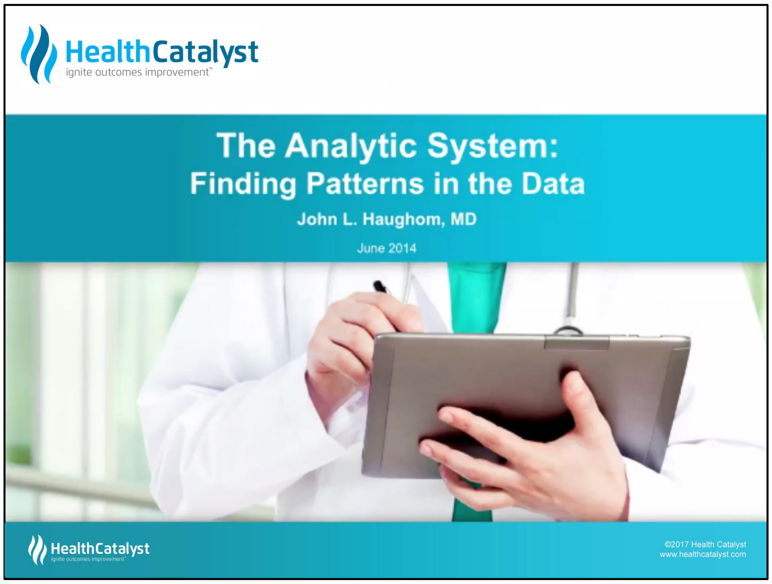
The Analytic System:
Finding Patterns in the Data
John L. Haughom, MD
June 2014



The Analytic System: Finding Patterns in the Data
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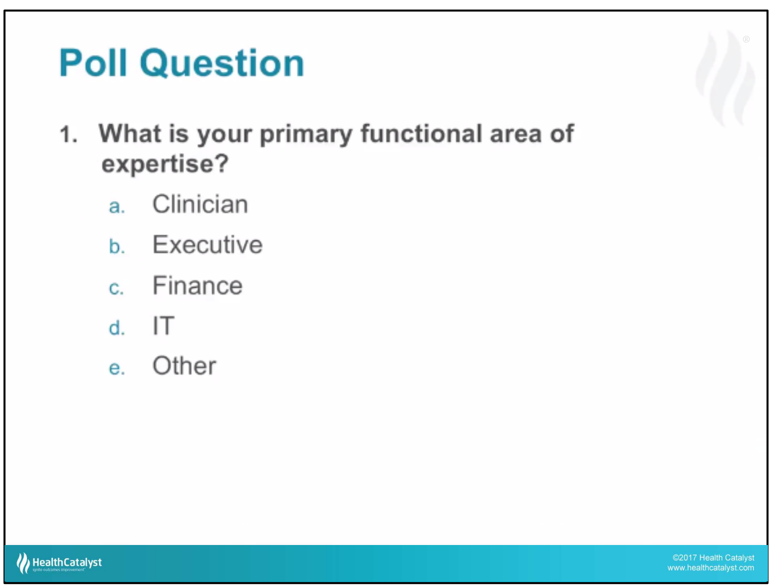
[John L. Haughom, MD]
Thank you, Tyler. It's my pleasure to be here again today. Today, we'll finish our discussion of the analytic system, including a live demonstration of modern analytics, illustrating how to bind meaningful patterns in the data. Prior to the webinar, one of the webinar participants, Terry Martin, asked me to illustrate how all of this fits in with the population strategy. That is exactly what the demonstration will do. The demonstrations are getting to the fun part and I think you'll enjoy it. Today's webinar will set the stage to begin our discussion of the second system, the deployment system, in our next webinar next month. So let's get started.

Healthcare: The Way It Should Be

Briefly, before we get started, I would like to announce that the book '*Healthcare: A Better Way'* is now complete and available for download in its entirety in PDF format for free. The link to access the book is illustrated on this slide. Those who'll attend the September Analytic Summit will get a free physical copy of the book. Before we dive in today's presentation, let me post our first poll question.



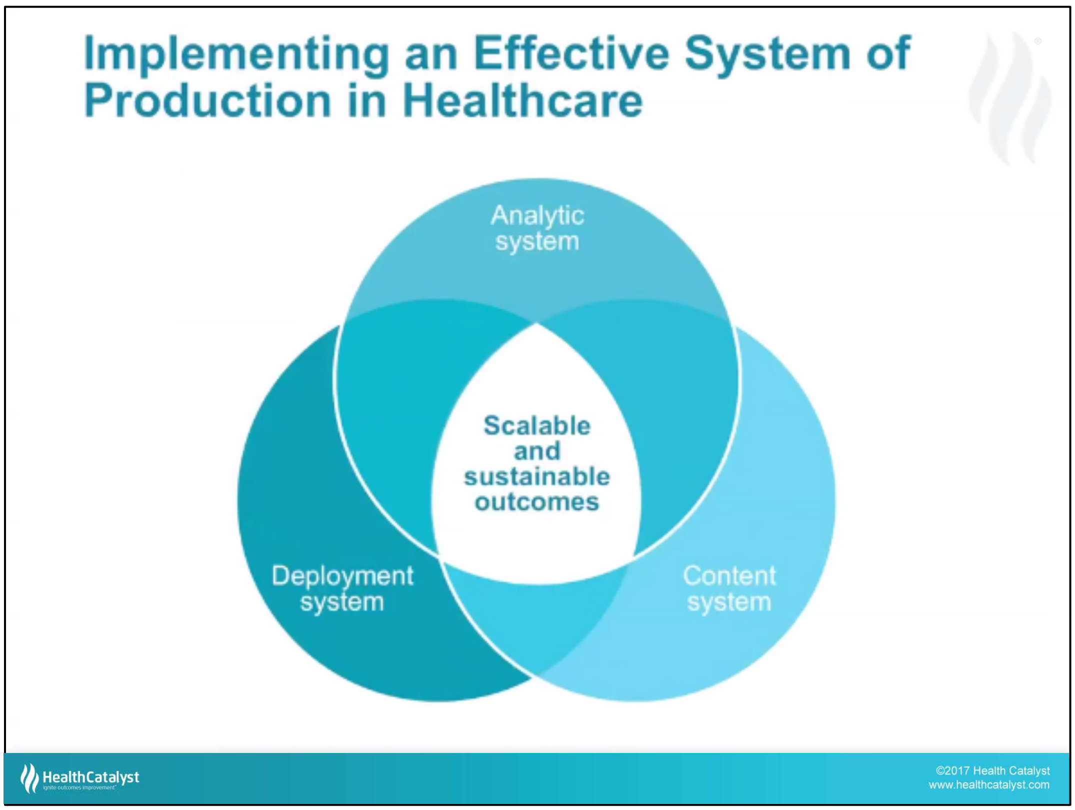
Poll Question: What is your primary functional area of expertise?

It's always good to understand the audience. So the question is what is your primary functional area of expertise? Clinician, operational executive, finance, IT or other? And I will pause here for a minute.

[Tyler Morgan]
Alright. We have that poll up and live. We'll leave that poll up just for a few more seconds and then share the results.

Alright. We'll go ahead and close the poll now. And here are the results. Dr. Haughom, we've got 15% clinician, 12% executive, 5% finance, 31% IT, and 37% other.

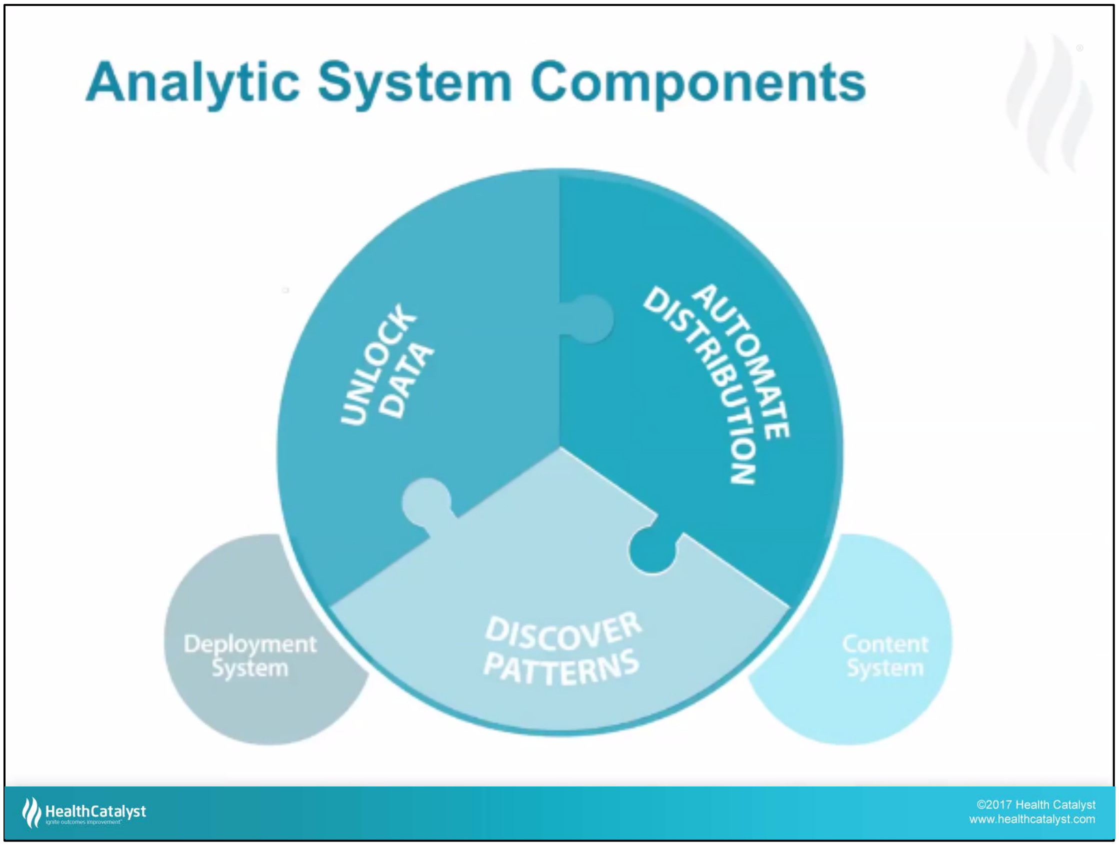
[John L. Haughom, MD]
Oh that's exciting. I mean we continue to have a really nice mix of participants. So I appreciate you all being here. I think that that's a very good mix for the point of this presentation.



