Incorporating Social Drivers of Health Data into Risk Stratification Models to Address Health Inequities: Defining the PRAPARE Stakeholder-Vetted Risk Stratification Model

Introduction

Risk stratification can be defined as a process for identifying and predicting patients that are, or are likely to be, at high risk and prioritizing the management of their care to improve their health and narrow health disparities. Organizations across the country increasingly employ various risk stratification methods in order to target high cost or otherwise complex patients who may benefit from resource intensive services that may not be widely available across a given setting. In using risk stratification, health centers hope to identify and understand the needs of this high-risk, high-cost group and create effective care-management programs for these patients in an attempt to improve patient outcomes and reduce the cost of care. Health centers also use risk stratification to inform the allocation of resources to care teams, prioritize care team workloads, determine the types of staff trainings needed for managing care, and identify manageable panel sizes for care managers and care teams. The National Academy of Medicine has also stressed the importance of risk stratification and has identified it as a salient priority in its “Vital Directions for Health and Health Care”.

However, recent research has shown that current Risk Stratification Models are significantly flawed, mainly because they rely on limited data to predict patient risk. These flaws include an inability to accurately assess patient risk, bias against racial minority patients, and bias towards patients with costly health conditions (e.g., patients near the end-of-life or patients with costly chronic conditions like end-stage renal disease). Currently, most prominent Risk Stratification Models use claims and utilization data to predict patient risk, but research has shown that clinical, claims, and utilization data only account for 10% of patient health outcomes. Thus, the major issue with these current models is that they fail to take into account the numerous variables that contribute to patient health. Most glaringly, these models fail to incorporate social drivers of health (SDOH), which have repeatedly been shown to drastically impact both patient health and the cost of health care.

In order to address the need for a risk stratification method that incorporates SDOH data, the Association of Asian Pacific Community Health Organizations, the National Association of Community Health Centers, the Oregon Primary Care Association and stakeholders collaborated to develop an evidence-based and stakeholder-driven approach to develop one of the first national Risk Stratification Models that incorporates SDOH data, using the Protocol for Responding to & Assessing Patients’ Assets, Risks & Experiences (PRAPARE). PRAPARE is a nationally recognized and standardized patient risk assessment tool built into the electronic health record (EHR) that is designed to assess and address patients’ SDOH needs. PRAPARE is the leading social risk screening tool used by federally qualified health centers and Medicaid managed care organizations and is commonly used by other health systems as well. PRAPARE is both evidence-based and stakeholder-driven, containing measures on 21 SDOH domains that align with national initiatives, including the standardized codification sets under ICD-10 and LOINC as well as health centers’ Uniform Data System (UDS).

In this paper, we describe our process in the development of the PRAPARE national standardized Risk Stratification Model using quantitative and qualitative feedback from federally qualified health centers. Health centers serve as ideal testing grounds for such a model given that the patient population at health centers have complex chronic conditions and multiple SDOH-related needs. The development and definition process used a collaborative, community stakeholder process to define the foundational and implementation principles and criteria, use case scenarios, intervention recommendations, and benefits of our stakeholder-vetted risk stratification model. The final version of this model incorporates clinical, mental health/substance use, SDOH, demographic, and utilization data to generate a comprehensive patient risk score and can be used on a patient, health center, and community/state/national policy level. This model features a local option, whereby health centers can modify the national model to better reflect the needs and resources of their patient population.

Methods
Development of the PRAPARE Risk Stratification Learning Collaborative (LC)

In developing our Risk Stratification Model, we first conducted an environmental scan of existing Risk Stratification Models in the published literature, focusing primarily on models that incorporate SDOH data while also considering current Risk Stratification Models that do not incorporate SDOH data. Overall, this scan revealed that there was no Risk Stratification Model in existence that featured a systematic and comprehensive method of incorporating SDOH data and a literature review of population segmentation methods emphasized the need for such a model, stating that health systems “need more efficient ways to routinely capture social and behavioral information” to be effective in their risk stratification processes. We also briefly scanned the models that did not incorporate SDOH to better

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understand the context around risk stratification modeling. Overall, we identified two primary lessons learned from these models:

1. Risk Stratification Models are most effective when they include both quantitative (e.g. billing and claims data) and qualitative (e.g. physician referral) data.
2. In order to increase clinical relevance, a Risk Stratification Model must incorporate clinical, patient, and stakeholder input during its development and utilization.

