Integrated care, which aims to coordinate a patient’s care across different settings and providers, has taken center stage in most Western health systems. In England, the dramatic reform introduced by the Health and Social Care Act of 2012 renewed the focus on integrated patient-centered care by emphasizing that “care is integrated around the needs of the patient.” In the United States, the Affordable Care Act integrates care through the development of new coordination programs and financing systems.

If care is to be truly centered on the patient, the patient’s specific care needs and other characteristics must be addressed. While it is practically impossible to develop care models and intervention programs for each individual, programs can be created for groups of patients with largely similar characteristics. The creation of these groups is known as patient segmentation. Segmentation divides a patient population into distinct groups—each with specific needs, characteristics, or behaviors—to allow care delivery and policies to be tailored for these groups.

The idea of segmenting patients for integrated care is not new. In 1970 Sidney R. Garfield, Kaiser Permanente’s cofounder, described how Kaiser Permanente’s integrated care model distinguished between sick, well, worried well, and early sick patients to tailor medical and preventive services for the different groups. However, the exponential growth in health care big data, together with the developments in data-mining tools, provides new opportunities to use data for segmentation analysis.

Data from administrative systems or electronic health records (EHRs) can be used to allocate patients to segments—based, for example, on their long-term conditions—and analyze costs and outcomes per segment. There are also a
range of off-the-shelf tools for patient segmentation data analysis, which vary in type and sophistication.10–13 (For more details, see online Appendix 1). The Johns Hopkins Adjusted Clinical Groups System uses a granular system of diagnosis code mapping as the basis for different groupings.12 The Community Assessment Risk Screen provides a simple method for allocating patients to one of ten risk levels.13 And the 3M Clinical Risk Groups system distributes patients among 272 groups for a more detailed risk analysis.10

In this article we describe how this type of data-driven segmentation can be applied in integrated care. We propose a framework that outlines the potential applications of segmentation in integrated care, and we illustrate its use through international examples. We then explore, through three detailed case studies, the practical considerations involved in segmentation analysis. Based on the case studies, we discuss why and how policy makers should encourage the use of data for segmentation in practice.

A Framework For Patient Segmentation In Integrated Care

Levels of Integration Integrated care can be organized in a variety of ways. The following three levels of integration have been described in the literature: macro-, meso-, and micro-level integration.15–18 For each level, a corresponding population strategy can be identified.

▸ Whole Population: Macro-level integration applies to the whole population. Although the types of providers included in a macro-level program may vary, these programs aim to integrate care for all patients. Examples are integrated care organizations such as Kaiser Permanente in the United States, which provide integrated services for their entire covered population.

▸ Subpopulation: Meso-level integration provides integrated care services to a specific subpopulation. Often this subpopulation is based on a long-term condition (for example, diabetes or dementia) or age (such as patients older than seventy-five), which allows specialist services to be included in the integrated care package. An example is bundled payments in the Netherlands, where care providers receive an annual payment to manage and deliver care for a group of patients with a specific condition.19

▸ High-Risk Population: Micro-level integration focuses on selected individuals deemed to be at high risk of certain outcomes, such as an unplanned hospitalization. Instead of integrating care across the entire delivery system, this type of integrated care relies on teams or individuals who coordinate services and provide case management. In the English National Health Service, primary care providers are encouraged to identify patients through risk stratification and proactively manage their conditions and coordinate their care with other providers.20

Identifying and Understanding the Target Population Patient segmentation can support these three population strategies in the following two ways: it can help identify a target population, and it can provide detailed insights into the target population (for an overview of the framework, see Appendix 2).24

Understanding the population is particularly important for macro-level integration, where an entire population is included, since care needs will vary significantly across the members of the population. Through patient segmentation, different needs can be identified, and tailored policies and budgets can be set for homogeneous patient groups. The “Better Health for London” report, developed by the London Health Commission, segments the entire population of London into fifteen groups, around which multistakeholder population health initiatives are organized24 (For more details, see Appendix 1).14

Meso-level integrated care models, which focus on specific subpopulations, can use segmentation to choose the subgroup. Delaware’s State Health Care Innovation Plan segments the state’s population and uses this information to select priority subgroups for two focused interventions: improved care coordination for patients with multiple long-term conditions or mental health needs, and overall effective diagnosis and treatment for people with no long-term care needs.22

For meso-level integrated care, segmentation can also help health professionals better understand the targeted subgroup. While the care needs of a defined subgroup will not be as diverse as those of an entire population, there will still be significant variation across members of the subgroup. Kaiser Permanente’s Senior Segmentation Algorithm segments the population over age sixty-five into four groups, and care priorities are set for each segment.22 The segment assignment is included in the patient’s EHR, and it prompts medical specialists to take certain actions that are tailored to the segment’s specific needs. The ValCrónica pilot program in Spain focuses on the subgroup with long-term conditions, which is segmented by risk level to adjust the intensity of telemonitoring interventions.24,25

Micro-level integration requires high-risk patients to be identified. The Counties Manukau district health board in New Zealand is including an automated risk score in its e-summary health record, which is available to all system providers.
across care settings. Based on patients’ risk strata, different care management interventions are offered to improve outcomes and reduce unplanned hospitalizations.