Implementing an Effective System of Production in Healthcare

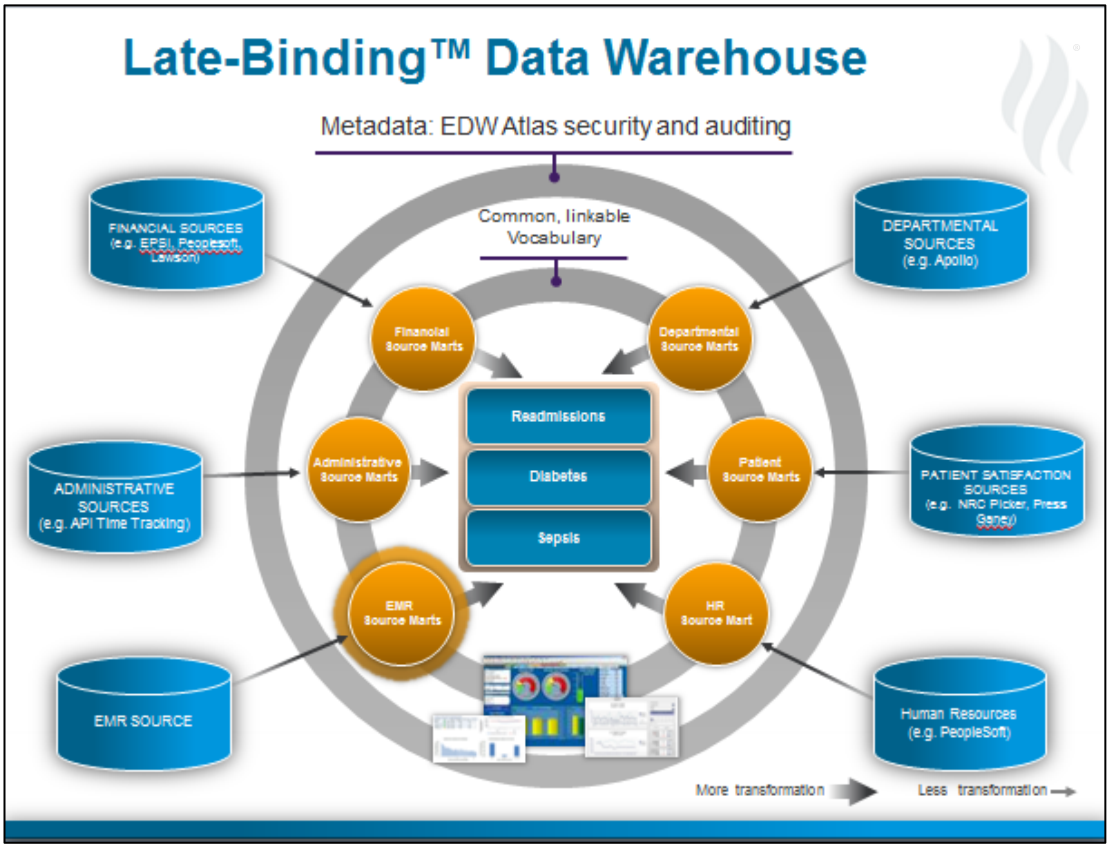
Alright. To start, let me provide a brief recap of the last webinar to provide some context for today. I believe all healthcare organizations would benefit enormously from developing a systematic approach to improvement. In essence, this is a strategy for managing complexity and change. With the goal of achieving scalable and sustainable improvements and outcomes over time, it is often useful to have a framework to discuss improvement, a framework that can help with discussions and health organizations crack a thoughtful data-driven improvement strategy to support a new way of delivering care that is safer, higher quality and more reliable.

In my experience, such an effective framework is illustrated on this slide. It divides the channels into three critically important components that in combination, can ignite sustainable, meaningful, and scalable change. We are in the process of building three systems which collectively represent such a strategy. They are the analytic system, the deployment system, and a content system.



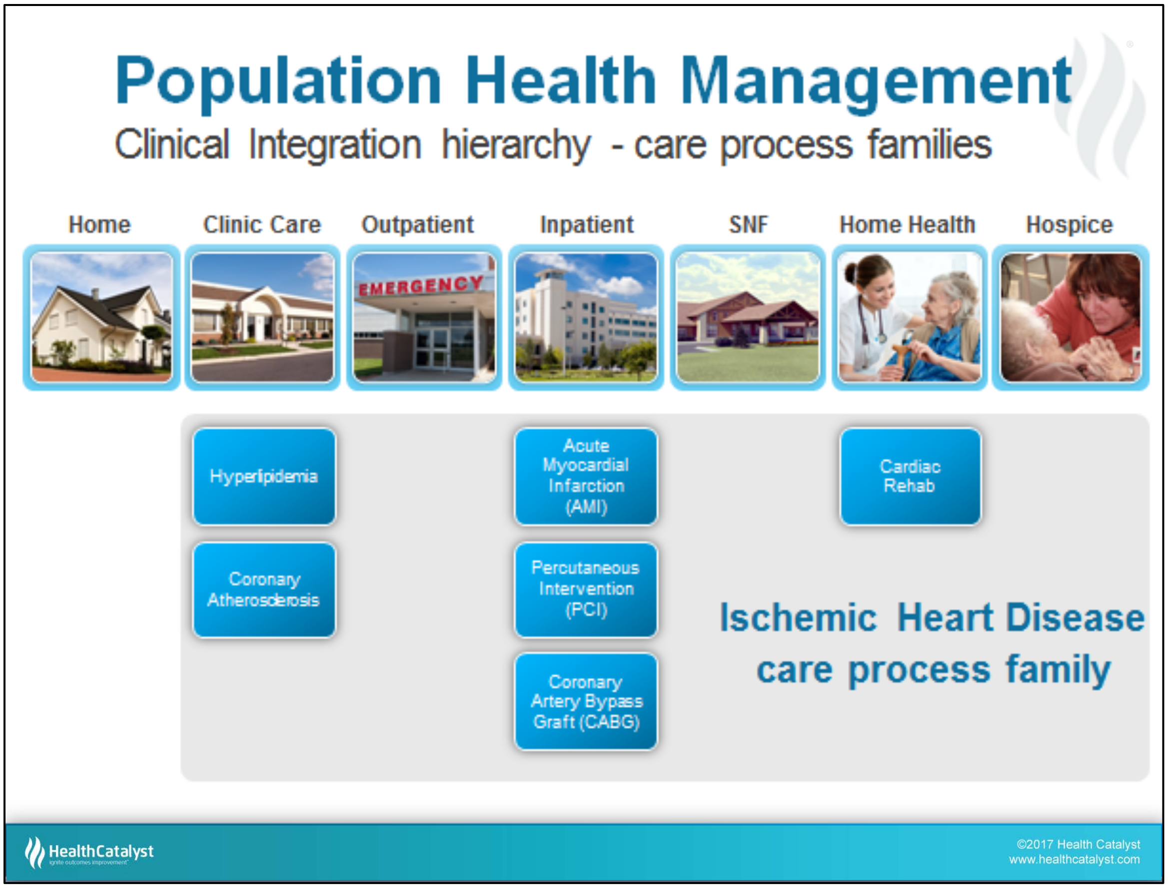
Analytic System Components

In the last webinar, we began to understand the first of the three systems, the analytic system. If you are going to continuously improve, it is critically important for you to unlock your data and develop an effective measurement system. Measurement is the basis for assessing and sustaining potential improvements in healthcare, quality, safety, efficiency, and cost. In order to know whether a change is in improvement, an analytic system is absolutely essential. The three components of an analytic system are shown in this slide. First, an organization needs to effectively unlock their data, make it available. Once the data is unlocked, an organization needs to broadly distribute the data to individuals across the organization. This needs to be done in as close to real-time as possible and is best done by automating the process. Once the process is automated, an organization needs to teach end users how to access and use the data. This is so called self-serve analytics, and I'll show you an example of that today in the demonstration. This automated process is in sharp contrast to the traditional report cue mentality, where one had to request and wait days to weeks for a data analyst or an IT to build the report that ultimately may or may not meet their needs. We covered these first two components of the analytic system in the last webinar. Today, we'll focus on the third component, discovering patterns in the data. We will discuss how this is done and illustrate the process with the demonstration.



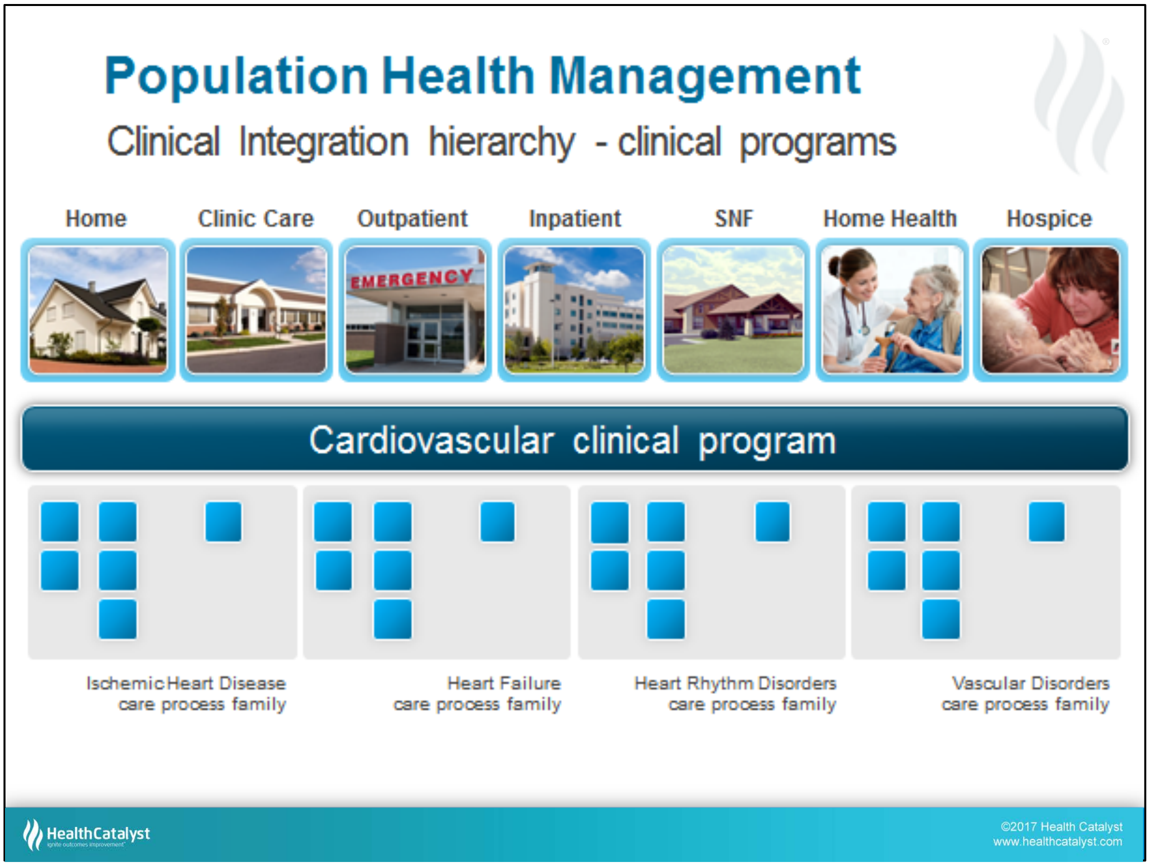
Late-Binding ™ Data Warehouse

In the last webinar, we also discussed three conceptual data models that are used in designing an enterprise data warehouse. The enterprise data model, the dimensional data model, and the Late-Binding ™ Data Model. We reviewed the pros and cons of each of these three models in different situations. Because of healthcare's complexity and tendency to change very dynamically, it is best to have a model that can maximally support flexibility. Health Catalyst® uses the Late-Binding ™ Data Model that is illustrated on this slide because it offers the greatest flexibility for improvement teams in the highly dynamic healthcare delivery environment.



Population Health Management
Clinical Integration Hierarchy – Care Process Families

In the previous webinar, we also discussed a clinical integration hierarchy that helps us organize our thinking about the healthcare delivery system. This hierarchy applies across the continuum, from the home, to the clinic, to outpatient venues of acute care, and ultimately to most acute care venues. The most granular level of the hierarchy are care processes. This slide illustrates examples of ischemic heart disease care processes that make up the majority of the ischemic heart disease care process family.

