Objectives

• Review the basics of the quality indicators

• Explain the different types of rates and how to use them (observed, expected, case mix-adjusted, smoothed)

• Discuss tips on how to tease out what is a true performance issue and artifacts of hospital documentation and coding practice
Who is AHRQ?

To improve the quality, safety, efficiency & effectiveness of health care for all Americans
Background of the AHRQ QI

- Reflect quality of care inside hospitals, focusing on potentially avoidable complications and related iatrogenic events.
- Can be used to help hospitals identify potential adverse events that might need further study.
- Developed through contract with UCSF-Stanford Evidence-based Practice Center & UC Davis.
- Use existing hospital discharge data.
- 10 are endorsed by National Quality Forum.
- 4 were adopted by CMS for RHQDAPU (plus composite that includes 5 others).
Four QI Modules

- **Inpatient QIs**
  - Mortality, Utilization, Volume

- **Patient Safety QIs**
  - Complications, Unexpected Death

- **Pediatric QIs**
  - Neonatal QIs

- **Prevention QIs** (Area Level)
  - Avoidable Hospitalizations / Other Avoidable Conditions
Structure of the PSIs

**Numerator (Potentially preventable adverse event)**

**Denominator**

Exclude: less likely to be preventable

Exclude: more likely to be present on admission

Include: population at risk

Universe of discharges

AHRQ QI Rates

- AHRQ QI software generates:
  - Observed rates
  - Expected rates
  - Risk-adjusted rates (with SE)
  - Smoothed (reliability-adjusted) rates

http://www.ahrq.gov/qual/qitoolkit/b1_applyingqis.pdf
Observed Rate

- The *observed rate* is the actual rate observed by the hospital without any adjustments.

- Good to identify cases for further follow-up, and to better understand areas of strength and those needing improvement.

- The observed rate is usually not appropriate for comparison across hospitals or over time because hospitals’ patient case mixes can vary.

- Helpful to compare with expected rates.
Expected Rate

• The *expected rate* is the rate a hospital would have if it had performed the same as the reference population given the provider’s actual case-mix.

• Observed to Expected (O/E) ratio = observed rate / expected rate.
  – O/E > 1 means the hospital performed worse
  – O/E < 1 means the hospital performed better
  – O/E = 1 means no difference in performance
Risk-adjusted Rate

- The *risk-adjusted rate* is the rate the hospital (or provider) would have if it had the same case-mix as the reference population given the hospital’s actual performance.

- Observed rate/expected rate x population rate

- Used for making comparisons across hospitals, or for comparisons within your hospital over time, because it adjusts for differences in the patient mix and allows you to examine real changes in performance.
Helpful Information

- In addition to comparing your rate to others...

  - If your risk adjusted population rate is greater than your expected rate, your case-mix is less severe
    - RA rate > Expected rate = Less severe

  - If your risk adjusted population rate is less than your expected rate, your case-mix is more severe
    - RA rate < Expected = More severe
Smoothened Rate

- This is a weighted average of the hospital's risk-adjusted rate and the reference population rate, where the weight reflects the reliability or stability of the hospital's risk-adjusted rate.

- Reliability is affected by hospital size, the patient population along with the types of quality and safety events that occur in your hospital.

- For a hospital with less reliable QI rate estimates, its smoothed rates will shrink more toward the pop mean, compared to smoothed rates for a hospital with more reliable rates resulting in smaller year-to-year fluctuations.