In addition to identifying high-risk individuals, segmentation can also provide insights into the risk strata. Risk stratification provides only a one-dimensional view of the population, and segmentation can increase understanding of what the identified high-risk patients’ actual needs are. As described above, Spain’s ValCrónica program segments a population by risk and long-term condition. By segmenting high- and medium-risk patients based on their long-term conditions, providers can offer tailored interventions, such as condition-specific education and biometric devices.

**Practical Applications Of Segmentation**

There are a number of practical issues to consider when applying segmentation, including data requirements, segmentation logic, and how the segment information can be used to deliver care. This section explores these considerations through three case studies. First, the Better Health for London initiative provides an example of how a segmentation analysis of a whole population can provide insights to inform macro-level policy decisions. Second, the ValCrónica pilot program in Spain focuses on people with long-term conditions and uses segmentation to tailor interventions for this subpopulation. Third, the Counties Manukau district health board example demonstrates how risk-based segmentation can be used as a case-finding tool for identifying high-needs patients.

**‘BETTER HEALTH FOR LONDON’ (WHOLE POPULATION)** “Better Health for London,” a report developed by the London Health Commission, applies patient segmentation to develop patient-centered, needs-based care for everyone. It creates a holistic view of the population’s needs to support population health initiatives for integrated care (Exhibit 1).

The segmentation model was adapted from the Whole Systems Integrated Care project in North West London, which uses a similar segmentation approach. The development of the segments was partially data driven. A purpose-built one-off database was constructed for one of the London regions that linked administrative data for nearly 200,000 patients from primary, secondary, mental health, community, and social care settings. This provided a detailed view of costs, diagnoses, and other characteristics at the patient level. A decision-tree analysis was used to determine which characteristics, such as morbidities or age groups, were significant predictors of total cost and should be used for the segmentation.

To determine the final segments, the results from the analysis were considered in combination with the following practical requirements:

- Patients within a segment need to have broadly similar physical, mental, and social needs;
- Patients need to remain in the same segment over time to allow for long-term care planning;
- Care professionals need to be able to assign a patient to a segment; and
- There must be the potential to set financial budgets per segment.

Following the “Better Health for London” report, thirteen transformation programs were organized around the segments to achieve the goals of the report. The Healthy London Partnership, established in May 2015, brings together providers, commissioners, and representatives of public health and other health organizations into transformation programs. These programs are intended to integrate and improve

### Exhibit 1

London Health Commission segmentation of the population of London

<table>
<thead>
<tr>
<th>Condition</th>
<th>0–12</th>
<th>13–17</th>
<th>18–64</th>
<th>65 and older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mostly healthy</td>
<td>Segment 1</td>
<td>Segment 2</td>
<td>Segment 3</td>
<td>Segment 4</td>
</tr>
<tr>
<td>One or more long-term physical or mental conditions</td>
<td>Segment 5</td>
<td>Segment 5</td>
<td>Segment 6</td>
<td>Segment 7</td>
</tr>
<tr>
<td>Cancer</td>
<td>Segment 5</td>
<td>Segment 5</td>
<td>Segment 8</td>
<td>Segment 8</td>
</tr>
<tr>
<td>Severe, enduring mental illness</td>
<td>Segment 9</td>
<td>Segment 10</td>
<td>Segment 11</td>
<td>Segment 11</td>
</tr>
<tr>
<td>Learning disability</td>
<td>Segment 9</td>
<td>Segment 10</td>
<td>Segment 12</td>
<td>Segment 12</td>
</tr>
<tr>
<td>Severe physical disability</td>
<td>Segment 9</td>
<td>Segment 10</td>
<td>Segment 13</td>
<td>Segment 13</td>
</tr>
<tr>
<td>Advanced dementia, Alzheimer’s, and related conditions</td>
<td>Segment 9</td>
<td>Segment 10</td>
<td>Segment 14</td>
<td>Segment 14</td>
</tr>
<tr>
<td>Socially excluded groups</td>
<td>Segment 15</td>
<td>Segment 15</td>
<td>Segment 15</td>
<td>Segment 15</td>
</tr>
</tbody>
</table>

care for specific segments, such as children, cancer patients, people with mental health conditions, and the homeless. For people in the healthy segments, there is a program to encourage healthy behavior and prevent the development of long-term conditions, while for patients with long-term conditions, the focus is on improving self-management. By bringing together different stakeholders around a defined group of patients with similar needs, care can be integrated and tailored.