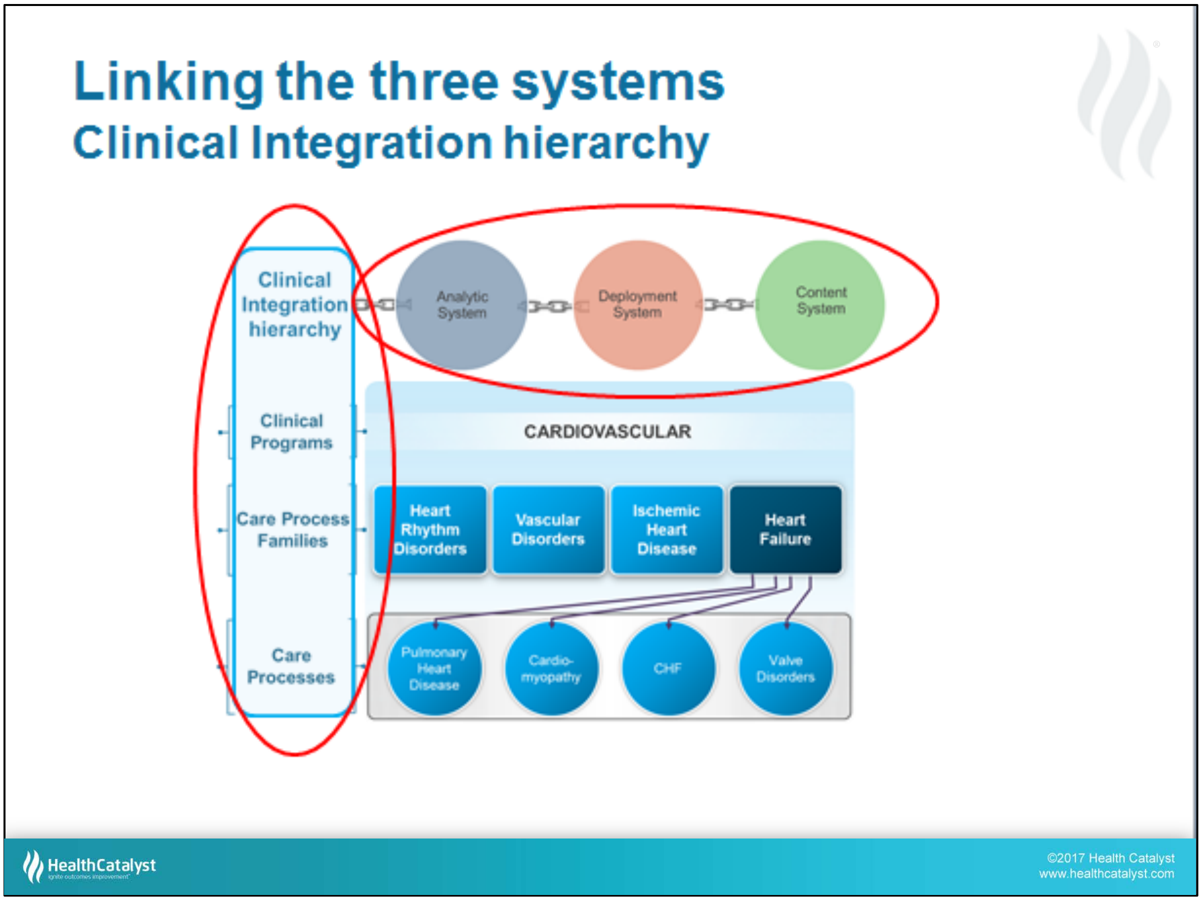


Population Health Management
Clinical Integration Hierarchy – Clinical Programs

Ischemic heart disease and its care process family siblings of heart failure, hearth rhythm disorders and vascular disorders make up the next level of the clinical integration hierarchy, the cardiovascular clinical program. There are four care process families that make up the vast majority of clinical conditions in the cardiac domain. In summary, care processes are part of care process families. Multiple care process families make up a clinical program, such as the cardiovascular clinical program illustrated on this slide.

Clinical Integration Hierarchy
Clinical Programs – Ordering of Care

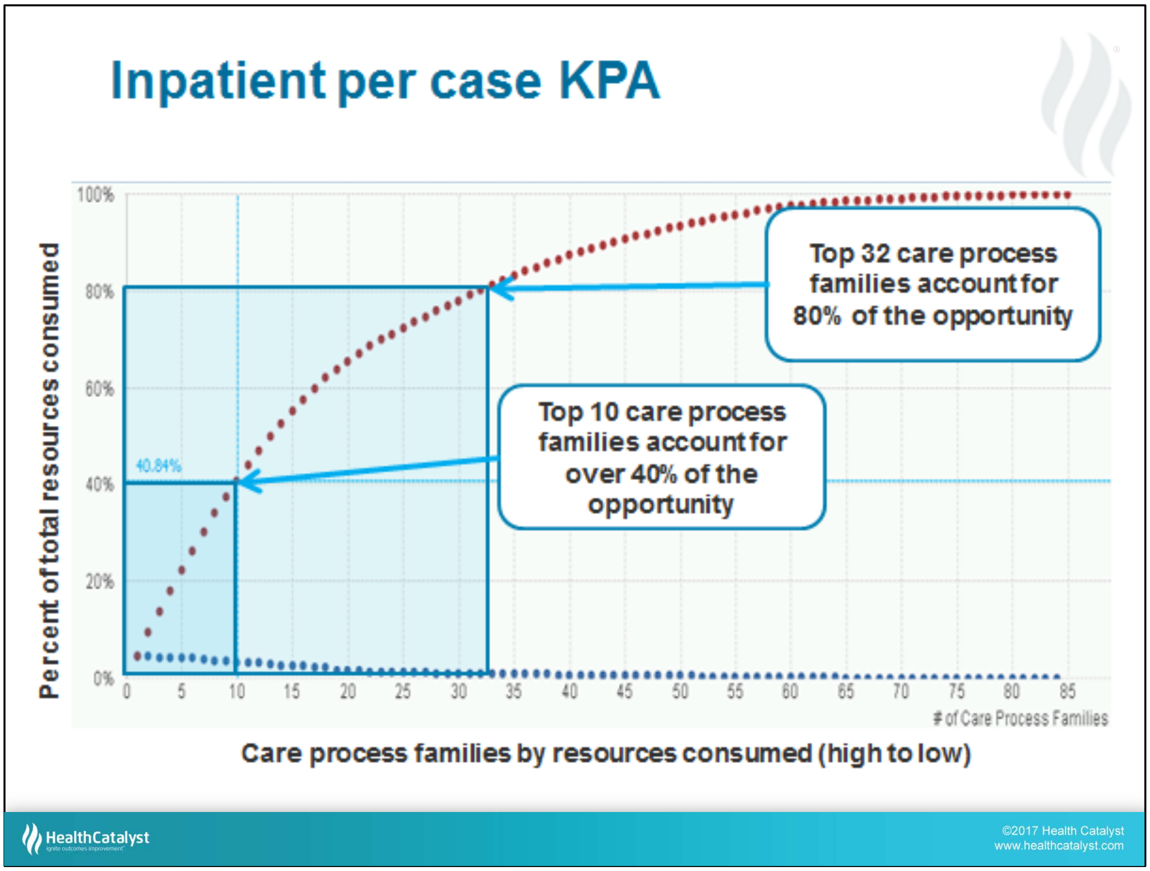
The cardiovascular clinical program is one of several major clinical domains as shown in this slide. Clinical programs are organized based on physician specialist and other clinicians who share or manage in the care processes and who are responsible for the ordering of care for patients. Each of these domains or clinical programs consists of a group of care process families. In our demonstration today, I will use a heart failure care process family example from the cardiovascular clinical program encircled here.



Linking the three systems
Clinical Integration Hierarchy

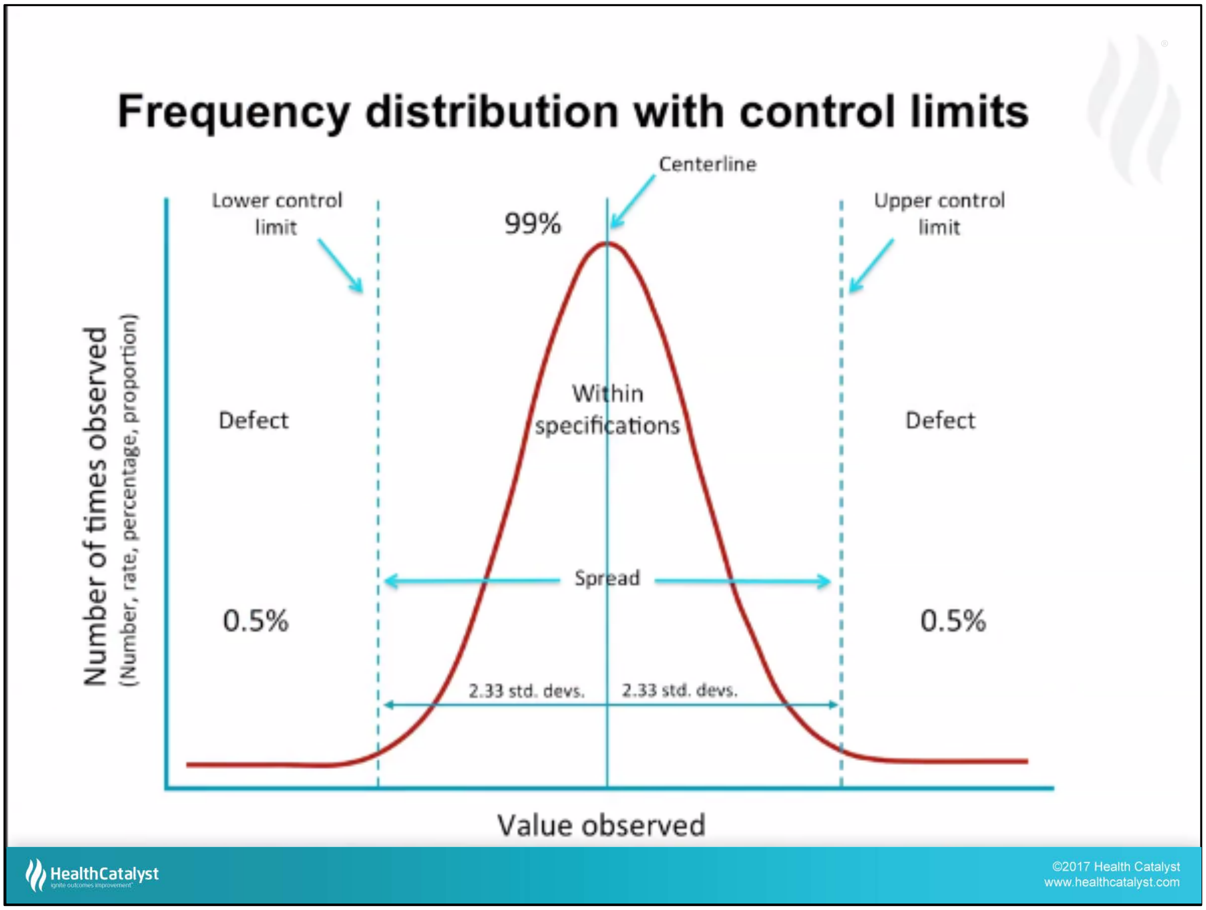
This slide is an attempt on my part to pull together everything that we are talking about. We are in the midst of discussing the three systems, which are essentially the three components of a sound strategy that organizations can use to assure their ability to support meaningful and sustainable improvements in outcomes. Last month, we began with the discussion of the first of these three components, the analytic system, and we will conclude that discussion today. In the next webinar, we will begin discussion of the second component, the deployment system. Following that, we will turn our attention to the last of three components, the content system.

We have also introduced the concept of a clinical integration hierarchy encircled here, which is essentially a framework to help us organize our thinking about the complex realm of healthcare delivery. And at the top of the hierarchy are the major clinical programs illustrated in the last slide that comprised the majority of healthcare delivery. In turn, each clinical program is comprised of a series of care process families that constitutes the majority of care in that clinical program. Finally, there are series of care processes that constitute the majority of care in each care process family. In this case, I've illustrated the heart failure example. The heart failure care process family is comprised of four components that represent the majority of care in the heart care process family, pulmonary heart disease, cardio-myopathy, congestive heart failure, and valve disorders. Of course there are other components of the heart failure care process family but these four care processes represent the majority of the care in this process family and they therefore represent the majority of the opportunity to improve care and lower costs.



