Improving Population Health Management Strategies: Identifying Patients Who Are More Likely to Be Users of Avoidable Costly Care and Those More Likely to Develop a New Chronic Disease

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Objective. To explore using the Patient Activation Measure (PAM) for identifying patients more likely to have ambulatory care–sensitive (ACS) utilization and future increases in chronic disease.

Data Sources. Secondary data are extracted from the electronic health record of a large accountable care organization.

Study Design. This is a retrospective cohort design. The key predictor variable, PAM score, is measured in 2011, and is used to predict outcomes in 2012–2014. Outcomes include ACS utilization and the likelihood of a new chronic disease.

Data. Our sample of 98,142 adult patients was drawn from primary care clinic users. To be included, patients had to have a PAM score in 2011 and at least one clinic visit in each of the three subsequent years.

Principal Findings. PAM level is a significant predictor of ACS utilization. Less activated patients had significantly higher odds of ACS utilization compared to those with high PAM scores. Similarly, patients with low PAM scores were more likely to have a new chronic disease diagnosis over each of the years of observation.

Conclusions. Assessing patient activation may help to identify patients who could benefit from greater support. Such an approach may help ACOs reach population health management goals.

Key Words. Risk, patient activation, ambulatory care–sensitive utilization

To be successful, accountable care organizations must be able to effectively manage the health of their total population, not just the patients who seek care. Being accountable for the health of an entire enrolled population is referred to

as population health management (PHM) (Felt-Lisk S 2011). PHM aims to keep a population as healthy as possible and to minimize the use of costly medical care. The concept of PHM is key to the larger health goals articulated in the ACA and is reflected in the new payment models that reward improved health while de-emphasizing the volume of care provided. This shift from volume to value represents a major change for delivery systems. PHM, while foundational to the success of accountable care, also represents a significant challenge for delivery systems to redesign care so that they are managing the care of an entire population.

Unlike disease management, care management, or wellness programs, PHM is concerned with the total population of patients, from those with minimal health risks to those who have complex health conditions. PHM aims to tailor a variety of interventions to patients based on their levels of risk, with the patients' risk level determining what interventions they are offered. PHM is new and is still evolving. On an operational level, the goal of PHM is to slow the progression of risk in the patient population and at the same time to minimize the use of costly utilization, such as emergency department (ED) use and hospitalizations (Institute for Healthcare Transformation 2012).

How well health care delivery systems can mount effective PHM programs is still unclear. The success of these programs depends on the accuracy of the risk assessments (for all levels of risk), the effectiveness of the selected interventions, and the fidelity of the implementations (Felt-Lisk S 2011). A further consideration in PHM is the efficient use of resources to achieve the goals of improved health and decreased use of costly care. One way to increase efficiency is to not only take into account risk levels but also to consider the likelihood of responsiveness to the intervention or "impactability." The concept of "impactability" discussed by Geraint Lewis and colleague (Lewis et al. 2013) introduces the notion that risk stratification approaches should not just identify people at high risk for a health event, but they should identify people who are most likely to respond to interventions to improve health outcomes. This concept, while discussed in the context of managing the high-risk patients, has applicability for all risk levels. Efficiencies may be gained by identifying patients whose behaviors or utilization maybe changed with appropriate

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interventions. Thus, this concept of impactability represents a more targeted and efficient use of resources.

One potential measure of impactability is a patient's activation level, which is the extent to which a patient has the knowledge, skills, and confidence to manage her health and health care. The Patient Activation Measure (PAM), is a valid and reliable measure of patients' self-management skills and confidence (Hibbard et al. 2005). A recent longitudinal panel study shows that changes in PAM scores are associated with changes in clinical outcomes and costs in the expected direction (Greene et al. 2015). Several studies indicate that targeted interventions undertaken in the clinical setting can successfully increase PAM scores (Deen et al. 2011; Shively et al. 2013; Shane-McWhorter et al. 2015). In this investigation, we explore whether considering a patient's activation level can help health care delivery systems identify patients at higher risk for poor outcomes. If so, future research can investigate whether providing those patients additional support and interventions could help delivery systems improve population health.