- Risk-adjusted rate * weight – reference population rate * (1 – weight)
Smoothed Rate Ratio

- Used to assess whether any difference between a hospital’s risk-adjusted rate and the reference population rate is likely to remain in the next measurement period

- Smoothed Rate Ratio = \( \frac{(\text{smoothed rate} - \text{ref population rate})}{(\text{risk-adjusted rate} - \text{ref population rate})} \)

  - Larger the ratio, the more similar the smoother and RA rates
  - A ratio > 0.80, means the difference is likely to persist
  - A ratio < 0.80, means a greater share of the difference may be due to random differences in patient characteristics (that are not controlled for in the risk-adjustment model) due to small numbers in the patient population.
Picture of Smoothed vs Non-Smoothed Rate
<table>
<thead>
<tr>
<th></th>
<th>Hospital A</th>
<th>Patients</th>
<th>Rate</th>
<th>Hospital B</th>
<th>Patients</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>High risk</td>
<td>5</td>
<td>0.270</td>
<td>High risk</td>
<td>20</td>
<td>0.120</td>
<td></td>
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<tr>
<td>Low risk</td>
<td>95</td>
<td>0.040</td>
<td>Low risk</td>
<td>80</td>
<td>0.062</td>
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<tr>
<td>Expected</td>
<td>100</td>
<td>0.055</td>
<td>Expected</td>
<td>100</td>
<td>0.070</td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>0.052</td>
<td></td>
<td>Observed</td>
<td>0.074</td>
<td></td>
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</tr>
<tr>
<td>O/E</td>
<td>0.936</td>
<td></td>
<td>O/E</td>
<td>1.050</td>
<td></td>
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</tr>
<tr>
<td>Risk-adjusted rate</td>
<td>0.059</td>
<td></td>
<td>Risk-adjusted rate</td>
<td>0.066</td>
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## Example 2

<table>
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<tr>
<th></th>
<th>Hospital A</th>
<th>Patients</th>
<th>Rate</th>
<th>Hospital B</th>
<th>Patients</th>
<th>Rate</th>
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<tr>
<td>High Risk</td>
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<td>0.270</td>
<td>High Risk</td>
<td>25</td>
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<tr>
<td>Low Risk</td>
<td>95</td>
<td>0.040</td>
<td>Low Risk</td>
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<tr>
<td>Expected</td>
<td>100</td>
<td>0.055</td>
<td>Expected</td>
<td>200</td>
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<tr>
<td>Observed</td>
<td>0.052</td>
<td></td>
<td>Observed</td>
<td></td>
<td>0.069</td>
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<tr>
<td>O/E</td>
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<td>O/E</td>
<td></td>
<td>1.100</td>
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</tr>
<tr>
<td>RA</td>
<td>0.059</td>
<td></td>
<td>RA</td>
<td></td>
<td>0.069</td>
<td></td>
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</tbody>
</table>
Risk Adjustment

- Inpatient Quality Indicators
  - Gender, age (5-year groups), age*gender interaction and APR-DRG** with risk-of-mortality subclass
- Patient Safety Indicators
  - Gender, age, modified DRG and AHRQ comorbidity
- Pediatric Quality Indicators
  - Gender, birth weight, age in days, age in years, modified DRG and AHRQ CCS
- Hierarchical linear modeling
  - Accounts for stratification and clustering

http://www.hcup-us.ahrq.gov/reports/methods.jsp
**APR-DRG = all patient refined diagnostic related groups
Validation Activities

• Gather evidence on the criterion validity of the PSIs based on medical record review as “gold standard”
• Improve guidance about how to interpret & use the indicators, especially for quality improvement
• Retrospective cross-sectional study design
• Populations
  1. 47 volunteer US hospitals (2006-07)
  2. Parallel study of 28 VA hospitals (Rosen et al)
  3. Second national sample of 46 hospitals/hospital systems that included indicator negative cases
  4. Series of UHC Clinical Benchmarking Projects
  5. Academic Medical Centers within CA, Postop DVT after TKR
  6. Moore Foundation Grant-Northern CA
Systematic Case Review

- Did the patient have the condition of interest?
- Was the condition present on admission (POA)?
- Where there any other indicator exclusions?
- Was the documentation complete?
- Was the chart coded correctly?
- Were there any gaps in quality of care provided?

