

Building risk stratification into a Palliative Care algorithm in the acute care setting

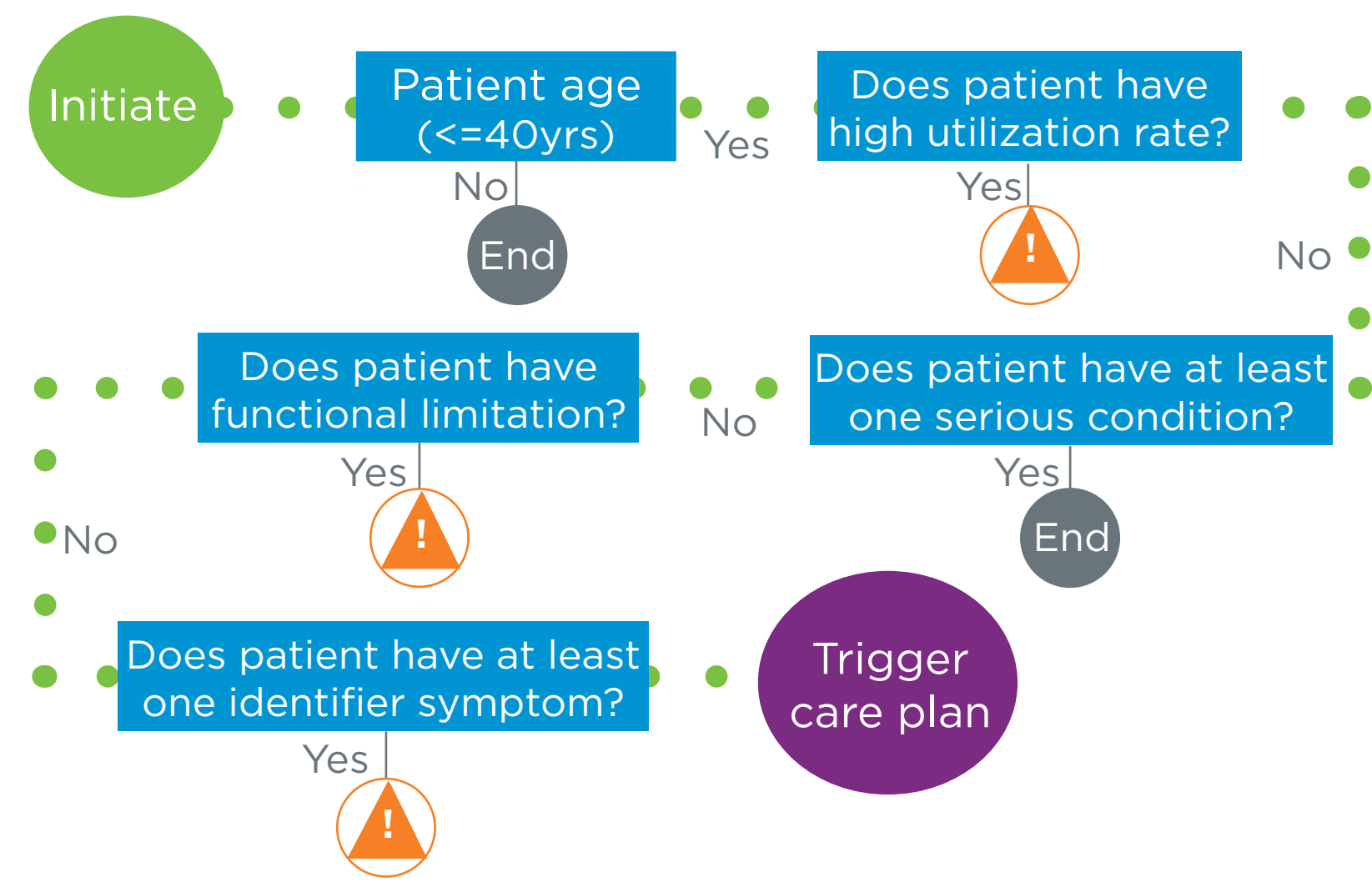
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1. Cerner Corporation; 2. Intermountain Healthcare

