

Summary of Risk Variable Reselection (RVR) Technical Expert Panel (TEP) Evaluation Measures

Chapter 4, Deliverable 4-3j

Centers for Medicare & Medicaid Services: Measure Instrument Development and Support

Development, Reevaluation, and Implementation of Outcome/Efficiency Measures for Hospitals and Eligible Clinicians, Hospital Option Period 2

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Center for Outcomes Research and Evaluation Project Team

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Summary Report of Technical Expert Panel Meetings: Reevaluation of CMS Claims-based Hospital Outcome Measures (Risk Variable Reselection)

Background

The Centers for Medicare & Medicaid Services (CMS) has contracted with Yale New Haven Health Services Corporation — Center for Outcomes Research and Evaluation (CORE) to reevaluate CMS hospital claims-based outcome measures previously developed by CORE. As part of this project, CORE is working to determine if modifications can be made to improve the statistical model performance and face validity of the measures.

CORE is obtaining stakeholder input on this work and has assembled a national Technical Expert Panel (TEP) of clinicians, health services researchers, statisticians, patient advocates, and other stakeholders. The TEP is providing input to help shape considerations for methodological approaches to risk variable reselection.

This report presents the CORE measure reevaluation team and the TEP members, and summarizes the issues discussed, as well as feedback and recommendations received from the TEP during its first two meetings. CORE will update the report to include feedback and recommendations from future meetings as they occur.

Measure Reevaluation Team

The CORE measure reevaluation team consists of individuals with expertise in outcome measure development, health services research, clinical medicine, statistics, and measurement methodology. This work is led by co-leads Kashika Sahay, MPH, PhD; Elizabeth W. Triche, PhD; and Shu-Xia Li, PhD. Lisa G. Suter, MD Director at CORE and Professor of Medicine at Yale University School of Medicine, oversees the work. See [Table A1](#) in Appendix A for a list of the CORE measure reevaluation team members.

As part of the reevaluation work, the Risk Model Re-specification team is actively working to update the risk-adjustment methodology for all 21 hospital claims-based outcome measures currently in public reporting (see table 1 below). The goal of this work is to improve the validity of the measures and to address stakeholder concerns.

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Table 1: 21 Hospitals Claims Measures Currently in Public Reporting

Hospital Readmissions Reduction Program (HRRP) ¹	Hospital Value-Based Purchasing Program (HVBP) ¹	Inpatient Quality Reporting (IQR) ^{1,2}
AMI Readmission HF Readmission PN Readmission COPD Readmission CABG Readmission THA/TKA Readmission	AMI Mortality HF Mortality PN Mortality COPD Mortality CABG Mortality THA/TKA Complications	HWR AMI Payment HF Payment PN Payment AMI EDAC HF EDAC PN EDAC Stroke Mortality
¹ Acute Myocardial infarction (AMI), Heart Failure (HF), Pneumonia (PN), Chronic Obstructive Pulmonary Disease (COPD), Coronary Artery Bypass Graft (CABG), Total Hip Arthroplasty/Total Knee Arthroplasty (THA/TKA) ² Hospital-Wide Readmission (HWR), Excess Days in Acute Care (EDAC)		

This work is led by co-leads Kashika Sahay, MPH, PhD; Elizabeth W. Triche, PhD; and Shu-Xia Li, PhD. Lisa Suter, Director at CORE and Professor in the Department of Rheumatology at Yale University, oversees the work.

Jennifer Robinson, serves as the project’s Contracting Officer Representative, providing ongoing input.

TEP Composition

In September 2019, CORE released a public call for nominations to convene the TEP. Potential TEP members were recruited via emails to individuals, professional societies, and organizations recommended by the measure reevaluation team and stakeholder groups, email blasts sent to CMS email listservs, and through a posting on [CMS’ website](#).

At the time of the first TEP meeting in 2020, the TEP was comprised of 16 members; In 2021, 14 TEP members were able to reconvene at the time of the second TEP meeting. Current participants are listed in [Table 2](#). The TEP is comprised of clinicians, health services researchers, statisticians, patients, patient advocates/caregivers, health insurance representatives, and hospital administrators. The role of the TEP is to provide input to CORE on key methodological and clinical decisions for the risk variable reselection task. The original appointment term for the TEP was from October 2019 through April 2020. We reconvened the TEP in late 2021 after a pause due to COVID-19. The reconvened TEP term was from August 2021 – March 2022.