Specifically, we assess whether PAM scores are predictive of outcomes in two key areas critical to the success of PHM. First, we assess the potential for using a PAM assessment for identifying patients who are more likely to have ambulatory care-sensitive (ACS) ED use or hospitalizations. While these measures have been used primarily to evaluate the adequacy of care delivery, we apply them here to focus on patient factors that may be important contributors to this type of avoidable utilization. Second, we explore whether a PAM score can predict future increases in chronic disease burden. The ability to identify patients more likely to have preventable costly utilization, and to identify patients who are more likely to have future increases in disease burden would lay the foundation for future efforts to refine PHM strategies by identifying which patients would benefit from more self-management support.

METHODS

This retrospective cohort study was conducted collaboratively with Fairview Health Services, a pioneer accountable care organization in Minnesota with over 250 primary care providers and 44 primary care clinics. In 2010, Fairview began routinely collecting the PAM from patients during primary care visits and storing it in the electronic health record (EHR). We used data from the EHR between 2011 and 2014 in order to examine the relationship between PAM in 2011 and our outcomes of interest in the three following years.

Sample

Our analytic sample of 98,142 adult patients was drawn from the Fairview primary care clinic population. To be included, patients had to have a PAM score in 2011 and at least one clinic visit in each of the three subsequent study years (2012–2014). Patients were excluded from the analysis if they indicated to Fairview that they did not want to participate in research or if they suffered from dementia in any of the study years, as defined by Minnesota Community Measurement (2009).

Variables

The independent variable in our analyses is the PAM, a widely used and validated measure of patient activation (Greene and Hibbard 2012; Hibbard and Greene 2013; Hibbard, Greene, and Overton 2013). We use the four levels of PAM (Hibbard et al. 2005). The lowest, level 1, indicates a person does not yet understand the importance of her role in managing her own health and has only limited self-management skills. The highest, level 4, indicates a person who is proactive about her health and has developed self-management skills.

There were two sets of dependent variables. The first relate to ACS ED and hospitalizations. To measure ACS visits, we used the Agency for Healthcare Research and Quality's Prevention Quality Indicators (PQIs) version 4.5, which have been used as a measure of ACS ED and hospitalizations in prior research (Johnson et al. 2012; Davydow et al. 2013; Bhattacharya, Shen, and Sambamoorthi 2014; Gao et al. 2014). We computed separate rates of whether or not patients had any ACS ED visits or any ACS hospitalizations.

The second dependent measure we examined was whether there was a new diagnosis of one of seven chronic conditions (diabetes, chronic obstructive pulmonary disease, congestive heart failure, coronary artery disease, depression, hyperlipidemia, and hypertension) in the follow-up years. All the dependent variables are based upon EHR data and/or utilization within Fairview Health System, which in addition to the primary care clinics includes 55+ specialty clinics and 6 hospitals.

Analytic Approach

After running descriptive statistics on the patient sample by PAM level, we conducted bivariate analyses. For the first research question, we examined

the percentage of patients at each PAM level, assessed in 2011, who had ACS utilization (separately examining ED visits and hospitalizations) in 2012, 2013, and 2014. For the second research question, we computed the percentage of patients in each level of activation who had a new diagnosis of at least one of the chronic conditions listed above in the 3 years (2012–2014) after the PAM measurement was collected. We used the chi-square test to indicate whether there were differences in the percentage of people with ACS utilization (or new chronic conditions) across PAM levels; differences between individual PAM levels and the dependent variables were not tested.

Our analysis then moves to a multivariate approach. We used logistic regression to examine the relationship between PAM levels in 2011 and the dependent variables in the following 3 years. In these models, we examine outcomes for each level of activation as compared to the reference group (highest level of activation). In these multivariate models, we controlled for patients' age, gender, median income for the patient's zip code, and baseline diagnosis of chronic conditions. For the ACS models, we controlled for whether the patient had a baseline diagnosis for most of the chronic conditions that are directly related to the PQIs (diabetes, hypertension, chronic obstructive pulmonary disease, and heart failure). As we unfortunately did not have data on all the chronic conditions directly related to the PQIs, we conducted supplementary analyses that included a version of ACS utilization that included only those 11 indicators related to the chronic conditions above or that are not related to chronic conditions. These results were consistent with those presented here, for all ACS utilization. The ASC models additionally controlled for whether a patient was diagnosed with depression, because of the established relationship between depression and ACS utilization (Yoon et al. 2012; Davydow et al. 2013; Bhattacharya, Shen, and Sambamoorthi 2014). For the new chronic condition analyses, we controlled for whether the patient had each of the seven chronic conditions at baseline.