**ValCrónica Program in Spain (Subpopulation)** ValCrónica is a program initiated by the Health Agency of Valencia, Spain, and Telefónica with the aim of integrating and improving care for a subpopulation: patients with long-term conditions.\(^{20}\) It was implemented in 2011 as a pilot covering four health centers in Valencia; another two health centers joined the program later.\(^{21}\) An important focus of this integrated care model is on preventing complications of long-term conditions, which is carried out through telemonitoring and education. These interventions are tailored to patients’ needs using a segmentation approach.

The ValCrónica program relies on a shared electronic primary care record, called Abucasis, which brings together demographic data, information about vaccinations, and data from primary care and prescribing providers and on hospital discharges and other activity.\(^{22}\) It is accessible to primary and secondary care providers, and the information exchange between settings is a crucial enabler for the integration of care. In addition, the care records are used in the telemonitoring intervention to identify patients with long-term conditions, allocate them to different segments, upload patient-recorded measurements, and monitor outcomes.

The pilot program segments patients using the Community Assessment Risk Screen score, which predicts a patient’s risk of hospital admission based on the following three simple criteria: having had a hospital admission in the previous six months, the number of long-term conditions, and having five or more prescriptions.\(^{23}\) Two benefits of using this method are that the score can be easily calculated from routine data in the EHR, and the method is free to use.

In 2015 the Clinical Risk Groups stratification method was validated for the Valencia region. Developed by the 3M Company, this is a more complex methodology that—as noted above—allocates patients to one of 272 groups.\(^{20}\) Compared to the Community Assessment Risk Screen, the Clinical Risk Group system costs much more to use, but its widely used standardized approach makes multicenter or international studies possible. Nevertheless, local analysis showed that the two risk-scoring methods produce largely similar results (Domingo Orozco-Beltrán, associate professor, Department of Medicine, University Chair of Family Medicine, Miguel Hernández University, personal communication, September 9, 2015).

In addition to the patient risk score, segments in the ValCrónica program are also defined by the presence of the following four long-term conditions: type 2 diabetes, chronic obstructive pulmonary disease, heart failure, and hypertension\(^{24}\) (Exhibit 2). These conditions and their combinations were identified as posing the highest risk.\(^{25}\) Segmenting by condition allows interventions to be developed for a specific condition. More importantly, programs are also adapted for different combinations of conditions, which addresses important multimorbidity issues.

In practice, the segmentation is used to deliver a highly tailored telemonitoring and education intervention. The level of risk determines the intensity of the intervention. Patients allocated to the highest risk stratum receive a tablet personal computer for communicating with their primary care physician, disease-specific biometric devices, telemonitoring, and education and support for self-care.\(^{26}\) Patients at the lowest risk level are provided with communication and education through a web portal only. The segment’s morbidity profile determines the educational program that is created for patients, as well as which biometric devices are made available. These include monitors for blood pressure, blood glucose levels, or heart rate.

The telemonitoring and education initiative is part of ValCrónica’s integrated care program. The measurements from the biometric devices are uploaded to the patient’s EHR, where primary and secondary care providers can access them. If values fall outside recommended thresholds, an alert is generated for the primary care physician to allow for proactive intervention and coordination of care.

A study that followed 200 patients in the program for one year showed a 51 percent reduction in the use of emergency primary care services and a 32 percent reduction in the use of emergency acute care compared to the year before.\(^{30}\) In addition, patients have reported a high level of satisfaction with the program: 86 percent of patients said that it helped them understand their disease better.\(^{24}\)

**At Risk Individuals in Counties Manukau District Health Board (High-Risk Popula- tion)** Counties Manukau is one of twenty district health boards that fund and provide public health services in New Zealand. Counties Manukau is in the process of an ambitious system integration program, which aims to integrate...
services across primary, secondary, and community care. As part of this effort, the health board has introduced a risk-stratification procedure to identify what it calls “at risk individuals.” The aim is to allow primary care providers to identify patients at risk of poor health outcomes and proactively provide them with patient-centered care plans and care coordination services.

Primary care practices within Counties Manukau are starting to use the Combined Predictive Risk Model to stratify their enrolled populations. The model was developed by the Greater Auckland Integrated Health Network and predicts an individual’s risk of an unplanned hospital admission in the next six months. It is based on data from a large range of sources, including patient registries, primary care consultation data, and hospital care data.