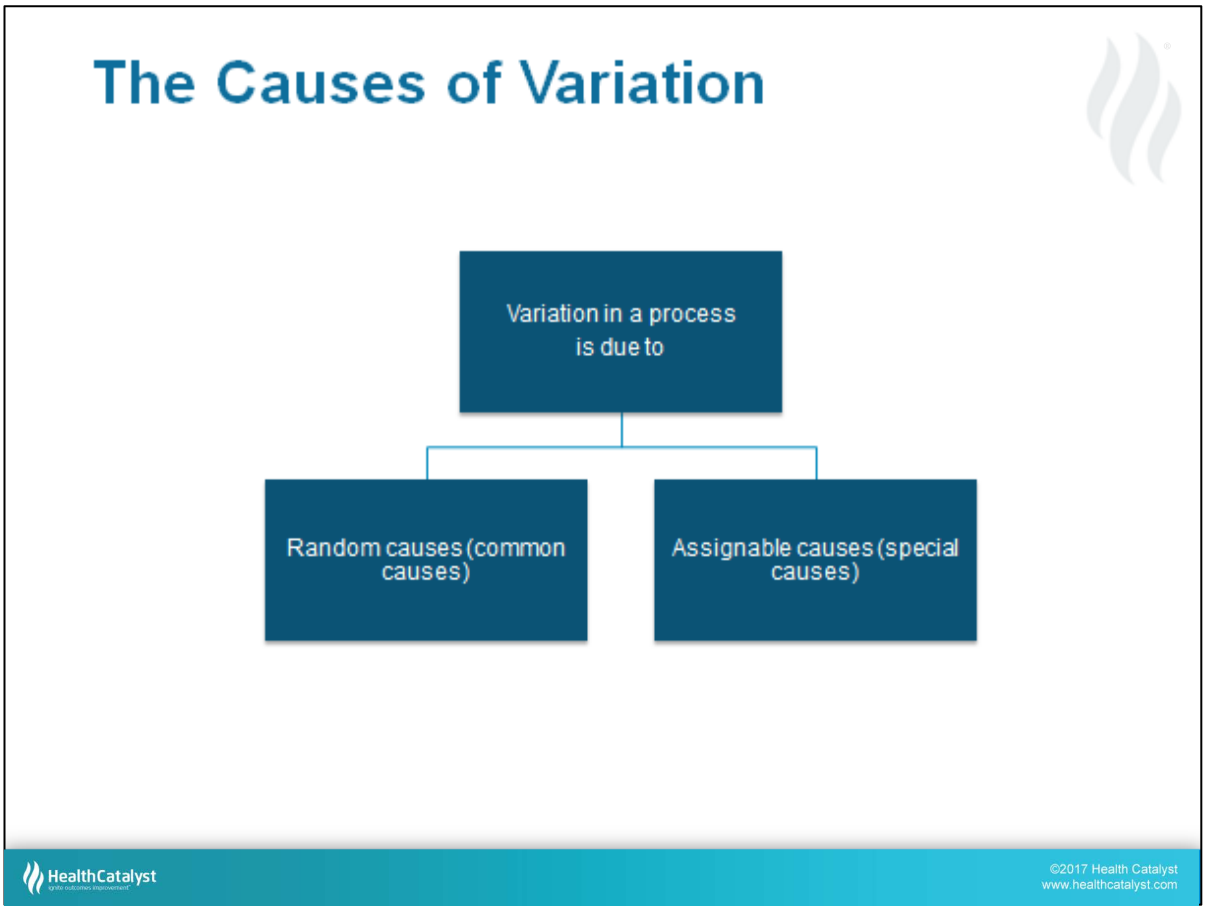
Inpatient per case KPA

The clinical integration hierarchy provides a useful model for organizing the complex care delivery process and determine where to focus care improvement resources to achieve the greatest possible impact in terms of value or return on investment. The key variables we are considering in the prioritization are variation and resource consumption. Once care process families are mapped to cost, relative resource consumption can be identified and ranked as illustrated on this slide. Each of the blue dots represent one of these care process families, such as heart failure, arthritis, pregnancy, etc. The red dots represent the cumulative total of the blue dots. If you focus on the first 10 blue dots, the cumulative total is over 40% of resources consumed for this particular organization. Extending out to the 32 care families, we reached a point of about 80% of total resource consumption. In addition to highlighting costs, this approach provides a reasonably good surrogate for the rest of the patients. For example, the higher the resource consumption, the more likely the patient is in an intensive or costly care environment, such as the ICU. Both because of patient benefit and cost reduction opportunities, it's reasonable to assume that focusing on the top 32 care process families would yield the greatest benefit.



Frequency Distribution with Control Limits

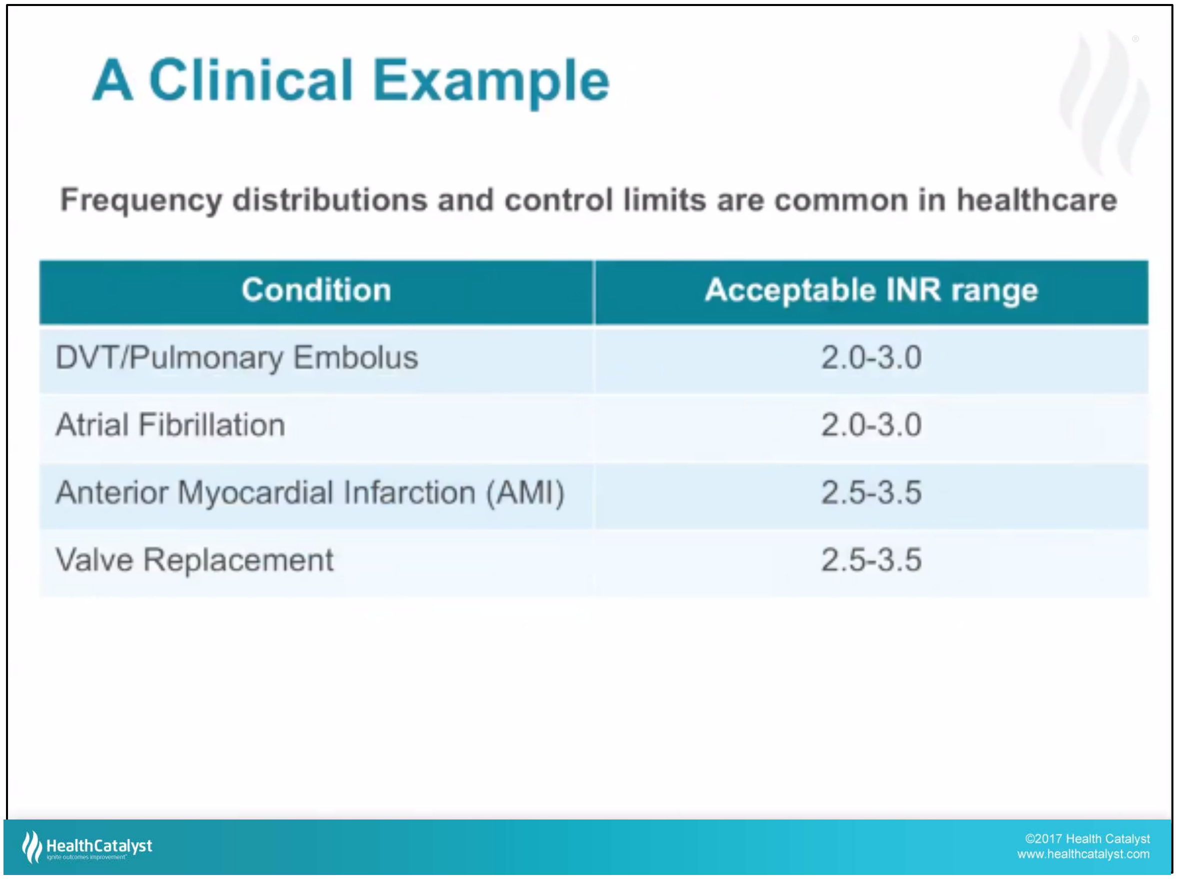
Deciding whether to act on variations of data depends on differentiating between variations that are inherently part of the process, so-called random or common cost variation, and those variations that are not part of the process, so called assignable or special cost variation. The output of a process can be graphed as a frequency distribution. A frequency distribution tracks the performance of a process across a group of observations or measurements. It shows the number of times illustrated on the Y axis, each possible value occurred illustrated on the X axis. While it is not possible to exactly predict any single future observation of our process, the frequency distribution gives a range in which nearly all of the processes and future measures are likely to fall. Stated in other way, how a process behaved in the past is a reasonable predictor of how it will behave in the future. Process capability is defined as the degree to which a process meets specification, a specification explicitly stays in acceptable range for a measurable performance or outcome parameter. That is usually expressed as the proportion of all measured points that follow within the specific specification range. A defect is a process of but does not meet the specifications. That is an output that falls outside of the specification range. The specification range is generally defined by control limits illustrated here by the dotted lines. Control limits represent action or decision thresholds. They generally are measured in units of standard deviations and are often referred to by the term (13:34). This essentially tells us how well a process works. In frequency distributions, the parameters that drive the specificational limits are the centerline and the spread. The centerline is the horizontal line on the control chart that represents the average or the need for a process. That is best is founded by control limits or the process. These parameters explain how the random component of a process behaved in the past. The frequency distribution illustrated in this slide demonstrates the frequency distribution with the control limit set at 2.33 standard deviations from the mean, such that 99% of the measurements are deemed acceptable and 1% of the measurements are deemed outside the specifications or half percent below and half percent above the control limits.



The causes of variation

When he developed the concept of process variation, Walter Shewhart recognized that sources of variation at any point in the process could be one of two types, common or random cause variation and assignable or special cause variation. Most complex processes have many sources of variation. Most of these sources are minor and can be ignored. Such random variation represents the sum of many small variations arising from real and small causes that are inherent to any complex process. Random variation tends to follow the laws of probability, that is it behaves as a statistically random function. Because random variation represents the sum of many small causes, it cannot be traced back to the root cause. Instead, it represents a physical attribute of the process. It represents what we would call appropriate variation. If our processes had different levels of random variation, while random variation is an important part of measuring and monitoring the process, it is not useful in setting improvement goals for a process.