Responsibilities of TEP members include:

- reviewing background materials provided by CORE prior to each meeting;

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- participating in TEP meetings held by webinar/teleconference; and
- providing input on key clinical and methodological decisions.

Table 2. TEP Roster — Member Name, Professional Role, Organization, and Location

Name, Credentials, and Professional Role	Organizational Affiliation, City, State
Ann Borzecki , MD, MPH; <i>Attending Physician and Research Scientist</i>	<ul style="list-style-type: none"> • VA Bedford Healthcare System, Bedford, VA • Center for Healthcare Organization and Implementation Research, Bedford, MA
Michael Duan , MS; <i>Principal Data Scientist</i>	<ul style="list-style-type: none"> • Premier, Inc., Charlotte, NC
Richard Dutton , MD, MBA; Anesthesiologist, Adjunct Professor, Chief Quality Officer	<ul style="list-style-type: none"> • Baylor University Medical Center • Texas A&M University • US Anesthesia Partners, Dallas, TX
James Huddleston , MD; Orthopedic Surgeon, Professor of Orthopedic Surgery, Chair, Health Policy Committee	<ul style="list-style-type: none"> • Stanford University Medical Center • American Association of Hip and Knee Surgeons, Rosemont, IL
Laura Grangaard Johnson , MPH; Senior Research Analyst	<ul style="list-style-type: none"> • Stratis Health, Bloomington, MN
Ryan Merkow , MD, MS; Surgical Oncologist, Health Services and Outcomes Researcher, Faculty Scholar	<ul style="list-style-type: none"> • Northwestern University, Surgical Outcomes and Quality Improvement Center • American College of Surgeons, Division of Research and Optimal Patient Care, Chicago, IL
Matt Cheung , RPh, PhD, FASHP, FCSHP; Adjunct Professor of Pharmacy, Medical Reviewer and Writer (patient)	<ul style="list-style-type: none"> • Pacific School of Pharmacy • Greenkey Resources, Inc. San Francisco, CA
Karie Fugate , HR Equity Measures and Analytics (patient)	<ul style="list-style-type: none"> • King County, WA
Marian Savage , PhD, RN, NEA-BC, CPHQ, PMP; VP, Quality and Patient Experience, President	<ul style="list-style-type: none"> • Roper St. Francis Healthcare System, Charleston, SC • National Association for Healthcare Quality
Sachin Shah , MD, MPH; Hospitalist, Assistant Professor of Medicine	<ul style="list-style-type: none"> • University of California, San Francisco Medical Center, San Francisco, CA
Lynn Stillman , BSN, RN; Program Manager Payment Innovation	<ul style="list-style-type: none"> • Anthem Blue Cross/Blue Shield of New Hampshire, Bedford, NH

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Name, Credentials, and Professional Role	Organizational Affiliation, City, State
Mary Vaughan-Sarrazin , PhD; Associate Professor, Department of Internal Medicine; Director, Quantitative Unit of Health Services and Clinical Research Core, Investigator	<ul style="list-style-type: none"> • University of Iowa, Iowa City, IA • Iowa City VA Medical Center
Thomas Webb , MBA, PhD candidate; Associate Vice President of Quality Analytics	<ul style="list-style-type: none"> • Rush University Medical Center, Chicago, IL
Bonnie Weiner , MD, MSEC, MBA; Cardiologist, Professor of Medicine, Director Interventional Cardiology Research, Chief Medical Officer, Senior Medical Director	<ul style="list-style-type: none"> • University of Massachusetts Medical School • Worcester Medical Center • Accreditation of Cardiovascular Excellence • Avania, Harvard, MA

TEP Meetings

CORE held its first TEP meeting on March 11, 2020 (TEP Meeting 1) and its second on December 6, 2021 (TEP Meeting 2). CORE anticipates holding additional meetings through 2022 (see [Appendix B](#) for the TEP meeting schedule). This report contains a summary of TEP Meeting 1 and TEP Meeting 2, as well as any feedback received from TEP members via email after the meeting.

TEP meetings follow a structured format. CORE presents key issues identified during measure reevaluation and a proposed approach to addressing them, and TEP members review, discuss, and advise on the issues.