To develop and test the PRAPARE Risk Stratification Model, we launched an applicant call for a Learning Collaborative (LC). The goal of the LC was to leverage the experiences of the stakeholders to develop an improved and stakeholder-vetted national standardized PRAPARE Risk Stratification Model with options for localized methodologies. The LC included nine community health center stakeholders across eight states, including state Primary Care Associations, each of whom had incorporated PRAPARE data into their existing custom risk stratification method. Participants from each LC team included active clinicians or managers, social and enabling service providers or managers, quality improvement staff, and key leadership. In recruiting input from stakeholders who were ingrained in their communities, the LC sought to highlight the voice of those who understand the needs of their patients the best.

The project team hosted five sessions monthly from May to September 2019 with the LC teams to discuss their experiences and recommend approaches to a national Risk Stratification Model that includes SDOH data, gather stakeholder feedback on the components and design of the model, and to discuss results from rapid testing of the draft models. A final face-to-face harvest meeting was conducted in November 2019 to finalize the Risk Stratification Model for pilot testing. The PRAPARE National Risk Stratification Learning Collaborative discussed five iterations of the model based on comments received from the teams and was finalized at the harvest meeting in November 2019 for next steps in testing.

Development and Definition of the Risk Stratification Model

Throughout the LC, we gathered input and feedback from the teams including their best practices and lessons learned in developing Risk Stratification Models incorporating PRAPARE SDOH. We examined and crosswalked each team’s current Risk Stratification Models and implementation practices to compare with the models found in our literature review. We used a variety of assessments including monthly surveys, discussions, and polls, to gather qualitative input on the most appropriate methodologies to integrate PRAPARE SDOH and other clinic data in the models. This qualitative input also formed the basis for many of our foundational and implementation principles, use case scenarios, intervention recommendations, and benefits of our Risk Stratification Model from a user perspective.

Results

Based on qualitative and quantitative Learning Collaborative (LC) Plan, Do, Study, Act (PDSA) evaluation results, the final stakeholder-vetted PRAPARE Risk Stratification Model included four total components: clinical, mental health/substance use, SDOH, and Utilization. For further information regarding the model algorithm, please see “Incorporating Social Drivers of Health Data into Risk Stratification Models to Address Health Inequities: The PRAPARE Stakeholder-Vetted Risk Stratification Model” (Weir, RC, Li, V, Haraguchi, S, Proser, M, Jester, M, Hood-Ronick, C, et al. Manuscript drafted for publication, 2022).

21 Hierarchical Condition Categories (HCCs). https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors
22 Adjusted Clinical Groups (ACG): https://www.hopkinsacg.org/
Components of the National PRAPARE National Risk Stratification Model

Based on input from the LC participants, the PRAPARE Risk Stratification Model incorporated the following components:

1. **Social Drivers of Health (SDOH):** Based on analyses as well as stakeholder experiences and input, we grouped SDOH factors into seven clusters. The SDOH Component was assigned a weight of 40%.

2. **Clinical:** Chronic conditions included in this component were based on existing risk stratification models, experiences, and input from the health center stakeholders. Use of existing national standards were considered for alignment and feasibility for health organizations nationally. The Clinical Component was assigned a weight of 20%.

3. **Mental Health/Substance Use (MH/SU):** MH/SU conditions included in this component were based on existing risk stratification models, experiences, and input from the health center stakeholders. The MH/SU Component was assigned a weight of 20%.

4. **Utilization:** This component included Emergency Department (ED) visits and inpatient hospital stays based on standards and experiences of the health center stakeholders in their own state models. The model weighs inpatient hospital stays higher than ED visits given that inpatient hospital stays are related to worse outcomes. The Utilization Component was assigned a weight of 20%.

Principles of the National Risk Stratification Model

Before creating our model, we worked with our LC participants to discern important principles to be upheld in the creation of the PRAPARE Risk Stratification Model. These principles were fine-tuned with the LC participants after PDSA cycles and during the final Harvest Meeting.