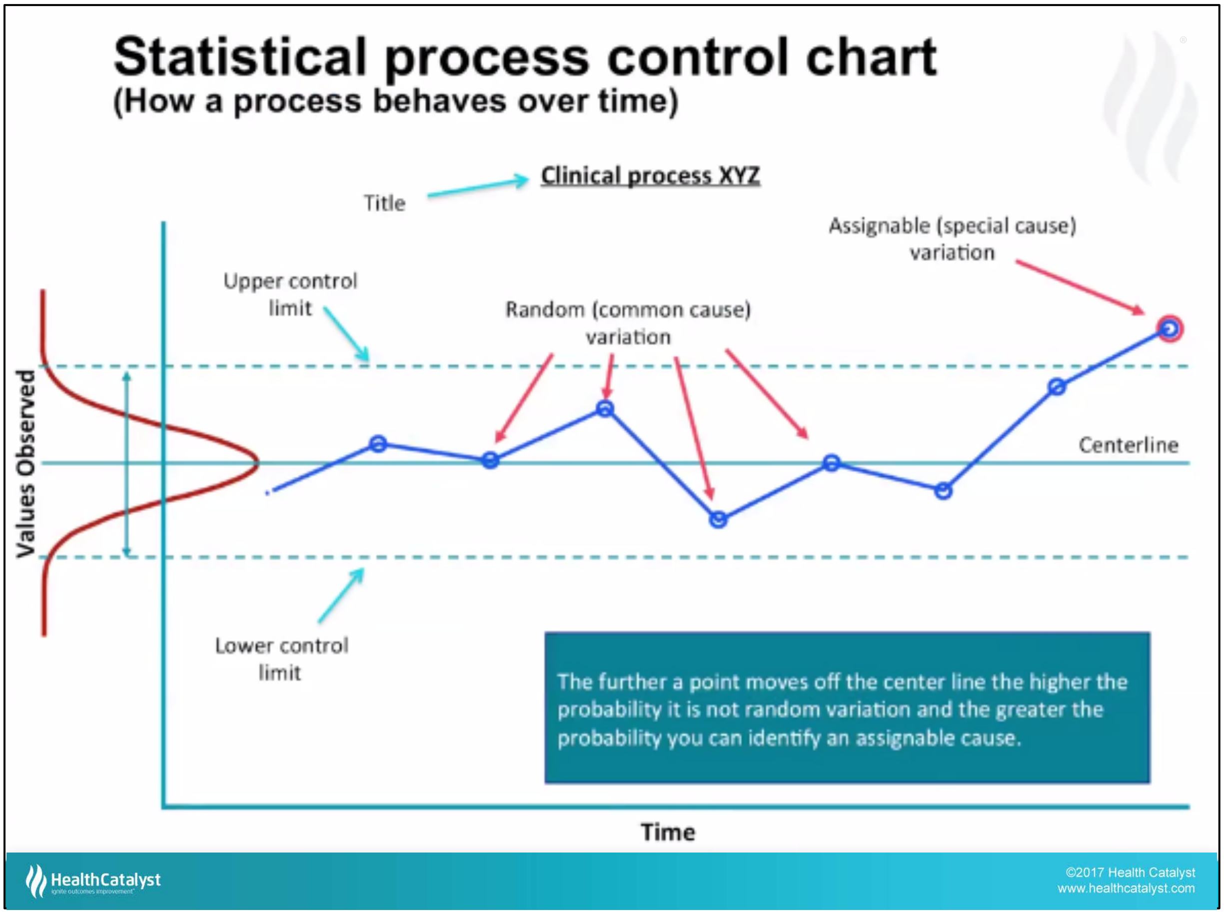
The other type of variation Shewhart observed was special cause variation, which is later called assignable variation by Deming. Assignable variation represents variation that arises from a single cause that is not attributable to the process. Therefore, assignable variation can be identified, traced to a root cause, and eliminated, or alternatively it can be implemented if it improves the outcome of the process. Unwanted assignable variation represents inappropriate variation. Identifying these two types of variation is important in quality improvement, if the dominant assignable sources of variation are identified, improvement teams could focus their attention on them. Improvement teams can track the assignable variation to its root cause. Once the root cause of the assignable variation sources are known, the team can eliminate them if they are found to contribute to a less than optimal outcome. Once an assignable cause or variation is removed, the process is said to be stable. Alternatively, if an assignable cause or variation represents an improvement, improvement teams can retain and exploit it in a new more stable process. When a process is stable, its variation should remain within the known set of control limits. The stability will persist until another assignable source of variation is introduced.



Condition	Acceptable INR range
DVT/Pulmonary Embolus	2.0-3.0
Atrial Fibrillation	2.0-3.0
Anterior Myocardial Infarction (AMI)	2.5-3.5
Valve Replacement	2.5-3.5

A Clinical Example

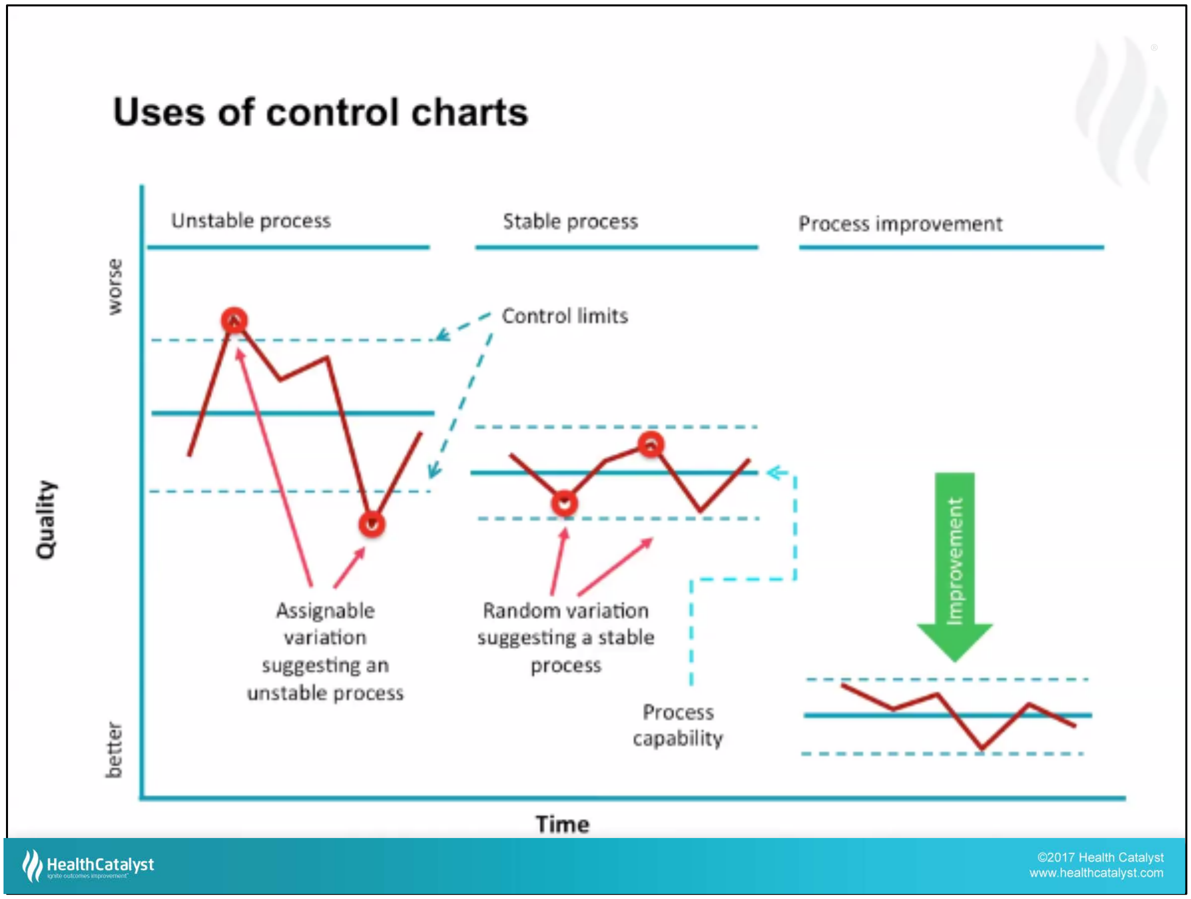
Specification ranges are actually commonly used in healthcare. For example, specification ranges are often set based on a balance between an appropriate therapeutic range for a medication that achieves therapeutic goals and yet minimizes complications of the treatment. Coumadin anticoagulation is an example of this. This slide demonstrates the range of coagulation that has been determined to be ideal for avoiding the most common complications of blood clots while also minimizing the risk of bleeding. For any given population of patients on Coumadin, one can plot their coagulation values in a frequency distribution. If the control limits are drawn too narrowly, more patients fall outside ideal therapeutic range and risk the consequences of clots. If the control limits are defined over a broader range, more patients will avoid the risk of clots but they will also face a higher risk of bleeding. If an anticoagulation value falls within the ranges illustrated on this slide, we simply view it as a random variation of the process, in this case, is of no real concern to clinicians. If an anticoagulation value falls outside of these ranges, we become concerned as clinicians and start looking for special causes of the variation. In that case, we ask questions like is the dose of Coumadin correct, is the patient taking the medication correctly, is the patient’s diet interfering, and a series of questions like that. As this example shows, we are trained in healthcare to accept what we believe to be random variation and pay attention to what we believe is special cause variation. The same is true for improvement projects.



Statistical process control chart
(How a process behaves over time)

Using this knowledge of variation, Walter Shewhart started to develop the concept of a controlled chart. Flipping a frequency distribution on its side and plotting individual observations from a process over time is the first step in creating a control chart. Each time you plot a point, you are saying to yourself, is it reasonable that the random nature of this process could be produced in this new measured result? Adding the upper and lower control limits defines the specification range of the process and allows one to differentiate between random cause variation and special cause or assignable variation. Adding these elements results in an SPC chart, as shown in this slide. SPC charts are a common and a very powerful tool for clinical and operational improvement teams to utilize as they strive to achieve optimal outcomes. A control chart is made up of several elements that, tied all, briefly describes the information displayed in the chart. The Y axis shows the scale of the measurement for variables data or the count or percentage of occurrence of an event for attribute data. The Y axis displays the chronological order in which the data were collected over time.

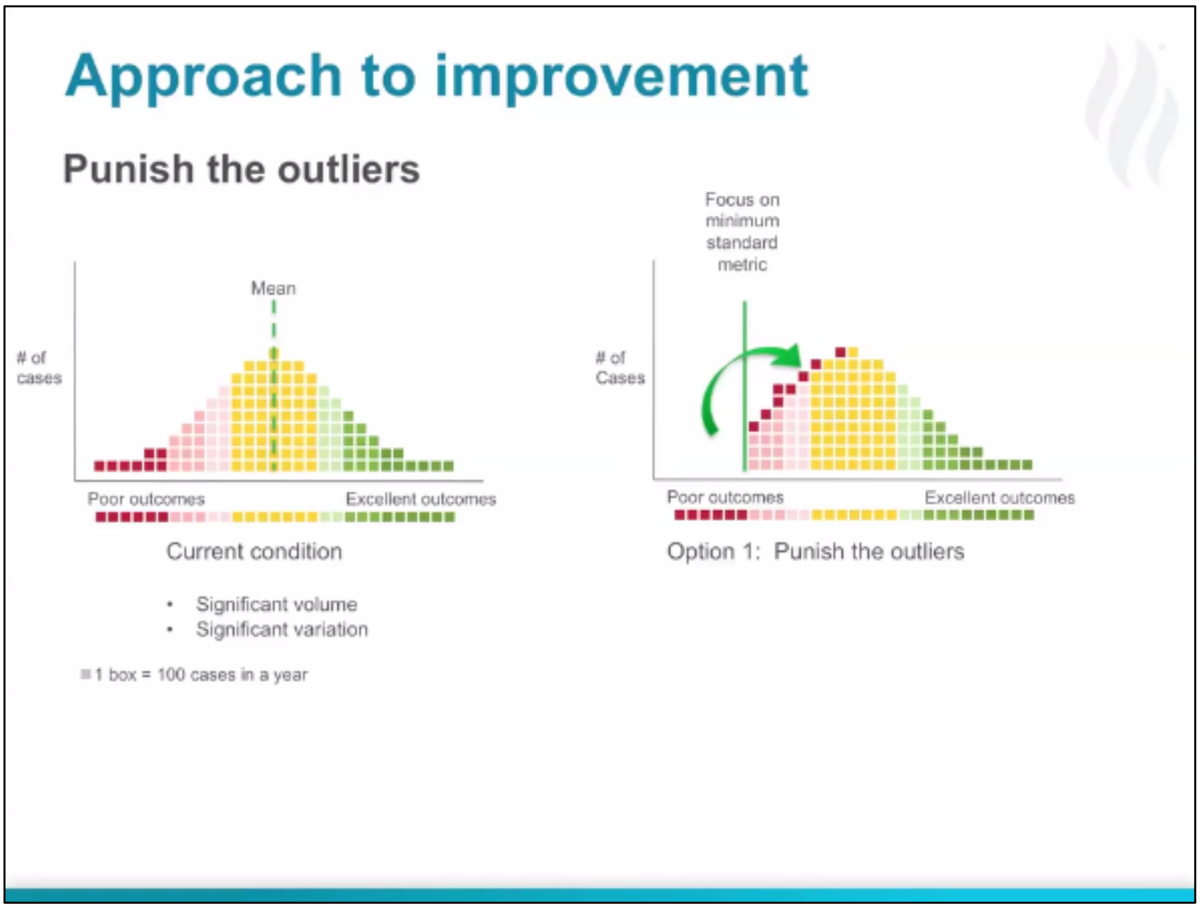
In healthcare, control limits are generally set at a distance of about 3-sigma above and 3-sigma below the centerline. They indicate variation from the centerline and are calculated by using the actual values plotted on the control chart graphs. The centerline is drawn at the average of mean value of all the plotted data. The centerline generally now is the expected outcome or output of a given process. If a process is improved, one can expect the centerline and therefore the process capability to move closer to the ideal or optimal outcome for that given process.