As the dependent variables are based only on Fairview utilization, the models also control for the percentage of hospital costs generated within Fairview (as opposed to outside of Fairview) at the clinic level. This was derived from data from one insurer for which we obtained total costs both within and outside of Fairview. All the regression models adjusted standard errors for the clustering of patients within primary care providers.

FINDINGS

Table 1 shows the characteristics of the study population distributed across the four levels of activation. The patients included in the study sample are disproportionately female (59 percent) and over 45 years of age (61 percent). Over a third (37 percent) had hypertension, 12 percent had diabetes, and almost a quarter (24 percent) had diagnosed depression. Only a small proportion of patients had any ACS visits (1.2 percent for ED visits and .5 percent for hospitalizations). The demographic, health status, and utilization factors are significantly associated with activation level. Lower activation is associated with a higher prevalence of each of the chronic conditions shown in Table 1. Furthermore, less activated patients are more likely to have ACS utilization in 2011.

Table 2 shows the bivariate relationships between PAM levels in 2011 and having an ACS visits to the ED or a hospital admission in 2012–2014. In

Table 1: Characteristics of the Fairview Patient Population Sample in 2011 by Patient Activation Levels

	<i>Study Sample</i>	<i>PAM 1 (Lowest)</i>	<i>PAM 2</i>	<i>PAM 3</i>	<i>PAM 4 (Highest)</i>
<i>n</i>	98,142	6,441	12,053	43,672	35,976
%	—	6.6	12.3	44.5	36.7
Gender (%)					
Male	41.5	49.6	49.4	44.2	34.2***
Female	58.5	50.4	50.6	55.8	65.9
Age (%)					
<30	12.9	8.7	10.2	12.7	14.9***
30–44	26.1	19.2	22.1	25.2	29.8
45–59	31.8	29.0	31.2	31.7	32.5
60+	29.2	43.1	36.5	30.4	22.8
Chronic conditions					
Diabetes (%)	11.7	18.9	16.4	12.0	8.5***
Hypertension (%)	37.1	50.5	46.3	38.6	29.8***
Chronic obstructive pulmonary disease (%)	3.8	7.6	5.4	3.8	2.4***
Congestive heart failure (%)	3.3	8.3	5.3	3.3	1.8***
Depression (%)	24.3	33.0	29.0	23.1	22.5***
Ambulatory care–sensitive utilization					
ED visits (%)	1.2	2.0	1.3	1.1	0.9***
Hospitalizations (%)	0.5	1.2	0.8	0.4	0.3***

Notes. Testing whether the demographic, health, and utilization of the sample differ significantly by PAM level.
****p* < .001.

Table 2: Bivariate Relationships between 2011 PAM Level and Hospital Admissions and ED Visits for Ambulatory Care–Sensitive Conditions in 2012–2014

	<i>PAM 1</i> (<i>Lowest</i>) (<i>n</i> = 6,441) (%)	<i>PAM 2</i> (<i>n</i> = 12,053) (%)	<i>PAM 3</i> (<i>n</i> = 43,672) (%)	<i>PAM 4 (Highest)</i> (<i>n</i> = 35,976) (%)
ACS ED visits				
2012	1.7	1.4	1.1	1.0***
2013	1.9	1.2	1.0	0.8***
2014	1.7	1.3	0.9	0.8***
ACS hospitalizations				
2012	1.4	0.9	0.6	0.3***
2013	1.4	0.9	0.5	0.3***
2014	1.1	0.7	0.5	0.3***

Notes. Chi-square test for differences across PAM levels in ACS utilization.