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<th>Foundational Principles</th>
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<tbody>
<tr>
<td>● Model should be automated and require minimal work for the clinic</td>
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<td>● Model should incorporate multiple data sources into risk score calculation (SDOH, behavioral, clinical, utilization data)</td>
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<td>● Data sources should be reliable and standardized (e.g., UDS and ICD 10 codes) across all health organizations to allow for national standardization and comparison</td>
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<td>● Model should use metrics that accurately predict patient risk (e.g., ED admittance), rather than metrics that are easier to obtain (e.g., claims data)</td>
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<td>● Metrics should apply to all patients regardless of race, gender, sexuality, etc. to prevent algorithmic bias</td>
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<td>● Model must be built with clinician and care team input</td>
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<td>● Model must allow for clinician modification of patient risk levels based on available resources and staff</td>
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<td>● Model must be flexible and allow for modification over time based on clinic and community resources</td>
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<th>Implementation Principles</th>
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<td>● Model should be used to inform, but not replace clinical judgment</td>
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<td>● Clinics should use hybrid approach, integrating risk stratification score with clinical judgment</td>
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<td>● Clinics must continuously evaluate risk model to ensure effectiveness</td>
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<td>● Model should be integrated into an easy-to-use workflow</td>
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<td>● Model should feature a low-tech implementation option for clinics with less capacity</td>
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<td>● Model should use a point system of 0-25 where lower scores represent lower risk</td>
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<td>● Clinics should be able to view both the overall risk score and each component’s score to better understand patient needs</td>
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<td>● Model should use standard deviation methodology to define risk tiers to account for risk scores relative to all other patients in the population</td>
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Use Cases of the National and Local Risk Stratification Model

During the LC process, participants identified use cases for the national model. For example, having a standardized national model allows for benchmarking across health organizations. This in turn can facilitate resource allocation, delivery of training and technical assistance, and research. The national model can also provide guidance and recommendations for health centers who are starting to use a risk stratification approach. In addition, EHR vendors and population management vendors seek to incorporate a standardized risk stratification system that is both tested and widely used.

Participants also identified use cases for the local model. With a local model, each health organization has the ability to vary the thresholds for the “high risk” patient group based on interventions available in the health center and resources available in the community. This customizability would allow health organizations to consider their patients’ needs relative to available care interventions and community resources. For example, a health center can decrease the “high risk” threshold for the SDOH component if interventions to address the SDOH need are largely unavailable or inaccessible for patients within their community. The LC participants stressed the importance of inclusion and documentation of standardized SDOH interventions/enabling services categories to improve the local model in the future. Additionally, health organizations will be able to collaborate with their respective care providers and communities to determine the local modifications they want to make to the national model. By including providers and community members in the collaborative decision-making process, health organizations will be able to enhance buy-in amongst providers and allow communities to prioritize what is important to them. Overall, the local model would enable health centers to modify the PRAPARE Risk Stratification Model to make it most effective for the specific communities they serve, while also having a standardized national model benchmark for national comparison.

Intervention Recommendations

The LC participants discussed various intervention recommendations based on a patient’s score which resulted in a risk tier to help guide other organizations in applying the Risk Stratification Model for action. While interventions will look different in each organization depending on the staff and resources available, it was generally acknowledged that information from this Risk Stratification Model should be used during daily pre-visit huddles. Addressing risk scores during the pre-visit huddles will increase better care planning and management by determining which patients will be assigned to particular care team members. The LC participants expressed a desire for customizable “alert mechanisms” that would trigger a particular workflow if certain conditions were identified that the organization considered urgent (e.g., suicidal, homeless, domestic violence, safety, etc.) so that they are not masked by the overall risk score. The group also stressed the importance of using this model to provide care to all patients in payer-agnostic ways, regardless of whether certain staff are funded to care for certain patient populations.