Chart abstraction instruments available @
Common Questions or Concerns

- Present on admission
- Impact of the number of codes
- Impact of dates of procedure
- Coding the source of admission
Case Study
Iatrogenic Pneumothorax

AHRQ Patient Safety Indicators
Iatrogenic Pneumothorax
Rate per 1000

<table>
<thead>
<tr>
<th>Year</th>
<th>Quarter</th>
<th>N</th>
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<tbody>
<tr>
<td>2003</td>
<td>Q2</td>
<td>2969</td>
</tr>
<tr>
<td>2003</td>
<td>Q4</td>
<td>4439</td>
</tr>
<tr>
<td>2004</td>
<td>Q2</td>
<td>4533</td>
</tr>
<tr>
<td>2004</td>
<td>Q4</td>
<td>4474</td>
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<td>4615</td>
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<td>2005</td>
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<td>5010</td>
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<td>2006</td>
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<tr>
<td>2006</td>
<td>Q4</td>
<td>5063</td>
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<tr>
<td>2007</td>
<td>Q2</td>
<td>5195</td>
</tr>
<tr>
<td>2007</td>
<td>Q4*</td>
<td>5164</td>
</tr>
</tbody>
</table>
Case study
iatrogenic Pneumothorax

Raw rates to review flagged cases

• Coding issues (12%)
  – Watch for inadequate documentation, such as “rule out” pneumothorax without alternative diagnosis established after study (CXR or CT)

• Potential clinical issue (88%)
  – Increase use of “bedside” ultrasound guidance during placement of central venous catheters, especially in the OR, ICU, and ED (proven to reduce iatrogenic injury during IJ placement)
# Action plan to reduce the rate of iatrogenic pneumothorax

**GOAL:** Reduce the rate of iatrogenic pneumothorax (IAP) from central venous catheterization (CVC) by 50% by 6 months.

<table>
<thead>
<tr>
<th>Action</th>
<th>Agent</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promote ultrasound-guided internal jugular (IJ) catheterization as the method of choice for CVC</td>
<td>Dr. Lee to revise CVC Website Curriculum &amp; Simulation Program to further promote IJ approach</td>
<td>Start Jan 22 &amp; ongoing</td>
</tr>
<tr>
<td>Limit use of subclavian approach (with faculty supervision) to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- access to the neck is limited (e.g., trauma/code resuscitations)</td>
<td>Drs. Maggio, Williams, Mihm &amp; Lee to educate ED, OR &amp; General Surgery.</td>
<td></td>
</tr>
<tr>
<td>- patients with suspected neck injuries</td>
<td>Drs. Mihm, Riskin and Daniels to educate ICU. Dr. Shieh to educate B2 &amp; D1.</td>
<td></td>
</tr>
<tr>
<td>- lack of other available sites</td>
<td>I. Tokareva to develop &amp; distribute educational materials to reinforce</td>
<td></td>
</tr>
<tr>
<td>Ensure availability of ultrasound equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Require all medical &amp; surgical interns to complete CVC Website Curriculum &amp; Simulation Program during orientation (“Bootcamp” for surgical interns)</td>
<td>Drs. Shieh, Maggio, Williams, Mihm &amp; Lee</td>
<td>June 30</td>
</tr>
<tr>
<td></td>
<td>Monitor quarterly IAP rates for impact</td>
<td></td>
</tr>
</tbody>
</table>
Follow-up monitoring

Findings

- Overall IAP rate per 1000 discharges is trending down
- The best performance occurred in 2009Q3 with IAP rate of 0.56 per 1000 inpatient discharges, but this remains slightly above target. Please note that if 2 cases in 2009Q3 are recoded and removed, SHC IAP rate would be at zero.
Cost-benefit
One hospital’s experience

• 14 pneumothoraces were prevented in 2009
• Each pneumothorax adds (on average) 4.4 inpatient days and $17,312 in hospital charges (3.9 days in VA, >5 days in Medicare)
• Estimated savings based on 14 cases:
  – $242,400 and 75 hospital-days


