at age x, less the number who died during the year, less the number who developed CKD during the year
2. Solve for $I_{CKD,x} = (N_{noCKD,x} – (N_{noCKD,x}* Q_{noCKD,x}) - N_{noCKD,x+1})/ N_{noCKD,x}$
3. Simplifying, $I_{CKD,x} = 1 – Q_{noCKD,x} - (N_{noCKD,x+1}/ N_{noCKD,x})$
    a. $N_{noCKD,x} = N_{total,x} * P_{noCKD,x}$
    b. $N_{noCKD,x+1} = N_{total,x+1} * P_{noCKD,x+1}$
4. Substituting 3a-3b, $I_{CKD,x} = 1 – Q_{noCKD,x} - (N_{total,x+1} * P_{noCKD,x+1}/ N_{total,x} * P_{noCKD,x})$
    a. $N_{total,x+1} = N_{total,x} - N_{total,x} * Q_{total,x}$
5. Substituting 4a, $I_{CKD,x} = 1 – Q_{noCKD,x} – [(N_{total,x} - N_{total,x} * Q_{total,x}) * P_{noCKD,x+1}]/ (N_{total,x} * P_{noCKD,x})$
6. Simplifying, $I_{CKD,x} = 1 – Q_{noCKD,x} – [(1 - Q_{total,x}) * (P_{noCKD,x+1}/ P_{noCKD,x})]$
7. Rearranging, $I_{CKD,x} =1– (P_{noCKD,x+1}/ P_{noCKD,x}) + (Q_{total,x}*P_{noCKD,x+1}/ P_{noCKD,x}) – Q_{noCKD,x}$
    a. $P_{noCKD,x} = 1 - P_{CKD,x}$
    b. $P_{noCKD,x+1} = 1 - P_{CKD,x+1}$
    c. $Q_{total,x} = M_x$
8. Substituting 7a-7b,
   $I_{CKD,x}=(P_{CKD,x+1} - P_{CKD,x})/(1 - P_{CKD,x}) + M_x*[(P_{noCKD,x+1}/P_{noCKD,x}) – (Q_{noCKD,x}/ M_x)]$

*Intuition: as M_x approaches 0, then $I_{CKD,x} = (P_{CKD,x+1} - P_{CKD,x})/(P_{noCKD,x})$

**Assumption: Population steady state (since N_{x+1} is derived from N_x in previous year)