Data Visualization Recommendations

During the LC process, we collected recommendations from the participants regarding how the PRAPARE Risk Stratification Model should be visualized in the EHR. The first recommendation was to construct a data visualization model with the care team in mind. Many suggestions emphasized the necessity of a simple visualization model. LC participants requested an easy-to-use, intuitive system that requires a minimal number of clicks to access the data visualization. They also requested that health centers and care team members be able to view both the raw PRAPARE data (e.g. scores for each condition group) and the Risk Stratification Model (e.g. cut-off thresholds for each risk level) in one touchpoint rather than having to view them separately. Other suggestions highlighted the need for a comprehensive data visualization system. LC participants requested a system in which the health center and care team can view each patient’s overall risk score as well as their score for each of the components (e.g., clinical, utilization, SDOH, etc.) and the patients’ current diagnoses/conditions in each component group. Some LC participants also suggested that each condition grouping within each component have its own cut-offs for risk tiers (e.g., low, medium, high, and very high) and that this risk tier is viewable in the visualization of each patient’s data. For example, if a patient has met criteria for the cardiovascular disease grouping under the clinical component, those specific diagnoses conditions should be highlighted. Some participants also expressed the desire to be able to aggregate and view
**PRAPARE data at different levels.** In other words, they preferred to see individual patient data as well as data for all the patients in the health center, congressional district, state, and nationwide.

LC participants also requested the capability to view gaps in patient data (e.g., if an uninsured patient does not have claims data and is thus missing data to complete the algorithm). Such data is helpful to better understand needs for advocacy, data sharing, or improved internal data infrastructure. Furthermore, LC participants requested the ability to view areas lacking in specific types of community resources (e.g., if an area high in food insecurity has a small number of food banks) which can aid in advocacy for more resources to meet community demand.

In regards to the electronic platform on which the data will be visualized, because not all health centers use population health platforms, they recommended integrating **PRAPARE data into both EHR and population health platforms** to increase accessibility and buy-in for the widest range of health centers possible. Lastly, some LC participants requested that the data visualization use the term “need” rather than “risk” to prevent fear and stigma in conversations with patients.

**Challenges and Solutions**

Participating health centers brought up several salient challenges and suggestions for the PRAPARE Risk Stratification Model. One challenge was the inconsistent access to complete PRAPARE data that made it difficult to compare health centers on a standard. Considering this challenge, the SDOH component was adjusted to allow for flexibility with incomplete data. Another challenge was the difficulty of collecting data (e.g., utilization and cost of care) for uninsured patients. This lack of data could potentially result in the under-representation of uninsured patients. The LC participants agreed to brainstorm and consider various ways that health providers could document these services for uninsured patients through other mechanisms. The LC participants also expressed a need for guidance on how to apply the national and local models. Specifically, they identified the need for explicit guidelines regarding the thresholds organizations would need to meet (e.g., having complete data) in order to use the national model. The development of guidelines and best practices will be a crucial next step to apply the PRAPARE national standardized Risk Stratification Model.

**Benefits of the National PRAPARE Risk Stratification Model**

Based on input from the LC participants we identified six categories that health centers would benefit from using the national PRAPARE Risk Stratification Model.

1. **Improve care management and interventions.**
   In using this model, health organizations will be able to make important decisions regarding care (e.g., the assignment of limited staff and resources) and interventions based on patient risk level, thus enabling them to better meet the needs of patients of all risk tiers.

2. **Standardize and adopt a systematic approach to patient care**
   PRAPARE provides a universal framework with nationally aggregated data that will allow enhanced knowledge sharing and communication between health organizations across the country.

3. **Demonstrate the complexity of patient needs**
   This model will allow health organizations to demonstrate the complexity of their patients’ biopsychosocial conditions as it relates to SDOH related needs, and develop more informed intervention target needs for their most complex patients.

4. **Decrease the total cost of care**
   Implementation of the PRAPARE Risk Stratification Model would allow health centers to prepare nationally for value-based payments and decrease the total cost of care by focusing care on the highest utilizers.

5. **Quality award incentives and participation in shared savings plan**
   This model would enable health centers to qualify for quality award incentives and participate in shared savings plans.