Case study: CVC-related bloodstream infection

Use of Simulation-Based Education to Reduce Catheter-Related Bloodstream Infections

Jeffrey H. Barrak, MD; Elaine R. Cohen, BA; Joe Feinglass, PhD; William C. McGaghie, PhD; Diane B. Wayne, MD

Background: Simulation-based education improves procedural competence in central venous catheter (CVC) insertion. The effect of simulation-based education in CVC insertion on the incidence of catheter-related bloodstream infection (CRBSI) is unknown. The aim of this study was to determine if simulation-based training in CVC insertion reduces CRBSI.

Methods: This was an observational education cohort study set in an adult intensive care unit (ICU) in an urban teaching hospital. Ninety-two internal medicine and emergency medicine residents completed a simulation-based mastery learning program in CVC insertion skills. Rates of CRBSI from CVCs inserted by residents in the ICU before and after the simulation-based educational intervention were compared over a 32-month period.

Results: There were fewer CRBSIs after the simulator-trained residents entered the intervention ICU (0.34 infections per 1000 catheter-days) compared with both the same unit prior to the intervention (3.20 per 1000 catheter-days) \(P < .001\) and with another ICU in the same hospital throughout the study period (3.03 per 1000 catheter days) \(P < .001\).

Conclusions: An educational intervention in CVC insertion significantly improved patient outcomes. Simulation-based education is a valuable adjunct in residency education.

Arch Intern Med. 2009;169(15):1420-1423
Case study: CVC-related bloodstream infection

Central Venous Catheter Related Bloodstream Infection

- Identify tunneled catheters that are infected at admission and code as POA
- Minimize use of femoral venous catheters, which are associated with higher rates of infection
- Remove catheters at earliest opportunity consistent with patient safety
- Improve documentation of line site, insertion and removal dates, and line type
- Use improved ICD-9-CM codes for central-line type
Summary of PPV Estimates from Community Hospitals

Pre-2008 implementation of POA (phase I/II validation project)
PSI 15: Accidental Puncture or Laceration

- Occasional over coding of intra-operative bleeding or other routine events as APL

- Most true positive cases had extenuating circumstances, although some were probably preventable with earlier conversion of laparoscopic to open abdominopelvic surgery, or use of Doppler ultrasound to identify key structures

- Hospitals with inexperienced operators performing technically difficult procedures may experience patterns of similar events
Postoperative Respiratory Failure

- **Coding**
  - Avoid using 96.04 code when intubation is an expected part of a subsequent procedure
  - Short term intubation, such as overnight, should not be coded as respiratory failure unless clinical criteria are satisfied

- **Clinical**
  - Evaluate causation - oversedation in one hospital was a leading cause of respiratory complications
  - Improve documentation of reasons for re-intubation or prolonged ventilation (on an ongoing basis)
  - Some patients probably could have been extubated earlier (and would then not have counted as respiratory failure)
  - Significant underuse (or underdocumentation) of lung expansion modalities, such as incentive spirometry
### PSI 12: Post DVT/PE

**Initial findings**

<table>
<thead>
<tr>
<th>United HealthSystem Consortium Cohort (n=450)</th>
<th>Coding</th>
<th>Clinical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>80% (46-100%)</td>
<td>100%</td>
</tr>
<tr>
<td>Specificity</td>
<td>99.5% (99.3-99.6%)</td>
<td>98.6% (98.6-99.2%)</td>
</tr>
<tr>
<td>Positive Predictive Value</td>
<td>87% (67-79%)</td>
<td>44% (36-52%)</td>
</tr>
<tr>
<td>Negative Predictive Value</td>
<td>99.6% (98.9-100%)</td>
<td>100%</td>
</tr>
</tbody>
</table>

| VA Cohort (n=112)                           |        |          |
| Positive Predictive Value                   | 43% (34-53%)   |          |

| AHRQ Cohort (n=121)                         |        |          |
| Positive Predictive Value                   | 84% (72-95%)   | 48% (42-67%)  |