Background

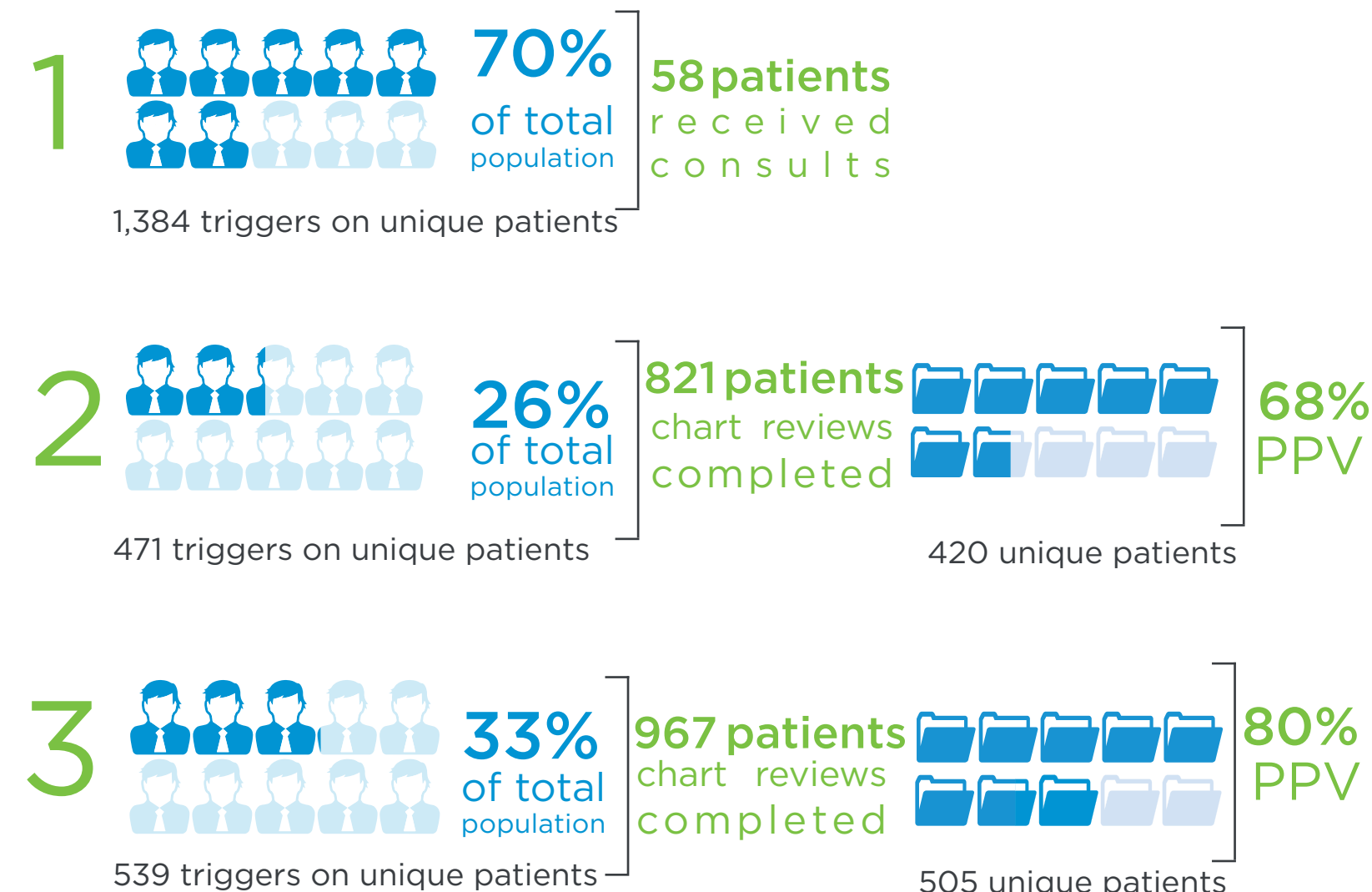
There is growing evidence that timely palliative care is especially needed in the acute care and in-patient hospital settings. Intermountain Healthcare in collaboration with Cerner Corporation has developed a palliative care identification algorithm which leverages historical and near real-time data to identify patients that would benefit from palliative care services at the time of admission.

