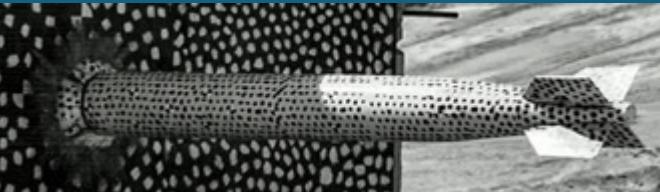
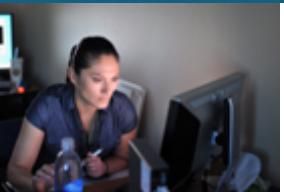




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SAND2021-0408C

Preliminary Work on a Digital Twin for Cancer Patients



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January 19, 2021

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Digital Twin for Cancer Patients: Overview



Background:

- Many treatment plans available to cancer patients
- Selection, ordering, and other details dependent on individual patient
- Time is important
- Digital twin development effort a collaboration between NCI and DOE

Goal:

- Identify optimal treatment strategy for individual patients
- Develop a patient model to determine specific outcomes, including response to individual treatments (response, resistance, side effects, etc)
- Reduce guesswork and speculation in cancer treatment
- Ultimately support development of new treatment options

3 Technical Approach: Divide and Conquer



1. Separate individuals into categories

- **Goal:** Simplify modeling
- **Challenges:** incompleteness, dimensionality, interpretation tradeoff

2. Construct dynamical models

- **Goal:** “Eigenpatient” models
- **Challenges:** Data coarseness, induction “physics,” multiobjective optimization

3. Select model for individual

- **Goal:** Place patient into category
- **Challenges:** Noise & uncertainty

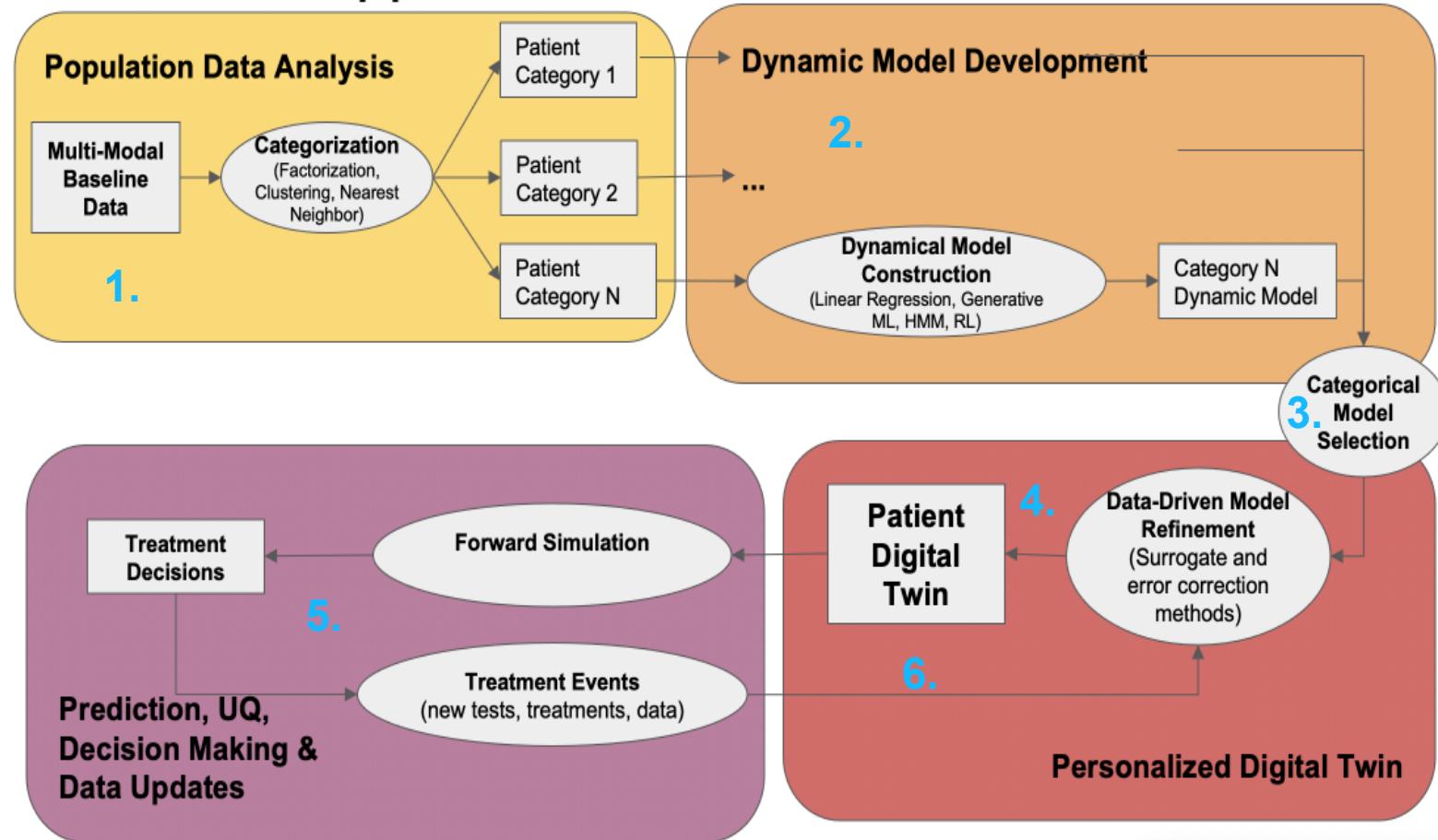
4. Personalize dynamical model

- **Goal:** Specialize selected model
- **Challenges:** #2 – with less data

5. Simulate and predict

- **Goal:** Estimate treatment effects
- **Challenges:** Interaction with treatment team, decision analysis

6. Iterate steps 4 and 5.



Selected Fundamental Research Needs and Challenges



- What data properties are needed to support digital twin construction?
 - Collection frequency
 - Test completeness
 - Breadth of data
 - Number of individuals
- What's the impact of available physics on data requirements?
- To what degree can we automate induction (and revision) of dynamical models?
- Can we capture the space of all possible interventions in a single model?
- Given the interdependencies among the major components of the proposed approach, what starting points allow us to validate progress?