Uses of control charts

SPC charts are useful for monitoring process variations over time, for differentiating between assignable cause and a random cause variation, for identifying and eliminating unwanted assignable variation, and for assessing the effectiveness of changes on improving a process, as demonstrated in this slide. This slide displays the key goal of a control chart, achieving and maintaining process stability. This consistency is characterized by the stream of data falling within the control limits. Less stringent control limits can result in misinterpreting random variation as assignable variation, as we illustrated in the slide on (22:31).

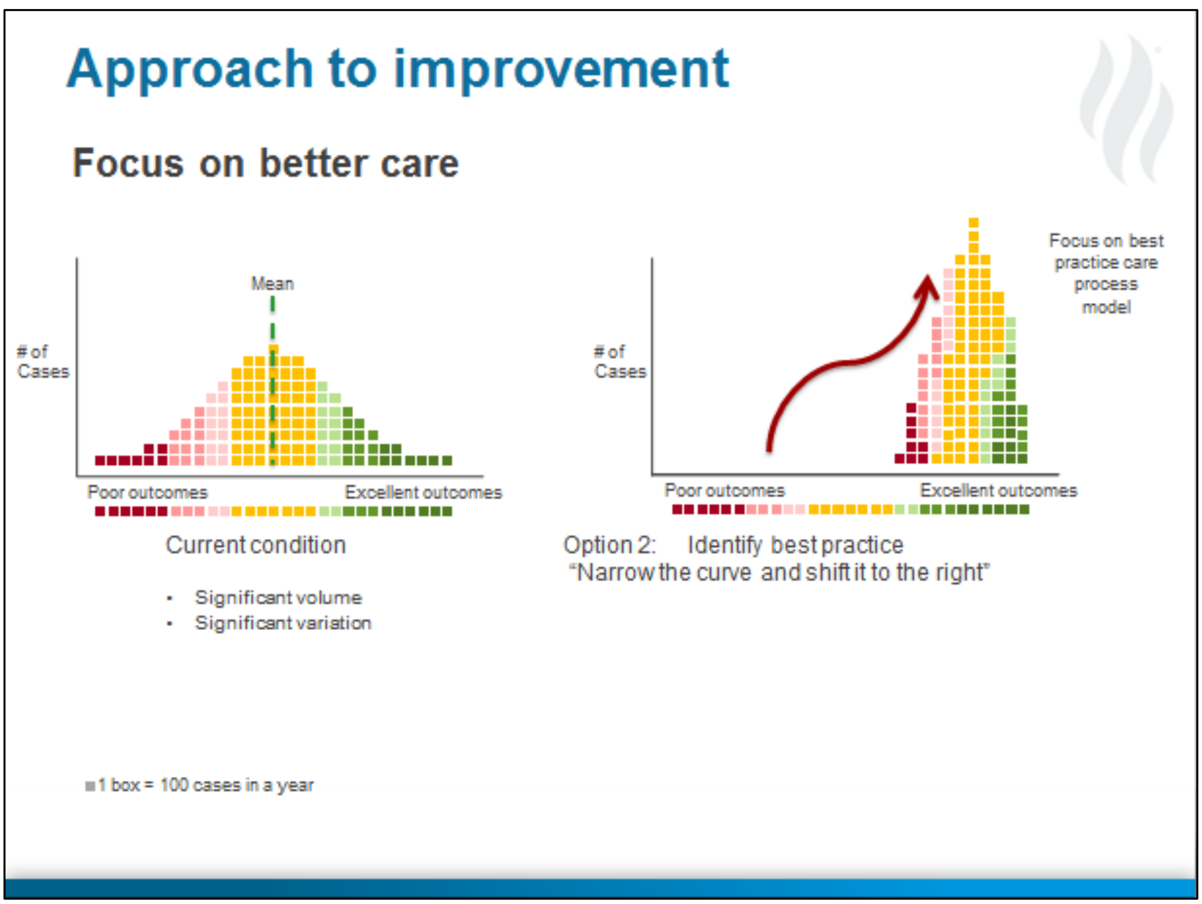
Control limits represent the limits of variation that should be expected from a process in a state of statistical control. When a process is in statistical control, any variation that's a result of random causes can affect the entire process in a very similar way. On the other hand, control charts that can also be used to identify assignable variation are special cause variation. There are several guidelines that indicate when a signal of assignable cause variation has occurred on a control chart. The foremost is that the data point appears outside the control limits, as illustrated here. Several other rules have also been promoted to help identify assignable cause variation based on patterns of data points that are created within the control limits. These rules are discussed in the book and I will not read them here. If you treat random variation as though it's a special cause variation, it results in tampering. The negative impact of tampering is also discussed in the book and I will not discuss it here. Because random variation is a physical attribute of a process, sure it recognized that the only way one can reduce random variation is to identify a new improvement process that yields a better outcome and a new level of random variation, as illustrated on the right side of this slide, that is it is a process that is superior to the original process. Managing random variation in this manner requires the use of the so-called plan, do, act or PDSA cycle.



Approach to Improvement
Punish the outliers

Once the care process families are prioritized, an organization can focus its attention on improving them. This starts with how to appropriately use data in quality improvement. How do we measure outcomes? How do we determine which are good outcomes and which are not? This brings us back to the concept of variation. A good outcome is generally this one that represents that optimal outcome for a given process, that is it represents best practice in the eyes of reasonable clinicians. Once we have determined the ideal outcome, the performance of clinicians can be plotted on a frequency distribution, like you see here. Using the frequency distribution, we can then determine which outcomes represent reasonable random variations from the norm and which represent assignable or special cause variation, or so called outliers, illustrated here in red. In this slide, the X axis shows variability in outcomes for clinical process with poor outcomes on the left and excellent outcomes for a process family on the right.

The Y axis on each grid shows the number of cases for each outcome. When you see the first grid, your initial reaction might be to target only the cases with poor outcomes, those in red. That is focused on the outcomes that deviate far enough from the norm, that they are deemed unacceptable by reasonable clinicians. This is called punishing the outliers or cutting off the tail. When you use this approach, the outliers usually improve just barely enough to meet the new minimum standard. Meanwhile, the acceptable outcomes which constitute most of healthcare's provider cases did not budge. This approach does not achieve the most important goal in case improvement that is it does not lead to continuously improving outcomes.

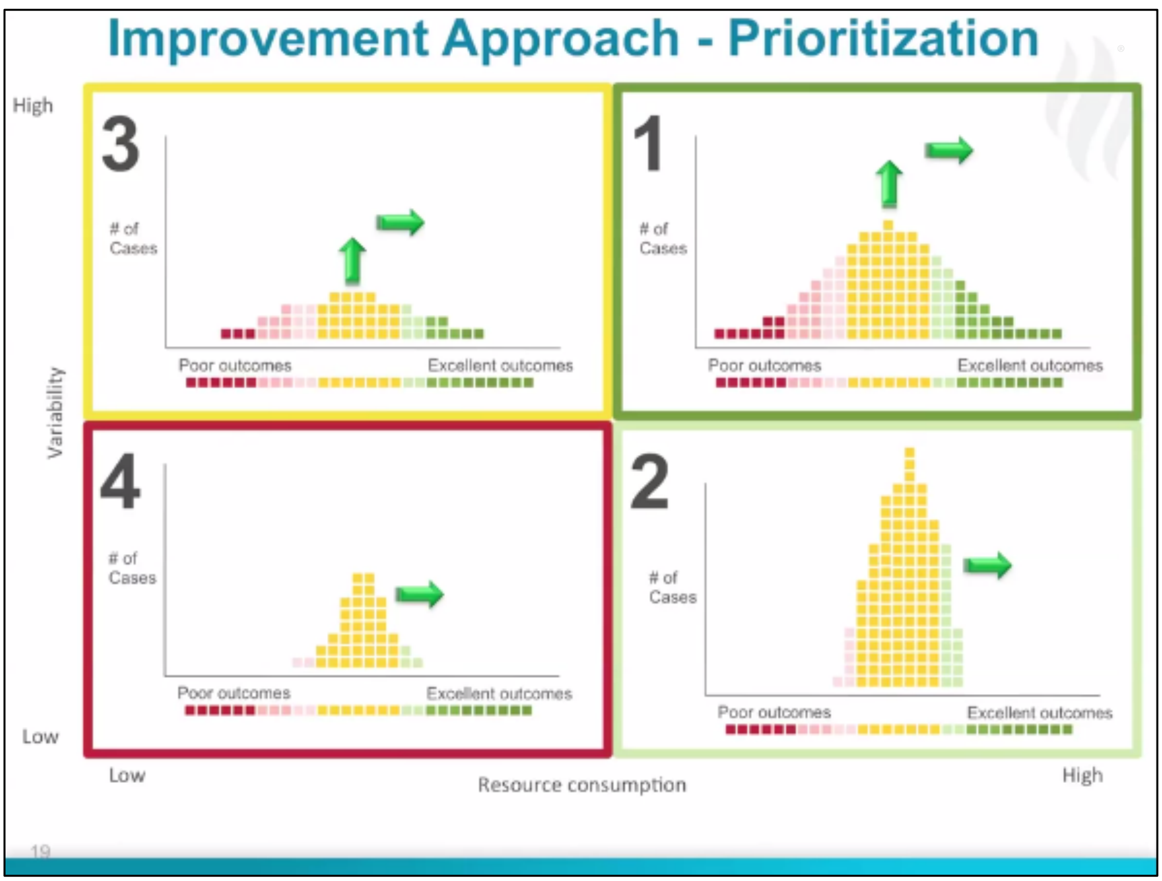


Approach to improvement
Focus on better care

The primary goal of quality improvement is to move everyone in the direction of continuously better care. If that is accomplished, you will move the centerline of the outcome frequency to the distribution in the entire bell-shaped curve for improved outcomes. By definition, this approach will automatically identify any outliers but the focus is primarily on improving everyone's performance rather than focusing on those few underperformers. Outliers will either learn to improve or self-select out by demonstrating unwillingness to improve.

A more effective approach to improving a care process family is to narrow the curve, that is narrow the spread of the frequency distribution, and move all cases closer to better outcomes, as the right-hand side of this graph illustrates. In order to achieve high quality outcomes and reduce wastes, one needs to focus on eliminating the inappropriate variation, that is focus on processes, and achieve continuous improvement by focusing on outcomes. This is illustrated on the slide by the narrowing of the distribution curve on the right and the entire curve shifting to the right.