Electronic palliative care identification algorithm



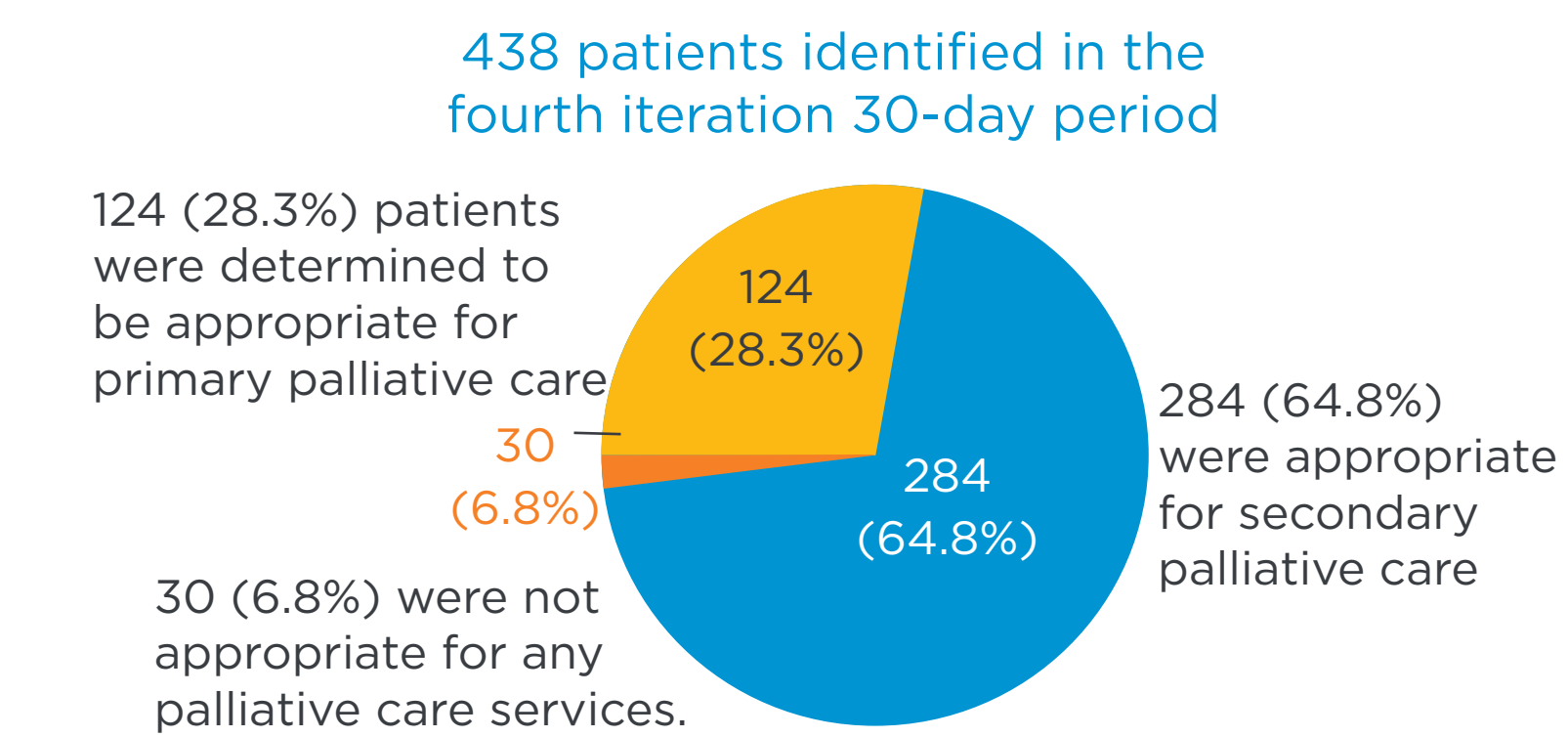
First 3 iterations

We utilized a non-randomized retrospective study design in a non-production technical domain. A mixed-methods approach using qualitative and quantitative methods helped triangulate the data and offered a more in-depth look at palliative care solutions. For the first iteration analysis, we extracted 30 days of silent mode clinical data from the Intermountain Healthcare system. We reviewed results and made adjustments based on a combination of clinical and technical findings. We repeated this process two more times to develop our third iteration algorithm. After 2,000 chart reviews, the algorithm was identifying 26% of the inpatient population as benefiting from palliative care services with a positive predictive value (PPV) of 94%. Risk stratification on the identified patient population would be necessary before going live in a real-world clinical setting.