First TEP Meeting Overview

Prior to TEP Meeting 1, CORE provided the TEP members with detailed meeting materials outlining CORE’s current approach to risk adjustment. Materials prepared for the meeting included:

- The slide deck for the meeting
- The meeting agenda
- A backgrounder

TEP members provided input on CORE’s current risk adjustment approach and shared thoughts on approaches to risk variable reselection for CMS’s 21 publicly reported outcome measures.

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Executive Summary of TEP Meeting 1

Overview of Information Presented by CORE

CORE:

- Presented a high-level overview of risk adjustment
- Introduced CORE's current approach to measure risk adjustment
- Presented a preview of TEP meeting 2

Overview of TEP Feedback

The TEP provided feedback on CORE's risk adjustment approach. Specifically, the TEP's feedback included:

- Questions about CORE's risk adjustment approach, including which data sources are used, whether Medicare Advantage patients are included in the measure cohorts, and how CORE conducts vetting of clinical risk variables
- A concern about the conceptual approach to risk adjustment

Detailed Summary of TEP Meeting 1

CORE welcomed participants, introduced the CORE project team, presented the TEP confidentiality agreement, and conducted roll call of meeting participants; 14 of 16 TEP members were in attendance. CORE noted they would reach out to TEP members not in attendance for their input.

CORE provided an overview of the risk variable reselection (RVR) project and reviewed goals of the meeting, including an introduction to risk adjustment, CORE's current approach to risk adjustment, and obtaining the TEP's feedback on the best approaches for reselecting clinical risk variables for 21 of the claims-based hospital outcome measures currently in CMS public reporting programs.

Introduction to Risk Adjustment and Current Risk Adjustment Approach

CORE Presentation to the TEP on Risk Adjustment

- CORE provided an overview on risk adjustment in the context of quality measurement, and CORE's processes for identifying candidate clinical and demographic risk factors, as well as their approach to considering social risk factors (SRFs) in measure risk-adjustment models.
- We noted that CORE compiles a list of clinical and demographic factors that have a conceptual relationship with the measure outcome and are independent of quality of care, generally compiled by examining peer-reviewed literature and receiving input from clinical experts. Clinical risk variables are defined using individual International Statistical Classification of Diseases, Tenth Revision (ICD-10) codes and

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Hierarchical Condition Categories (HCCs), which group ICD-10 codes into clinically similar groups.

- CORE reviewed the steps taken to test the clinical and demographic variables for inclusion in the risk model, and how the candidate risk variable list is narrowed, using analytic methods including stepwise logistic regression and bootstrapping. Final risk models are based on overall model performance, clinical sensibility, and parsimony.
- CORE noted SRFs are considered, examining the conceptual and empirical relationship between the SRF and outcome, the SRF's accessibility in the data, and influence on hospital-level effects. Inclusion of SRFs is impacted by additional factors such as potential unintended consequences, existing CMS programmatic adjustments, alternative program-level approaches, and tradeoffs for each measure.

TEP Questions/Feedback and CORE responses

- TEP question: Among claims under consideration, both for the readmission outcome and the 12-month lookback period, are Part B claims included in addition to hospital claims?
 - CORE response: Only inpatient claims are used to identify the readmission outcome, but the 12-month lookback period for the condition- and procedure-specific measures uses both inpatient and outpatient claims to identify risk variables.
- TEP question: Does CORE include Medicare Advantage patients in the measure cohorts?
 - CORE response: Medicare Advantage patients are currently excluded from the measures because they do not have associated claims; CORE, under contract to CMS, is currently working on further analyses to investigate methods for potentially incorporating Medicare Advantage patients into measures moving forward.
- TEP question: How are risk variables clinically vetted?
 - CORE response: Regarding clinical vetting, engagement begins during measure development, including review of codes with TEPs, in-house clinical experts, and external clinicians and researchers. During measure reevaluation, CORE continues to consult with clinicians and researchers to vet newly released ICD-10 codes.
- TEP comment: The outlined approach to identifying variables based on conceptual association may be flawed; many variables screened based on bivariate associations may be mediators, rather than confounders, and would not be appropriate to include in risk models.
- TEP question: How are factors such as gender and race considered in the risk models, given the existing controversy over whether these patient-level factors should be considered genetic or demographic in nature?