*** $p < .001$.

each of the 3 years, PAM levels are a significant predictor for these types of costly but preventable visits. For example in 2014, PAM level 4 patients had less than half the likelihood of having an ACS ED visit compared to PAM level 1 patients (0.8 percent vs. 1.7 percent). Similarly, PAM level 4 patients had less than a third the likelihood of having an ACS hospitalization as PAM level 1 patients, and less than half the likelihood compared to PAM level 2 patients.

Table 3 shows the multivariate version of this analysis, which controls for patient demographics and diagnosis of chronic conditions at baseline. Consistent with the bivariate findings, baseline PAM level is a predictor of ACS hospital utilization. In each year, patients in PAM level 1 had higher odds of ACS hospitalizations as compared to PAM level 4 patients (ORs 1.30–1.62). For ACS ED visits, PAM 1 patients had significantly higher odds of visits compared to PAM 4 patients in two of the 3 years of observation (ORs 1.51 and 1.33 in 2013 and 2014, respectively).

In Table 4, we show the bivariate relationship between baseline PAM level and the percent of patients who have a new chronic disease diagnosis in years 2012–2014. PAM level is significantly associated with being diagnosed with a new chronic illness. For example, in 2012, 2.9 percent of PAM level 4 patients had a new diagnosis, while 5.0 percent of PAM level 1 patients acquired a new diagnosis.

Table 5 shows the multivariate logistic regression results that control for demographics and baseline diagnosis of chronic conditions, which again

Table 3: Key Odds Ratios from Logistic Regressions Examining the Relationship between PAM Level in 2011 and ED Visits and Admissions for Ambulatory Care–Sensitive Conditions in 2012–2014

	<i>PAM 1 (Lowest)</i>	<i>PAM 2</i>	<i>PAM 3</i>	<i>PAM 4 (Highest)</i>
ACS ED visits				
2012	1.10	1.12	1.00	(1.00)
2013	1.51***	1.15	1.07	(1.00)
2014	1.33*	1.23*	0.96	(1.00)
ACS hospitalizations				
2012	1.62**	1.44*	1.25 [†]	(1.00)
2013	1.40*	1.28	1.09	(1.00)
2014	1.30 [†]	1.23	1.27*	(1.00)

Notes. Multivariable analyses controlled for age, gender, tertile of median income for zip code, and baseline chronic conditions. Models additionally adjusted for the proportion of hospital care received within the Fairview system and for clustering by primary care provider. Each level of activation is compared to the reference group (activation level 4).

[†] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4: Percent of Patients in Each Level of Activation with a New Chronic Disease Diagnosis in 2012–2014

	<i>PAM Level in 2011</i>			
	<i>PAM 1 (Lowest)</i>	<i>PAM 2</i>	<i>PAM 3</i>	<i>PAM 4 (Highest)</i>
New chronic condition (%)				
2012	5.0	4.0	3.2	2.9***
2013	4.6	3.6	2.9	2.6***
2014	5.5	4.4	3.5	3.0***

Notes. Testing whether there is a statistically significant difference in new diagnosis of chronic conditions across PAM levels.

*** $p < .001$.

mirror the bivariate findings. In all of the models, patients in PAM level 1 are significantly more likely to have a new diagnosis of a chronic disease in the 3 years of observation, as compared to PAM level 4 patients (ORs ranging from 1.21 to 1.31).

DISCUSSION

Other studies have documented that patient behaviors and choices are important determinants of health outcomes and costs (Hibbard, Greene, and

Table 5: Odds Ratios from Logistic Regression Analysis Predicting a New Chronic Condition in Each Study Year by Baseline PAM Level

Study Year	PAM Level in 2011			
	PAM 1 (Lowest)	PAM 2	PAM 3	PAM 4 (Highest)
2012	1.25**	1.11	1.00	(1.00)
2013	1.31***	1.11	1.02	(1.00)
2014	1.21**	1.10	0.98	(1.00)

Notes. Models were adjusted for age, gender, income tertile, and presence of chronic conditions at baseline. Models were additionally adjusted for percentage of care received outside of Fairview and clustering by primary care provider. Each level of activation is compared to the reference group (activation level 4).