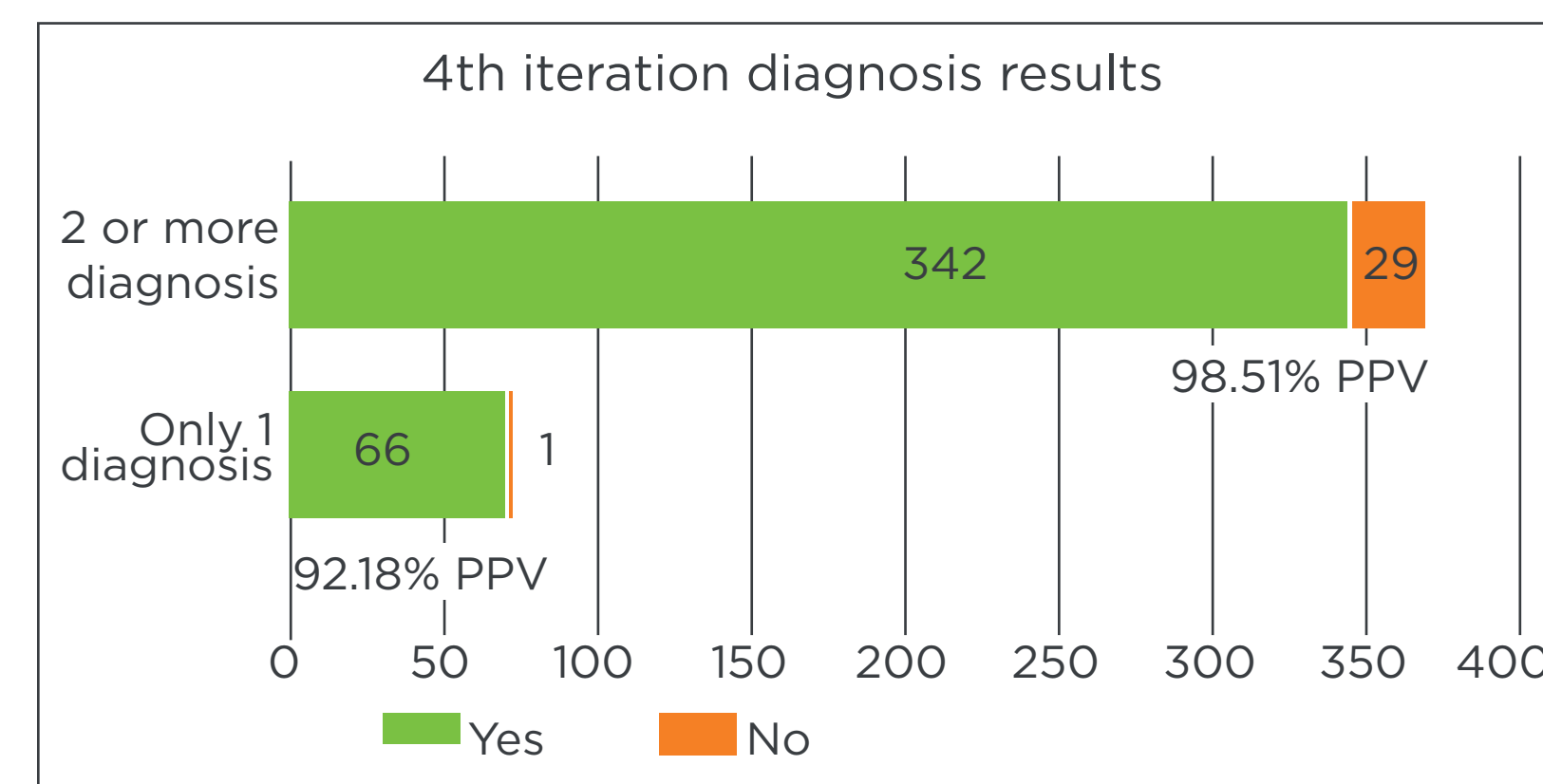


Fourth iteration risk stratification

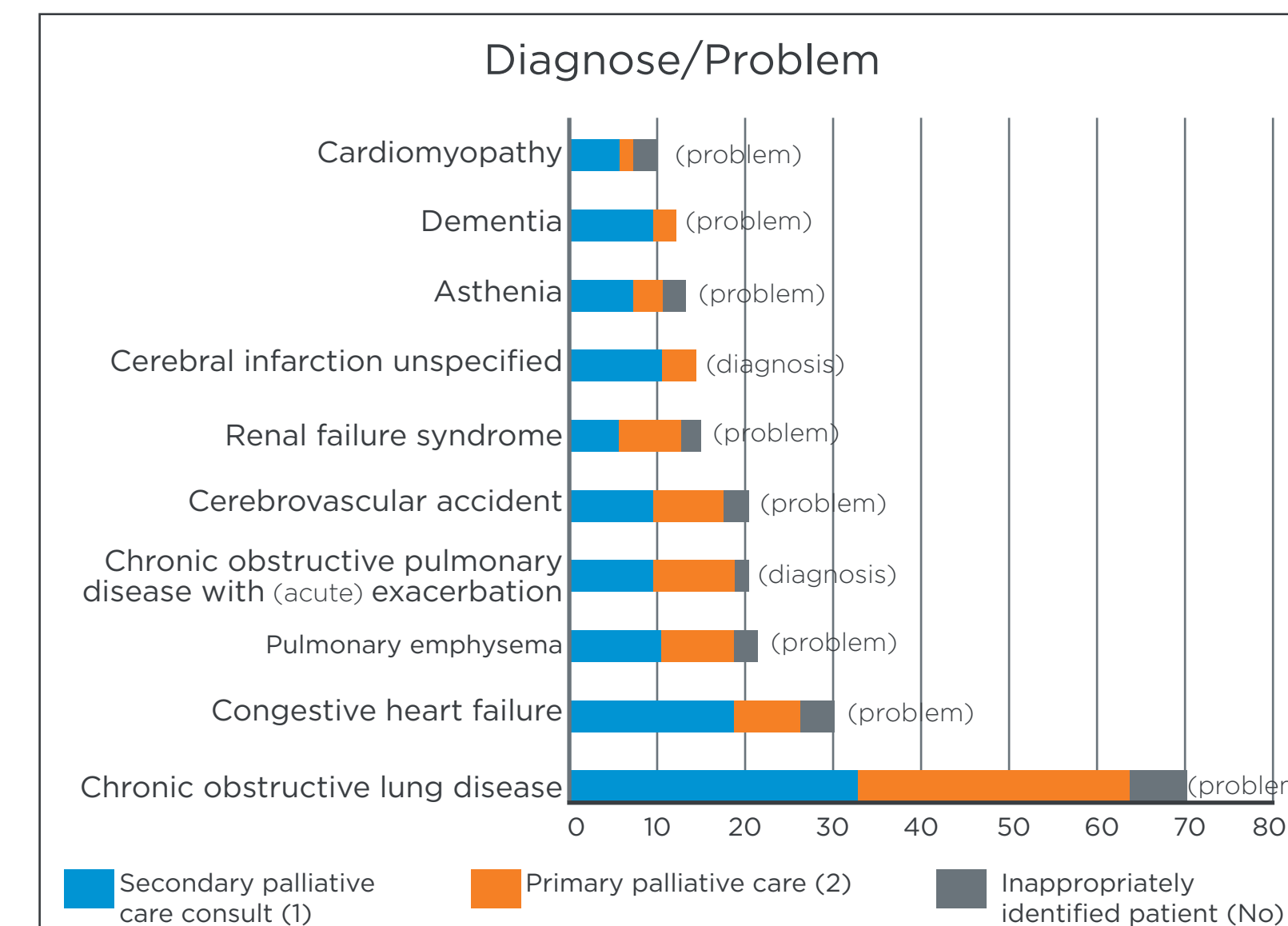
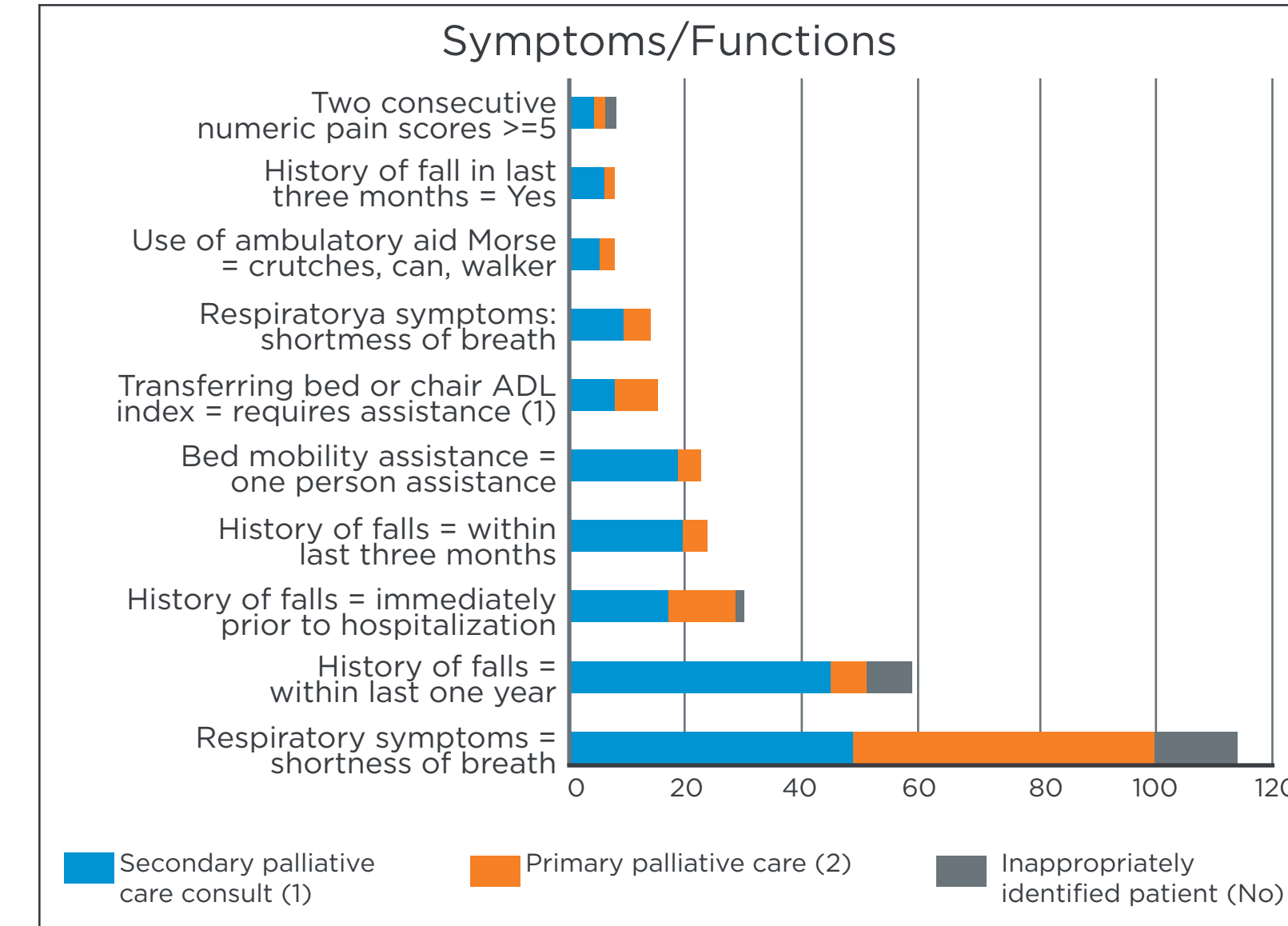
Dr. April Krutka and clinical team continued chart reviews on every patient identified by the algorithm in a silent mode setting, however this time they marked if a patient should receive either primary or secondary palliative care services. For the purposes of this analysis, primary level palliative care was defined as a discussion with a non-palliative care provider (hospitalist or primary care provider) about goals of care, symptom management or advance care planning. Secondary level palliative care was defined as an inpatient or outpatient consult with an expert palliative care provider. An age restriction of 40 years or older was added to the algorithm, as well as 46 additional oncology diagnoses.