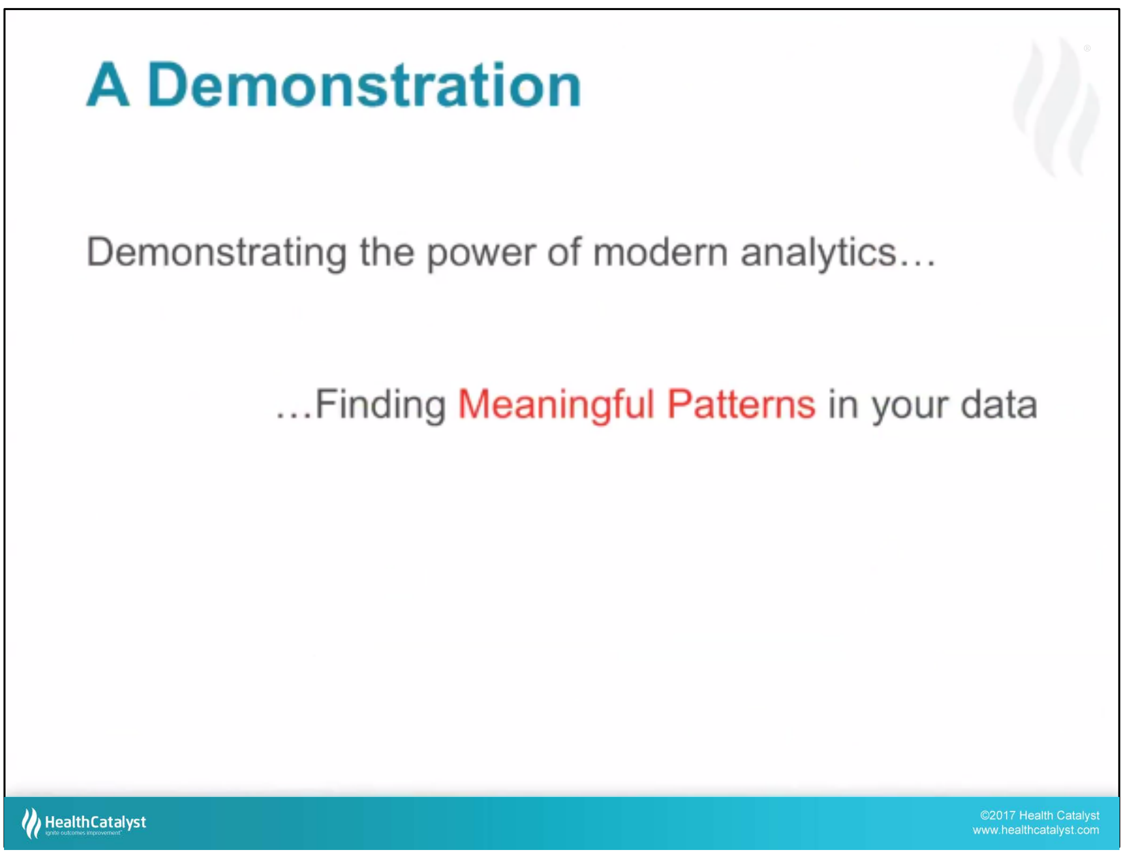
Instead of focusing on the outliers, improvement teams identify evidence-based shared baselines and use them to reduce inappropriate variation, a tactic referred to as inlier management. Inlier management improvements outcomes across the board, producing a much greater overall impact in improving care and lowering cost.



Improvement Approach – Prioritization

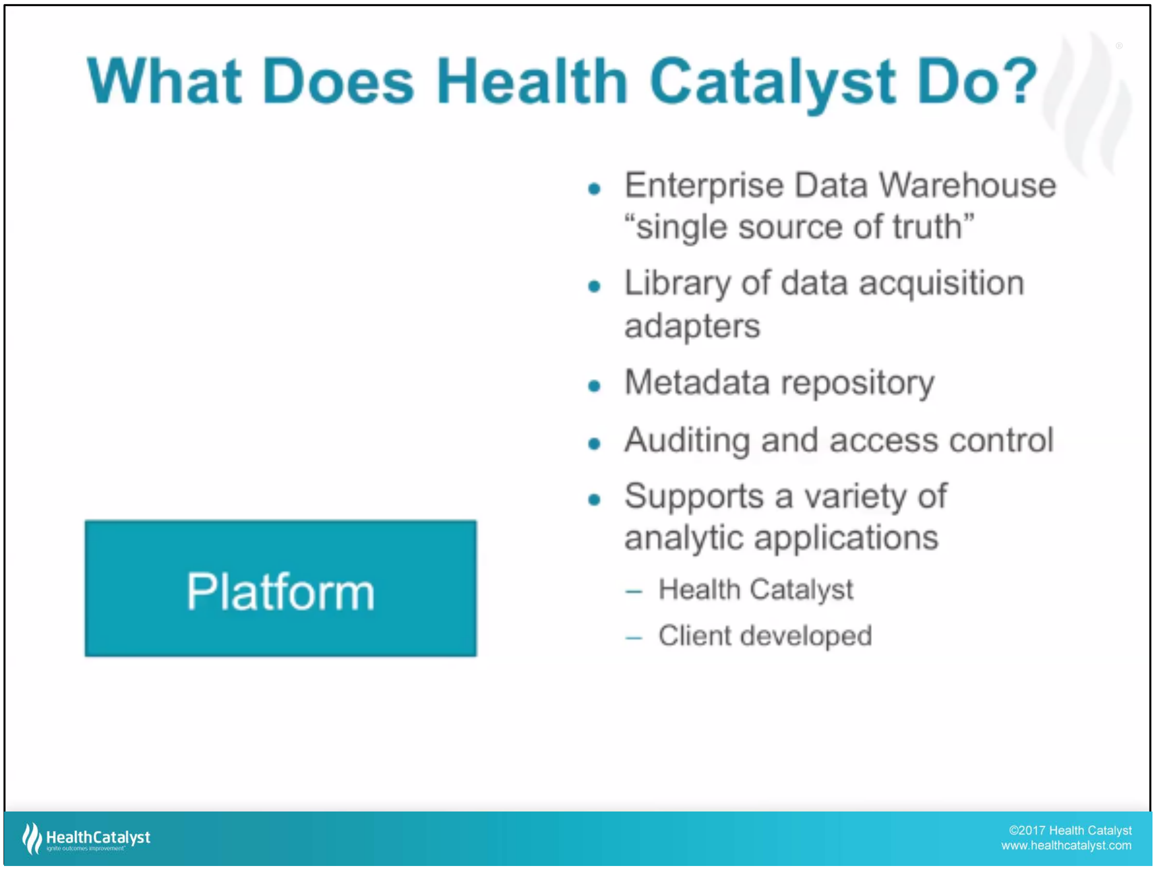
This slide illustrates that frequency distributions can help an organization choose which care process families to focus on. Care process families that consume more resources and have more variation, that's just those in quadrant 1, should be addressed first because they represent significant opportunities in terms of eliminating inappropriate variation and unnecessary costs. In quadrant 2, it shows care process families with high resource consumption but much less variability than quadrant 1. Because the potential yield is lower, a network will want to avoid focusing on the care process families where fewer resources are consumed, whether or not they have ample variation and outcomes, like those in quadrants 3 and 4.

In the upcoming demonstration, I will illustrate one way of visualizing how care process families consume resources and how this information could be used to identify improvement opportunities that should be pursued.



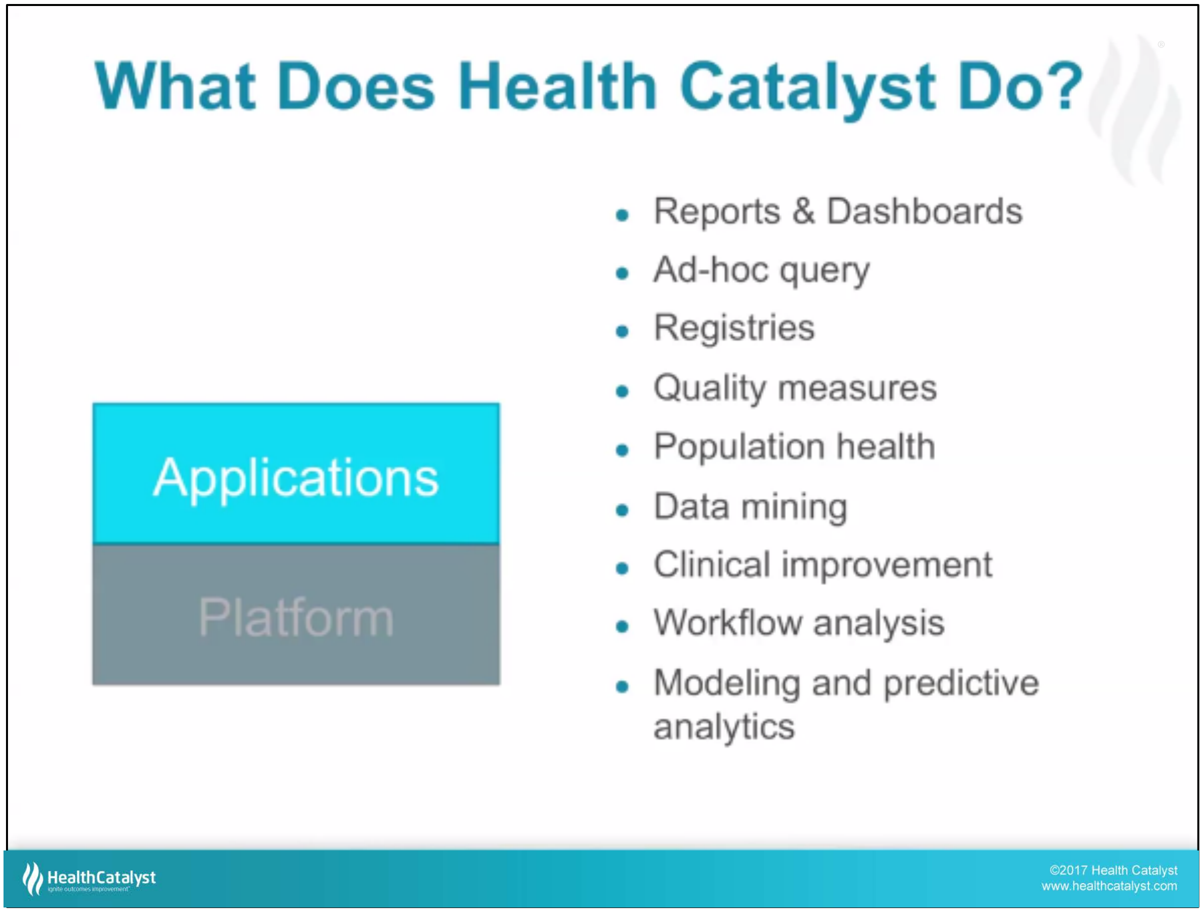
A Demonstration

Now, let's turn our attention to a demonstration of modern analytics. Before we get into the demos, let me explain very briefly what Catalyst does because I think it will help put things in context for you.



