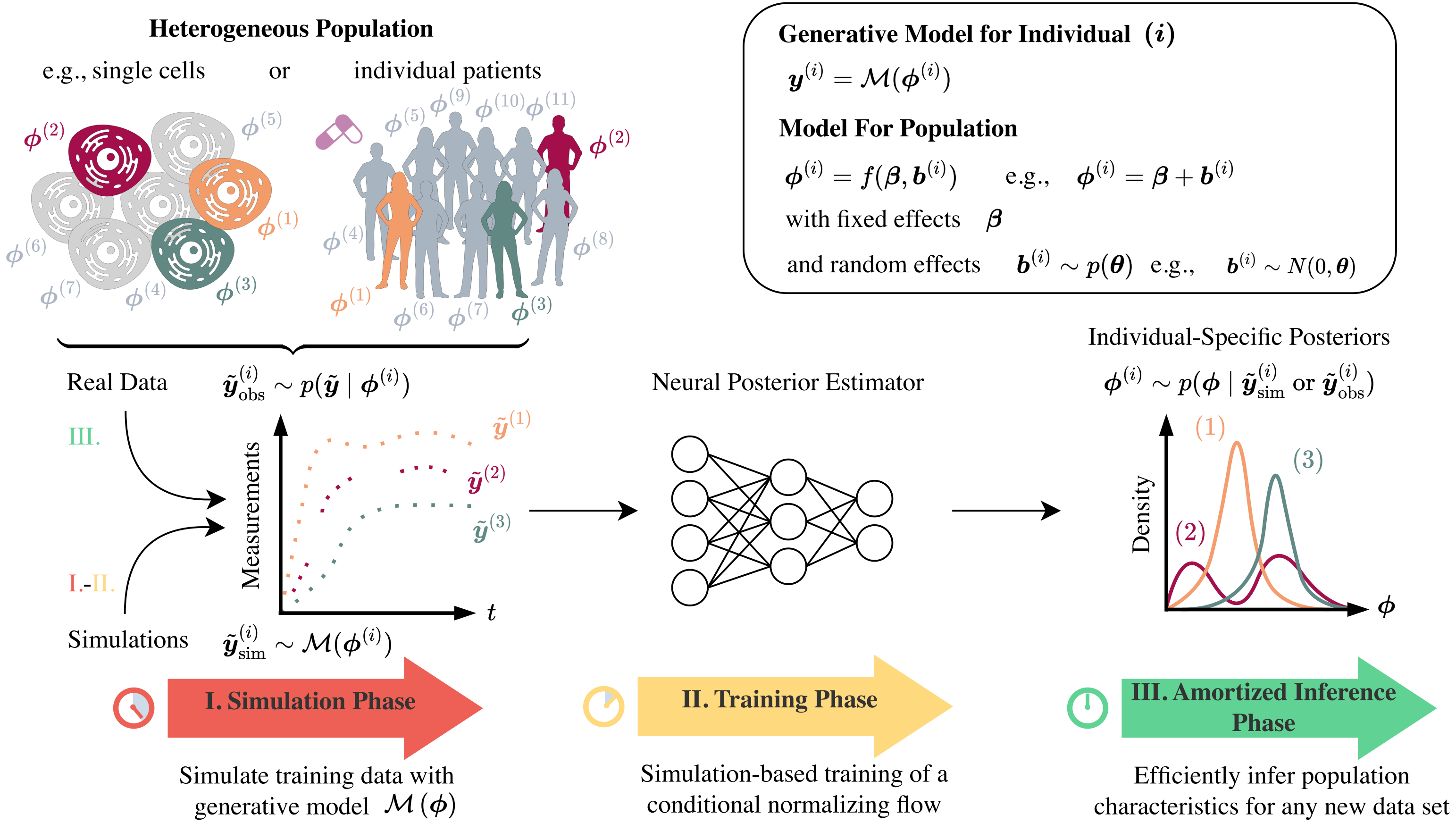

Heterogeneous Population
e.g., single cells
or
individual patients
Generative Model for Individual (i)
$\boldsymbol{y}^{(i)} = \mathcal{M}(\boldsymbol{\phi}^{(i)})$
Model For Population
$\boldsymbol{\phi}^{(i)} = f(\boldsymbol{\beta}, \boldsymbol{b}^{(i)})$ e.g., $\boldsymbol{\phi}^{(i)} = \boldsymbol{\beta} + \boldsymbol{b}^{(i)}$
with fixed effects $\boldsymbol{\beta}$
and random effects $\boldsymbol{b}^{(i)} \sim p(\boldsymbol{\theta})$ e.g., $\boldsymbol{b}^{(i)} \sim N(0, \boldsymbol{\theta})$
Real Data $\tilde{\boldsymbol{y}}^{(i)}_{\text{obs}} \sim p(\tilde{\boldsymbol{y}} \mid \boldsymbol{\phi}^{(i)})$
III.
I.-II.
Simulations $\tilde{\boldsymbol{y}}^{(i)}_{\text{sim}} \sim \mathcal{M}(\boldsymbol{\phi}^{(i)})$
Measurements
t
Neural Posterior Estimator
Individual-Specific Posteriors
$\boldsymbol{\phi}^{(i)} \sim p(\boldsymbol{\phi} \mid \tilde{\boldsymbol{y}}^{(i)}_{\text{sim}} \text{ or } \tilde{\boldsymbol{y}}^{(i)}_{\text{obs}})$
Density
$\boldsymbol{\phi}$
I. Simulation Phase
Simulate training data with generative model $\mathcal{M}(\boldsymbol{\phi})$
II. Training Phase
Simulation-based training of a conditional normalizing flow
III. Amortized Inference Phase
Efficiently infer population characteristics for any new data set