6. **Inform risk adjustment and resource allocation**
   Implementation of this model would provide a set of data to inform and better advocate for risk adjustment and resource allocation to support care coordination at the health organization level.
Discussion

Health providers are increasingly motivated to utilize and improve upon risk stratification methods that can drive care improvements and systemic change at the patient, organizational, community, and policy levels. In this paper, we documented the development of an evidence-based, national standardized Risk Stratification Model that can be tailored to local community efforts to address SDOH needs. In employing the Learning Collaborative (LC) process to develop our model, we engaged key stakeholders to better understand the needs of their underserved patients. We started by creating a stakeholder-based set of principles to guide development, implementation, and use of risk stratification inclusive of SDOH. We developed a model with four components—SDOH/demographic, clinical, mental health/substance use, and utilization data— that were developed based on stakeholder and clinician input and in alignment with national diagnostic codes/initiatives. The local option of our model allows health centers to adjust the weight of these components to best reflect the needs of their specific patient population. In addition to these components, use cases and recommendations were developed to guide patient interventions, as well as visualizations in the EHR. Lastly, our stakeholders identified potential challenges, solutions, and benefits of using the national PRAPARE Risk Stratification Model. Our work seeks to address the widely-identified need for risk stratification methods that incorporate SDOH data and future research is needed to further evaluate the model.

Unlike current Risk Stratification Models, the PRAPARE Risk Stratification Model includes a standardized and comprehensive method of acquiring patient SDOH information, which makes it best equipped to work with underserved communities who face diverse and complex socioeconomic risks. Current Risk Stratification Models rely on claims data which classifies individuals with the highest health care utilization as most “at risk”. Due to this type of classification, these models mask inequities, leaving out individuals who need health services but may not have access due to socioeconomic factors. This is especially important for uninsured patients who are undercounted in existing Risk Stratification Models. The PRAPARE Risk Stratification Model strives to remedy these inequities by incorporating comprehensive SDOH data into the assessment of patient risk.

As health centers and others make broader use of social risk screening tools (e.g., PRAPARE), health center stakeholders express growing interest in the use of risk stratification to better target comprehensive interventions for high risk patients. Risk stratification inclusive of social risk factors can improve population health, better position providers for value-based payment arrangements, and cultivate community partnerships and resources necessary to integrate non-clinical services into the health care setting thus enabling providers to better understand and address their patients’ health needs.

The PRAPARE Risk Stratification Model is useful on multiple levels. On a patient level, the Model will allow care teams to evaluate specific patient needs and respond through shared decision making, priority setting, and appropriate interventions. At the organizational level, using the model assists in determining major improvement areas among their patient population and improving operations in response. Lastly, on the level of community, state, and national policy, the Model would enable the identification of salient domains of need that could be addressed through advocacy, policy change, and care delivery system redesign.

With the finalized draft of a stakeholder-vetted national PRAPARE Risk Stratification Model, we plan to collaborate within a larger multi-state collaborative to develop a PRAPARE national analysis strategy. This will enable us to better understand SDOH national data trends and evaluate the validity, clinical utility, and impact of the model to inform chronic disease risk assessment and detection, treatment and decision-making, as well as outcomes resulting in better management of complex patient needs. Overall, the study will inform the development of national standardized electronic reporting of SDOH and identify optimal risk prediction models that can be used for engaging in organizational, statewide, and national transformation efforts to provide higher quality care to address complex needs of patients. Health organizations and payers are also highly pursuing this information to inform value-based payment and risk adjustment models. Through this effort, we also seek to build capacity for other health organizations and states nationally to effectively report and use standardized SDOH data to identify the most impactful SDOH risk factors for use in their delivery system transformation efforts in their communities, regions, states, and beyond.
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Manuscript Contributions
Rosy Chang Weir: Conceived of the original idea and led the PRAPARE Risk Stratification Learning Collaborative, with significant input from co-authors; Co-conceived model methodology; primary writer of manuscript
Vivian Li: Co-conceived the methodology and algorithm for the model; contributed significantly to the Learning Collaborative; secondary writer of the manuscript
Michelle Proser, Michelle Jester, Carly Hood-Ronick, Joe Lee, Albert Ayson Jr., Shel Lessington: Contributed significantly to the Learning Collaborative process and ongoing idea generation with the Learning Collaborative members
Samantha Haraguchi: AAPCHO intern, contributed significantly with literature review and writing of manuscript
Nalani Tarrant, Yuriko de la Cruz, Sarah Halpin, Jeffrey Caballero, and all authors contributed to the review and revision of the manuscript.

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