University HealthSystem Consortium cohort includes 505 flagged, randomly sampled surgical cases from 33 volunteer hospitals in 21 states; 450 cases were fully abstracted and submitted to UHC.
PSI 12: Postoperative DVT/PE Opportunities for Improvement

- Watch for inadequate documentation, such as “rule out” DVT or PE without alternative diagnosis established after study

- Use new ICD-9-CM codes to capture chronic VTE and upper extremity events

- More timely (day 0) use of pharmacologic prophylaxis may be beneficial, especially for perioperative patients at intermediate risk and without contraindications (consider adequacy of mechanical prophylaxis alone)
Postoperative DVT/PE after TKA
Follow-up study of PPV in 15 academic centers

- Positive Predictive Value
  \[ \text{Positive Predictive Value} = \frac{TP}{(TP + FP)} \]
  \[ = \frac{125}{(125 + 1)} \]
  \[ = 0.992 \]

- 126 VTE flagged by PSI 12 (+4 Readmission)
- 125 cases True Positive postop lower ext DVT or PE
- 1 case clinical False Positive (superficial) saphenous Vein
Postoperative DVT/PE after TKA
Follow-up study of NPV in 15 academic centers

- Negative Predictive Value
  \[= \frac{TN}{FN + TN}\]
  \[= \frac{458}{458 + 3} = 0.993\]

- Sensitivity estimate = 96% (95% CI: 86-100%)
  100% if limited to acute DVT or PE

- 463 cases not flagged as VTE by PSI 12
- 5 cases had VTE per UHC abstract
- 458 cases had no VTE (TN)
- 3 cases False Negative
  2 cases superficial or upper extremity thromboses
PSI 9: Postoperative Hemorrhage/Hematoma

- Screens for hemorrhage or hematoma requiring operative treatment following a surgical procedure

- 31 hospitals from 11 states

- N=181 flagged and N=281 unflagged records
  - PPV = 78% (95% CI 62-95%)
  - NPV = 99.7% (98.9-99.9%)
  - Sensitivity = 49% (26-72%)
  - Specificity = 99.9% (99.7-100%)
PSI 9: Postoperative Hemorrhage or Hematoma

- Impact of true positive cases was significant (i.e., most returned to OR), but opportunities for improvement are unclear
- Logic of indicator may capture both intraoperative and postoperative hemorrhage (especially if bleeding persists after surgery)
- Most cases not related to anticoagulants or antiplatelet agents
- Sensitivity might be improved to 87% by adding certain procedure codes to indicator
- Specification of diagnosis codes as “postoperative” may improve PPV
PSI 10: Postoperative Metabolic Derangement

- Screens for acute kidney injury requiring dialysis and diabetes-related coma, ketoacidosis, or hyperosmolarity following an elective surgical procedure

- 35 hospitals from 11 States

- N=94 flagged and N=230 unflagged records
  - PPV = 84.9% (95% CI 78.0-91.9%)
  - NPV = 98.7% (97.3-100.0%)
  - Sensitivity = 96.3% (90.4-100.0%)
  - Specificity = 94.2% (86.2-100.0%)

- Higher validity when limited to renal cases
Postoperative Metabolic Derangement-Acute Kidney Injury

• Majority of flagged records (86/94) were due to postoperative acute kidney injury requiring dialysis
  – 1/3 died; of the remaining, 38% required dialysis post-discharge

• Peri-operative hypovolemia & poor renal perfusion were the leading cause (when stated)

• Earlier recognition of renal failure may be beneficial

• Evaluate use of nephrotoxic medications, especially NSAIDs in postoperative setting