** $p < .01$, *** $p < .001$.

Overton 2013; Greene et al. 2015). The findings here add to that evidence and show that controlling for baseline chronic disease status, a patient's activation level or self-management capability is predictive of future progression in disease burden and also predictive of the use of costly care that could have been avoided. The relationship between patient activation and progression of disease burden and avoidable utilization appears to be enduring; we observed it in the 3 years after measuring activation levels that we examined.

The findings suggest important implications for delivery systems that are seeking to develop their PHM capabilities. First, the findings demonstrate new opportunities to identify patients who are at risk for poor outcomes and intervene early. By focusing on clinical risk only, as is often the case, delivery systems miss opportunities to identify patients whose utilization may be modified with interventions or whose disease burden is likely to increase.

PHM has the opportunity to broaden the assessment of risk beyond clinical markers, to consider the likelihood of whether patients will do their part in the care process. Understanding the patient's capability for self-management is a key part of understanding the risk of health declines and of avoidable utilization. The PAM score provides actionable information; it suggests a place to start with patients and other research suggests the types of interventions that might be effective with patients at different levels of activation (Hibbard, Greene, and Tusler 2009; Shively et al. 2013). Knowing about patient health behaviors does not provide insight into how best support patients, such information provides only what patient behavioral risk factors are. In contrast, we know that less activated patients have very low confidence in their ability to manage their health and often feel overwhelmed with that task. Knowing this, health care providers can suggest smaller steps toward making behavioral

changes and try not to further overwhelm patients too much information or too many changes at once.

PHM should focus on “impactability” or segmenting populations based on not just clinical risk, but the likelihood that interventions can modify patient behaviors. Because there is a growing body of evidence that it is possible to increase activation levels (Hibbard, Greene, and Tusler 2009; Wolever et al. 2010; Shively et al. 2013), the patient’s PAM score can be used to target patients with appropriate interventions to help them achieve an adequate level of self-management skill. This may be a more efficient use of resources, as it refines the targeting of support to those who are most likely to benefit from it. Future research, using controlled studies, is needed to test whether targeting interventions based upon activation level as well as risk level reduces costs and risks.

Finally, the findings indicate that a baseline PAM score is still predicting clinical outcomes and utilization 3 years later. This suggests that the relationships between activation and these outcomes are enduring, and therefore the potential benefits of investing in appropriate intervention could pay dividends over a longer period of time than the current budget cycle.

The findings of this study should be interpreted in light of the study’s limitations. Most notably, the findings demonstrate relationships between PAM and the various outcomes, but the study design is not able to establish causal relationships. It should be noted that if there is a causal link, the direction of causality between patient activation and health outcomes likely goes in both directions. That is, those who have heavier disease burden likely find it more difficult to manage their health on a day-to-day basis than those with better health and therefore have lower PAM scores. At the same time, those who lack self-management skills and have low PAM scores are more at risk for further health declines.

Other limitations relate to generalizability. We conducted this study in one innovative delivery system in Minnesota, where many quality measures are higher than state and national levels (Snowden et al. 2013; National Committee for Quality Assurance 2015). We do not know whether the findings would be consistent in other delivery systems. Our dependent variables rely only on Fairview utilization. It is unlikely, but possible that there is a relationship between activation level and use of non-Fairview clinics and hospitals that could bias our findings. We do control for differences in use of non-Fairview services based at the clinic level. In addition, we are only able to control for factors available in the EHR, other social factors, such as social support, which may contribute to outcomes and to patient activation were not measured.

Finally, in this study we did not assess changes in activation over time. We used only the baseline measurement of activation to predict future outcomes. Assessing changes in activation over time might yield a more precise assessment than our analysis.

In summary, the key goals of PHM management are to slow the progression of risk in a defined population and at the same time to minimize the use of costly and unnecessary utilization. The findings from this study suggest that assessing the patients' activation level may provide a new direction for identifying patients who are at risk for these undesirable outcomes and who may benefit from early intervention.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.