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- CORE response: CORE seeks to include biological, clinical, demographic, and comorbid conditions in risk models and carefully reviews these variables individually on a measure-specific basis.
- One TEP member asked if CORE could walk through a step-by-step example of how the risk adjustment process is conducted.
 - CORE noted they would present an example of the risk model development process at the next TEP meeting.

Second TEP Meeting Overview

Prior to TEP Meeting 2, CORE provided the TEP members with detailed meeting materials outlining CORE’s current approach to risk adjustment. Materials prepared for the meeting included:

- The slide deck for the meeting
- The meeting agenda
- A backgrounder with key definitions and terminology
- A preview video with an example of current risk adjustment strategies

TEP members provided input on CORE’s current risk adjustment approach, and shared thoughts on approaches to risk variable reselection for the hospital measures with a specific focus on frailty and data feature engineering. TEP members were given an example of Heart Failure Mortality to discuss and engaged in several round-robin discussions about the overall approach. TEP members were generally positive about the data feature engineering approaches. They had some concerns about potential gaming and a need for reevaluation efforts to ensure that hospitals with different present-on-admission (POA) coding guidelines were not penalized.

With respect to frailty, some TEP members wondered if individual codes relating to frailty would already be captured and the model may be artificially overfit with an additional frailty term.

Executive Summary of TEP Meeting 2

Overview of Information Presented by CORE

CORE:

- Presented a high-level overview of timeline for risk model re-specification over multiple years
- Provided background on current risk variable selection approaches and potential innovations using code-based and condition category-based features
- Solicited feedback with respect to the data feature engineering approach
- Discussed empirical results relating to different operational definitions of frailty
 - The goal is not to agree to a single definition of frailty, but to consider different statistical and data-based approaches to capturing frailty.

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- Presented a summary of next steps for future engagement over a series of meetings over the next couple of months/years

Overview of TEP Feedback

- The TEP provided feedback on CORE’s data feature engineering approach and frailty examples. The TEP asked about how the POA logic is applied to diagnosis codes. The TEP was interested to evaluate frailty data and wondered if an indicator variable comprised of individual ICD-10 codes differs from including the same codes individually within the risk model.
- The TEP noted concerns about:
 - Correlation/association versus causation of model inputs
 - Differences in hospital coding practices, including:
 - Under-coding
 - Variation in coding requirements for critical access hospitals (CAH) that may have implications for their coding practices
 - Predictive model may show a negative coefficient, but this does not correspond to a “true” reduction in risk (ex. hypertension has a negative coefficient)
 - Conflation of causal inference and predictive value in the risk model: note that identifying causal predictors requires a whole different approach than risk model development and that negative predictors are just a feature of prediction models; trying to manipulate those and weed out certain predictors will only lead to decrement in predictive function.
- The TEP offered suggestions, including:
 - Potentially removing risk variables with negative coefficients to avoid hospital gaming
 - Consideration of a penalty in the model to deprioritize gameable codes (ex. palliative care)
 - Including clinical adjudication to support the accuracy of administrative data elements used for risk modeling
 - Suggesting the use of bootstrapping for model estimates
 - Concerns about definitions of frailty and how upcoding may favor high resource hospitals
 - Agreement with the overall approach to consider ICD-10 codes individually and as part of condition categories (CCs)

Detailed Summary of TEP Meeting 2

CORE welcomed participants, introduced the CORE project team, presented the TEP confidentiality agreement, and conducted roll call of meeting participants; 12 of 14 TEP members were in attendance. CORE team members were introduced, and participants shared their credentials and interest in being on this TEP. The discussion was divided into two broad topics: clinical data feature engineering and risk adjustment for patient frailty, with round robin

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discussion at the end of each topic. After content discussion, the facilitator asked for TEP feedback on the logistics of the TEP meeting and the CORE team discussed next steps for TEP engagement.

