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Analytic Approaches for Causal Inference with Complex Multi-Component Interventions

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Analytic Approaches for Causal Inference with Complex Multi-Component Interventions

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ACHIEVE Quantitative Study Design

- **Hospital Adoption:** Survey hospitals to determine the scope and timing of transitional care components (TCC)

- **Cluster Identification:** Use qualitative and quantitative data to identify clusters of TCCs implemented together

- **Retrospective Analysis:** Use administrative data to:
  - Compare patterns of care and outcomes before vs. after adoption of TCC clusters
  - Detect changes in care and outcomes attributable to TCC implementation (2009-14)

- **Prospective Analysis:** Measure patient-centered care patterns, experiences, & outcomes across TCC clusters using an incomplete fractional factorial design
Overview of ACHIEVE Quantitative Design

US Hospitals
- HEN Hospitals
  - QIO ICPC Hospital?
    - Yes
    - No
      - CCTP in Community?
        - Yes
        - No

Kaiser Hospitals
- QIO ICPC Hospital?
  - Yes
  - No

Other Hospitals
- QIO ICPC Hospital?
  - Yes
  - No

Stratified probability sample of hospitals (assume 5 hospitals from each of 8 clusters)
(sampling probabilities within strata proportional to hospital patient volume)
Stratified random sample of 300 patients from each hospital (12,000 total)

Retrospective Claims Analysis: All hospitals/patients in all clusters included
Prospective Analysis: red TC clusters selected by Fractional Factorial Design
Dealing with Complexity: Retrospective Analysis

- **Principal components analysis/factor analysis**: Identify clusters of TCCs commonly implemented together.
- **Cluster analysis**: Identify comparison groups of hospitals/communities that use the same combinations of TCC clusters.
- **Qualitative data**: Site visit and focus group findings inform TCC cluster and comparison group identification.
- **Adoption/selection analysis**: Evaluate selection bias in hospital/community adoption of TCCs and the types of patients exposed.
- **Interrupted time series analysis**: Estimate changes in patient care and outcomes attributable to TCC implementation.
- **Hierarchical multivariate adjustment**: Control for patient, hospital and community covariates, balance across TCCs/groups.
- **Instrumental variables and person-centered effects**: Control for unobserved confounding and estimate patient heterogeneity in treatment effects.
Dealing with Complexity: Prospective Analysis

- **Incomplete fractional factorial selection:** Screen and sample a subset of TCC clusters (factors) and types of care settings (levels) that provide contrasts for the fullest possible range of TCC, hospital, and community combinations.

- **Care settings/levels:** A total of 40 care settings will be selected, balancing hospital and community characteristics (10 Kaiser settings).

- **Patient/caregiver sampling:** 300 patients from each setting surveyed within 45 days of discharge, plus 180 caregivers and 75 providers.

- **Outcomes:** Comparison of patterns of care, experiences with care, and patient-centered outcomes across TCC clusters and settings.

- **Hierarchical modeling & propensity score weighting:** balance and adjust for patient/hospital/community covariates across TCC clusters.

- **Tree-based models:** identify interactions among patient subpopulations, patient/caregiver characteristics, and TCC clusters.
Dealing with Complexity: Prospective Analysis

<table>
<thead>
<tr>
<th>Hospital/Community Care Setting Combinations</th>
<th>TCC Clusters</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>TCC 1</td>
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<tr>
<td>Academic affiliations</td>
<td></td>
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<tr>
<td>Community hospitals</td>
<td></td>
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<tr>
<td>System memberships</td>
<td></td>
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<tr>
<td>Rural settings</td>
<td></td>
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<tr>
<td>Community-based TC components</td>
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<td>...</td>
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Incomplete Fractional Factorial sampling from cells to reduce confounding and maximize identification of TCC effects and care setting interactions.