• Review ionic contrast documentation & use

• Dialysis before the first operative procedure and advanced renal failure present on admission were the leading causes of false positive records (should improve with POA codes)
Postoperative Metabolic Derangement-Diabetic Complications

- Most diabetic complications occurred in the PACU or ICU

- Although several records did not meet coding criteria for diabetic complications, there appears to be opportunities to improve glucose management
  - Non-symptomatic hypoglycemia in the PACU/ICU
  - Glucose >400 mg/dl without mention of DKA or hyperosmolarity
  - Tighter blood sugar control and monitoring esp. in type I DM post-operatively
  - Consider insulin drips instead of implanted pumps and/or SQ in the immediate postoperative period
Number of Codes

Figure 9. PSI Rates with Fewer Codes
Procedure Dates

Figure 8. PSI Rates w/o Dates of Procedure

- Decubitus Ulcer
- Postop Hemorrhage or Hematoma
- Postop Physio Metabol Derangement
- Postop Respiratory Failure
- Postoperative Hip Fracture
- Postoperative PE or DVT
- Postoperative Wound Dehiscence
Present on Admission

- Option in AHRQ software as of March 2007

- In general, when the outcome of interest is POA, the case is excluded from the denominator

- Indicators most impacted by POA events
  - Failure to rescue
  - Foreign body
  - Postoperative hip fracture
  - Postoperative physiologic metabolic derangement
PSI 3: Pressure Ulcer

- 32 UHC Academic Medical Centers
  - N= 1995 flagged records
  - N= 4007 unflagged & high risk records
  - Feb-June 30, 2008

- Version 3.1 – No POA information
  - PPV = 28.3% (95% CI 23.6-32.9%)
    - POA accounted for 76% of the false positives
  - Sensitivity = 48.2% (95% CI 41.0-55.3%)
  - Specificity = 71.4% (95% CI 68.3-74.5%).
PSI 3: Pressure Ulcer

- Events POA and poor documentation were responsible for the low performance of this indicator.
- Reclassifying records based on reported POA information and PU stage to approximate version 4.3 of the indicator improved:
  - Sensitivity (78.6; 95% CI 62.7-94.5)
  - Specificity (98.0; 95% CI 97.1-98.9)
  - But not PPV (23.8; 95% CI 12.2 -35.6%).
- New PU codes that including staging and use of POA information should improve indicator performance.
- With financial outcomes at stake and increasing public disclosure of hospital outcomes, many hospitals are working on improving documentation.
Pressure Ulcer—ample opportunities for improvement

- 52 (5.3%) were stage III or IV at the time of discovery
- 41.9% with a stage III/IV ulcer, had an additional PU
- In 220 cases (22.4%), the stage was not documented
- Documentation was complete in 3.6% (median) at time of discovery (location, dimensions, exudate, site)
- Most HA-PU (68.9%) were still present at discharge
- Physician documentation was present in only 44.4% of HA-PU, representing 67.6% of true positive cases, and 66.1% of all stage III/IV ulcers
- Large number of skin injuries that were not classified
- Turning every 2 hr- was present in only 49%, although 61.5% were in ICU
Summary

- AHRQ QI use readily available and inexpensive administrative data to reflect quality of care inside hospitals, focusing on potentially avoidable complications and related iatrogenic events.

- AHRQ software provides 4 different types of rates
  - Observed, expected, risk-adjusted, and smoothed
  - Risk adjusted rates should be used for tracking over time and for hospital comparisons
  - Smoothed rates are more reliable for hospitals with low numbers and will result in smaller year-to-year fluctuations

- By reviewing records for the condition of interest, documentation, coding, and adherence to national guidelines, hospitals can best tease out opportunities for improvement.
Acknowledgments

- Mamatha Pancholi, AHRQ Project Officer
- Jeffrey Geppert, Project Director, Battelle Health and Life Sciences
- Patrick Romano, MD, MPH, PI and Clinical Lead
- National partners