Data Feature Engineering

CORE Presentation to the TEP on Data Feature Engineering

- CORE described a hybrid approach to data feature engineering that includes individual ICD-10 codes and CCs to be input separately. A hybrid approach will allow CORE to select a parsimonious set of important individual ICD-10 codes while grouping other codes in CCs and combined CCs; Grouping codes with similar clinical and statistical characteristics may reduce the number of model inputs, while also potentially reducing the potential for gaming.
 - CORE clarified that feature engineering at the grouper level includes separating the conditions noted on the index admission claims from those on the historical claims, splitting broad CCs to allow for highly predictive codes to influence model characteristics, and combining CCs where there is clinical and statistical similarity among included codes.
 - CORE summarized the approach for risk model optimization, noting the pragmatic goal is to test and validate the model approach through an iterative process that includes identifying the most consistently predictive ICD-10 codes, examining the impact of the codes within the existing CCs, restructuring CCs based on these results, and testing model performance and face validity.
 - CORE asked for feedback on the validity of this approach and any items that should be considered in greater detail.
 - Individual code analysis demonstrates tradeoffs in the conceptual approach. CORE provided sample results based on a single performance period which included history code frequency, odds ratio range, and the mortality outcome rate range associated with each of these different approaches.

TEP Feedback/CORE Response on Data Feature Engineering

- Several TEP members expressed positive feedback for using individual codes in the reselection process.
- TEP feedback: TEP members expressed some concerns about negative coefficients and the potential for gaming.
 - CORE response: The goal of quality improvement efforts is not to establish causation, but rather measure a quality signal between hospitals.
- One TEP member noted that an important goal of the overall approach should be to improve the model c-statistic.
- One TEP member noted critical access hospitals (CAH) have variation in coding requirements especially with respect to POA codes. Thus, there is a need to stratify by hospital type to ensure coding practices do not unfairly penalize rural hospitals.

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- One TEP member noted considering adding a penalty in the regression model to deprioritize gameable codes.
 - CORE response: CORE noted that payment algorithms are determined by CMS and cautioned that the scope of this discussion is risk adjustment; the purpose of risk adjustment is to adjust for differences in case mix, not to identify causation.
- One TEP member noted that having a consistent amount of historical data is important; Another noted that individual codes are potentially subject to gaming and reevaluation activities should consider timing of reselection carefully
 - CORE response: CORE clarified 12 months before the index admission is included as history and reevaluation activities (including risk variable reselection) are scheduled to occur every 3 years.

Frailty

CORE Presentation to the TEP on Frailty

- CORE presented several options for operationalizing the complex construct of frailty as well as a conceptual model for why frailty should be considered.
- Options for operationalizing frailty include:
 - using the combined CC approach, or ‘Marked Disability and Frailty,’ which incorporates the Healthcare Common Procedure Coding System (HCPCS) codes and use of durable medical equipment (DME), such as power wheelchairs and oxygen;
 - including frailty-related ICD-10 codes shown in the literature to predict decline;
 - using a count of relevant frailty codes in a patient’s history; and/or
 - including a validated quantitative scale for frailty, or ‘Claims-based Frailty Index.’
- CORE asked the TEP members to consider whether we should look at a scale-based definition or a code-based approach and if there are other options we might consider.

TEP Feedback/CORE Responses on Frailty

- TEP feedback: ICD-10 codes that currently exist may lack functional status because the coders may not have the information they need for coding these details. Validation might be needed to ensure that the codes accurately reflect the patient’s functional status.
 - CORE response: CORE’s guiding principle for risk variable selection is based on a need to be able to consistently capture standardized selection data within a national database; that does not exist yet for objective measures of frailty.

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- TEP feedback: One TEP member noted that a frailty indicator from ICD-10 codes does not necessarily differ from having the ICD-10 codes as individual variables in the model.
- TEP feedback: CORE should clarify whether frailty will be measures using a ‘Deficit Accumulation Framework for Frailty,’ as opposed to alternative frailty definitions, which includes five specific domains and has not been translated into a claims-based definition.
 - CORE response: CORE used the Harvard validated claims-based frailty index (CFI) as an example of a validated claims-based scale for frailty, but CORE is not proposing implementing the CFI into the risk adjustment model.
- TEP feedback: It is possible individual codes stand by themselves to describe frailty. However, some codes could be grouped into an indicator variable when that makes sense, rather than trying to construct a composite rating score.
 - CORE response: CORE is looking at the potential additive effect of a separate frailty variable above and beyond the individual codes.
- TEP feedback: Disease registries such as cardiology often incorporate frailty and functional scales; CORE should consider the use of the functional scales more broadly, however availability of functional scales may vary significantly.
 - CORE response: CORE acknowledges that it is challenging to incorporate functional status into a claims-based metric in a standardized way. CORE stated that several of the validated claims-based scales use the deficit accumulation framework.