This determination was made by Dr. Krutka and her clinical team as they completed chart reviews on every identified patient. Future strategy will involve mimicking clinical intuition and expertise into the actual software rather than manual subjective opinion. Minimal research currently exists to define levels of risk specific to palliative care, therefore Cerner suggested utilizing machine learning to develop a first of its kind data-driven risk stratification.



| | Consult (1) | No consult (2) | No | All |
|-------------|-------------|----------------|----|-----|
| MK_ED | 153 | 79 | 21 | 253 |
| MK_IMC | 33 | 9 | 0 | 42 |
| MK_MED | 30 | 6 | 2 | 38 |
| MK_CVTU | 21 | 6 | 0 | 27 |
| MK_ICU | 15 | 4 | 0 | 19 |
| MK_ORTHO | 7 | 6 | 1 | 14 |
| MK_SIMC | 9 | 3 | 1 | 13 |
| MK_SS_PREOP | 5 | 4 | 2 | 11 |
| MK_REHAB | 5 | 3 | 1 | 9 |
| MK_SS_PACU | 2 | 3 | 1 | 6 |
| MK_SS_OR | 1 | 0 | 0 | 1 |



Future strategy: Predictive data model for risk stratification

Cerner Clinical Intelligence team has begun collaborating with Intermountain palliative care clinicians to develop an individual patient score to predict what risk the patient is at for needing palliative care services. Intermountain could then define specific clinical action dependent on patient risk score. In order to teach the model to early identify serious ill patients, we had to analyze the data downstream by scoring patients against cohort requirements of hospice admission or death within a year of inpatient palliative care encounter. This allowed us to review all data points prior to their palliative care service within Cerner's HealthIntent cloud-based platform (i.e., active medications, diagnoses, problems, procedures, assessments, utilization) to create concept variables for the model. Machine learning algorithms, such as logistic regression, are used to find the optimal coefficients for each variable to provide the most accurate risk score for Intermountain's palliative care patient population. Out of 6,186 potential palliative care patients, the model identified 1,245 (~20.1%) with a score of 50 or greater (high risk). The ROC-AUC score of this early prototype was 0.87 on the test set.

Algorithm integration and program development

From a regional, community-based perspective, Intermountain has used data from the first three iterations to strategically grow their palliative care program and development in the following ways:

- Project palliative care needs in the hospital present data to administration to get appropriate FTEs approved for workload. Approved for 1.0 FTE inpatient Social Worker, 1.0 FTE APC, and hope to have a second physician approved soon.
- Ability to 'control' their palliative care consult service usage. For example, if they have a slower year, they can turn more units on in the hospital, or add diagnoses to the algorithm to increase their census.
- Modify algorithm workflow. For example, Intermountain hospitalists requested an automatic consult, rather than a notification or message that interrupts their current workflow.
- Partner with stakeholders. Intermountain Hospitalists group requested modifications to the algorithm based on their specific needs, such as a focus on COPD patient admissions. At a system level, Intermountain is working with other clinical services, namely Cardiology, Respiratory, Oncology, Dialysis, and Geriatrics to collaborate at defining which patient cohorts are appropriate for palliative care. This involves integrating palliative consults into their disease specific workflows as well as utilizing their subspecialty expertise to validate the algorithm. We have early adoption from the Pulmonary team and will pilot with COPD patients across the system.
- Present to local Foundations for community financial. In addition, Intermountain is working with their planned giving health system leaders to develop a formal philanthropic strategic plan for palliative care.

Conclusion

Research has proven the Cerner/Intermountain third iteration palliative care algorithm is accurately identifying seriously ill patients in need of palliative care services. However, due to the high volume of patients identified in an acute care setting, additional risk stratification development is required to effectively triage these patients & determine who needs acute palliative support versus those who can receive services post-hospitalization. The first iteration palliative care predictive data model is showing very high sensitivity and specificity results, and the team is hopeful by scoring at-risk patients they will be able to deliver appropriate care in the best setting. It should also be noted that collaboration with key stakeholders and subspecialty providers ensures a smooth clinical workflow for all affected by this new technology, as well as support for palliative care program growth with a community-based approach.