To develop this risk algorithm, a one-off anonymized linked data set was created. However, implementation of the algorithm in practice requires primary care providers to have up-to-date access to linked data sets in which patients are identified. The data governance and information technology requirements related to this data provision are currently being addressed. Until the risk algorithm becomes universally available, the primary care practices are using a set of logic rules to identify eligible individuals, based on criteria such as the number of long-term conditions, diagnostic results indicating unstable conditions, and indicators of mental health or social risk (Claire Naumann, transformation manager integrated care, Counties Manukau district health board, personal communication, September 3, 2015).

The program for at risk individuals is an example of micro-level integrated care, in which a dedicated team or individual integrates all of the care for a high-risk patient. The risk algorithm stratifies patients into two groups: patients at very high risk and those at risk. Patients at very high risk receive intensive case management, including home visits, care planning and coordination across care settings, monitoring, and review. Patients identified as being at risk are assigned a care coordinator from their primary care practice, who develops a personal care plan with them. Patients’ e-summary health records and personal care plans can be viewed by providers across the system.

The program for at risk individuals was started in 2014, and as of March 2016 ninety-nine primary care practices were participating in the program, and over 20,000 patients were enrolled in it (Naumann, personal communication, March 5, 2016). The intervention for patients at very high risk is a continuation of the Very High Intensity User program, which saw a 45 percent reduction in the number of emergency care presentations and a 35 percent reduction in acute care bed days, according to a study that compared the six-month periods before and after enrollment in the program.

### Policy Implications

The framework presented in this article describes different population strategies for integrated care and how segmentation can support them. The segmentation of a whole population can support comprehensive population health strategies by ensuring that the health care needs of all population groups are considered. In contrast, segmentation of subpopulations and high-risk populations can be used to deliver targeted programs of integrated care to patients with high levels of need.

The Better Health for London initiative shows how the segmentation of a whole population can support population health strategies. Organizing integrated care programs around segments instead of by provider or condition makes it possible for all relevant stakeholders across the health system to be involved. For some segments this involvement will go beyond medical care and will include social and community care or mental health services. In addition, since programs are developed for the different segments, they can be fully tailored to each group’s unique needs and priorities.

Physicians and other care providers can use segmentation as a case-finding tool to identify patients with a specific condition or risk and to help providers deliver integrated care to these
subpopulations. Both the ValCrónic program and the program for at risk individuals in New Zealand use data from EHRs to identify a target population and allocate patients to segments. This information is used to deliver interventions tailored to each segment, to ensure the most effective use of resources.

There is a wide range of approaches to segmentation, ranging from segmenting based on long-term conditions to advanced software solutions that use a granular aggregation system or risk algorithm. Deciding on the right approach involves a trade-off between simplicity and precision. For high-level strategic decisions, segmenting by condition may suffice, while the calculation of capitated budgets will require more detailed information. However, a population health plan would be unmanageable if the population were divided into hundreds of segments.

In addition, a custom segmentation analysis can be developed, as was done by the London Health Commission and Counties Manukau, or an off-the-shelf solution can be purchased, such as the 3M Clinical Risk Group system in Valencia. Developing a segmentation analysis in house allows organizations to fully tailor their segments to their local context and aims, but it requires expertise in data mining. Software solutions may be more limited in the segments they create, but they often provide a suite of intuitive analysis tools to review the segments.

However, the use of all of these methods requires access to software and technical guidance. Advanced technologies are costly, and individual providers may not have the required scale to implement them. Policy makers can encourage uptake by investing in research into segmentation algorithms and making them available to care providers. Alternatively, systemwide programs, such as the one that implemented the Clinical Risk Group system in Valencia, should be considered as a way to provide all health care providers with high-quality analytics and standardize the approach across the system.

All of the case studies rely heavily on detailed patient data, often obtained from different data sets linked at the patient level. This highlights an important policy issue, since the availability of linked health care data sets is still limited in many countries. Data governance requirements have complicated the implementation of Counties Manukau’s risk tool in practice. Policy makers should consider some of the levers at their disposal—such as building support, creating an evidence base, investing in capabilities, setting an example, involving patients, and legislating—to facilitate and promote the use of big data in health care.

Conclusion

Segmentation provides a range of benefits to policy makers and care providers who aspire to integrating health care. A segmentation data analysis can help select a homogeneous target population and tailor an intervention to different patient types within a population. As health care continues to move toward a patient-centered approach, and big data and analytics become even more ingrained, policy makers should consider the significant benefits of patient segmentation analysis for integrated care and support its use.

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NOTES

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14 To access the Appendix, click on the Appendix link in the box to the right of the article online.