Input Received After Second TEP Meeting

One TEP member asked questions about the implications of risk adjustment for payment purposes. CORE responded via email that the risk adjustment we work on is for calculating risk scores in a standardized way to compare hospitals across the country. CMS programs make decisions relating to payment through other mechanisms that are not the focus of the current project.

Next Steps

The next steps for this TEP include moving forward with the risk variable reselection for the mortality measures.

- In the next phase of interaction, the TEP will have a deeper discussion about SRFs; participants can look forward to communication about their availability in early 2022.
- The RVR team will circulate this report to TEP members for feedback as well as brief CMS on the TEP discussion points.
- CORE will reconvene the TEP to review empirical results once we have tested the model.

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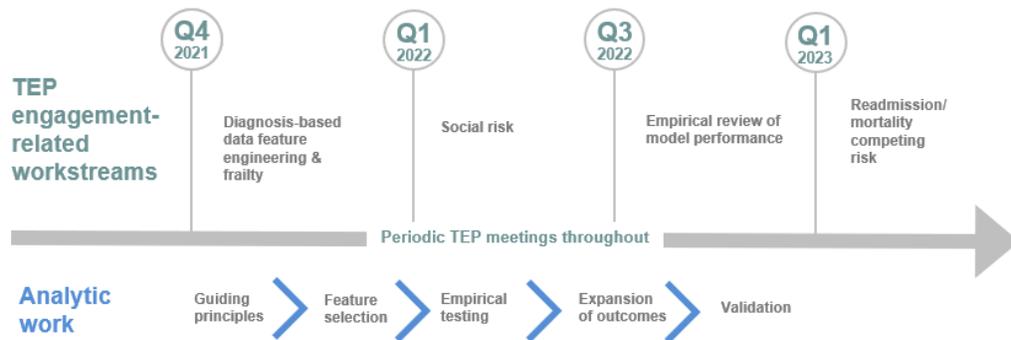
- In addition to meetings, CORE expects to use ad hoc surveys and informal feedback sessions to obtain feedback on social risk considerations, frameworks, and data structures.

Ongoing reevaluation efforts described in the next section will include implementing the approaches discussed with the TEP and sharing additional empirical results for TEP review.

Ongoing Reevaluation

Ongoing reevaluation work will focus on individual code analysis and selection using machine learning techniques to identify the codes and CCs that should be selected. We will follow up with the TEP with respect to empirical strategies for assessing social risk.

Figure 1:Ongoing Reevaluation Process Timeline



Conclusion

The TEP provided valuable feedback on conceptual and operational strategies for feature selection and frailty variables. The TEP was generally positive about data feature engineering and was interested in seeing the empirical results for frailty. Future activities will focus on social risk adjustment and an expansion of the empirical results and measures tested.

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Appendix A. CORE Reevaluation Team

Table A1. Center for Outcomes Research and Evaluation (CORE) team members for Risk Variable Reselection reevaluation team

Name	Team Role
Kashika Sahay, MPH, PhD	Project Co-lead
Elizabeth Triche, PhD	Project Co-lead and Associate Director
Shu-Xia Li, PhD	Project Co-lead and Associate Director
Karen Dorsey Sheares, MD, PhD	Subject Matter Expert
Lisa G. Suter, MD	Project Director
Zhenqiu (ZQ) Lin, PhD	Analytic Director
Chenxue (Tracy) Liang, MS, MPH	Statistician
Shelby Brewer, MPH	Project Coordinator
Emily Bean, MPH	Research Associate
Anna Sigler, MPH	Project Manager

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Appendix B. TEP Meeting Schedule

CORE will engage and seek input from the TEP as they develop the measure through email communication and meetings:

1. **TEP Meeting 1:** Wednesday, March 11, 2020; 5:00-7:00PM EST (Location: teleconference/webinar)
2. **TEP Meeting 2:** Monday, December 6, 2021; 2:00-4:00PM EST (Location: teleconference/webinar)
3. **TEP Meeting 3:** TBD Early 2022 (Location: teleconference/webinar)

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