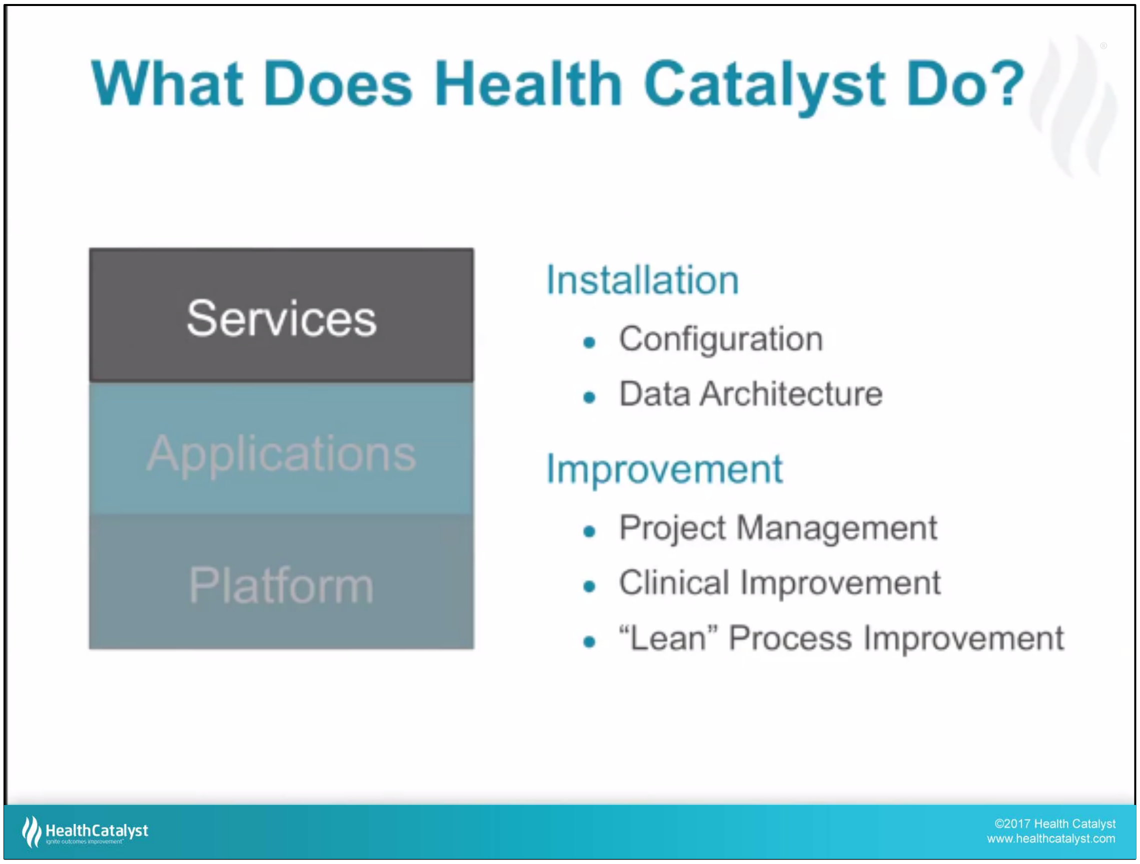
What Does Health Catalyst Do? - Platform

One of the things that Catalyst provides is an enterprise data warehouse platform. The platform consists of our data warehouse products and is designed to serve as a single source of truth for the data possessed by each Health Catalyst client. We have a library of data adaptors, so we can plug into most commercial source systems and pull the data contained at them directly from those source systems into the data warehouse. The data warehouse is then in a position to become the information backbone for our clients. All of the analytics demonstrations you'll see today and in subsequent webinars that I do are based on the data that exists in our enterprise data warehouse platform. The demonstration consists of very real data but of course it's been de-identified to preserve privacy and confidentiality.



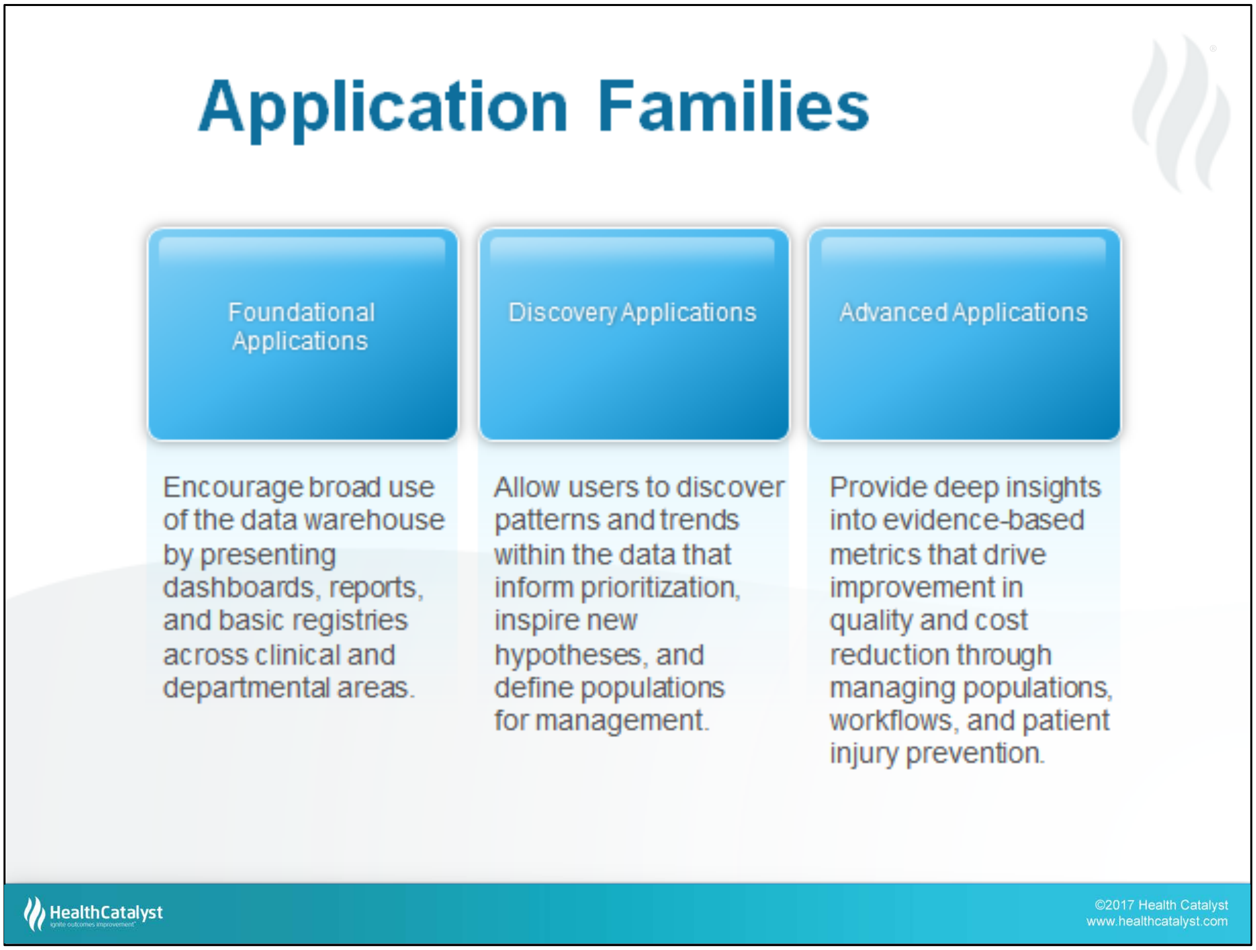
What Does Health Catalyst Do? – Applications

In addition to providing the data framework, Health Catalyst also supplies analytical applications. These applications could be anything from registries to readmission reports, population health tools, data mining tools, and assortment of many other tools. There are applications capable of providing a wide variety of information that end users of all types at Catalyst clients need to see and use. In a moment, I will show you a slide that illustrates many of these applications. The demonstration today and in future webinars will focus on looking at some Health Catalyst applications that specifically deal with clinical improvement and population health management. So we focus on an important future topic and that is population health management.



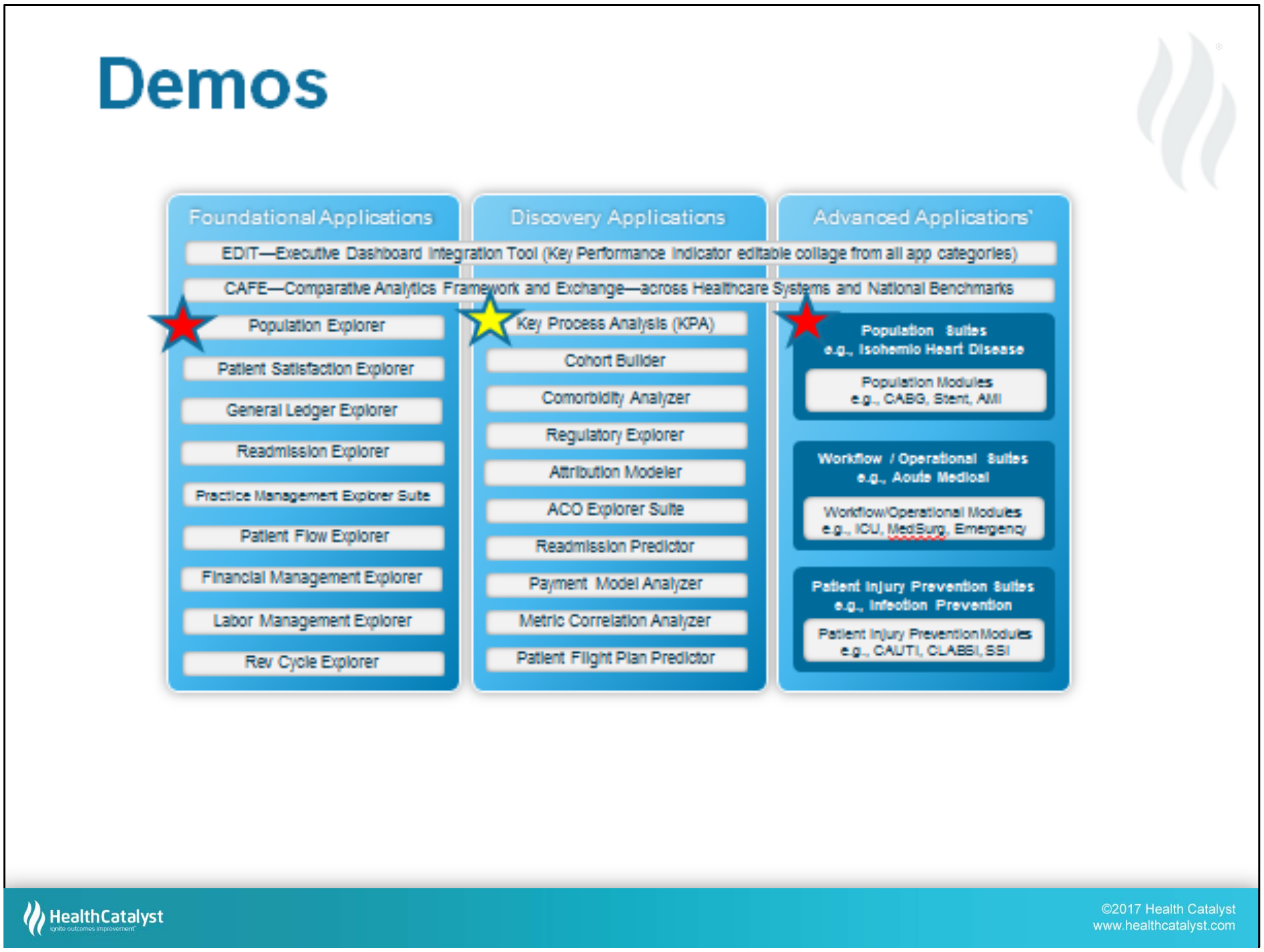
What Does Health Catalyst Do? – Services

Last, but not the least, we have the Health Catalyst Services arm. The services arm includes both technical services and clinical services. When Health Catalyst installs the analytic platform, we train an organization's technical people on how to manage and configure the platform. The technical services team fills this need. In addition, we have a clinical services arm. Of course, promoting change in an organization and creating sustainable improvements and outcomes is not just about technology. There is also a very large people and cultural aspect to it. The Health Catalyst Clinical Services arm is about helping Health Catalyst clients to take our products and translate data analytics into meaningful change across their organization. In order to accomplish this, there's a large organizational piece that must be dealt with successfully. We will be talking about this in future webinars, especially when we cover the deployment system, starting with the webinar next month.



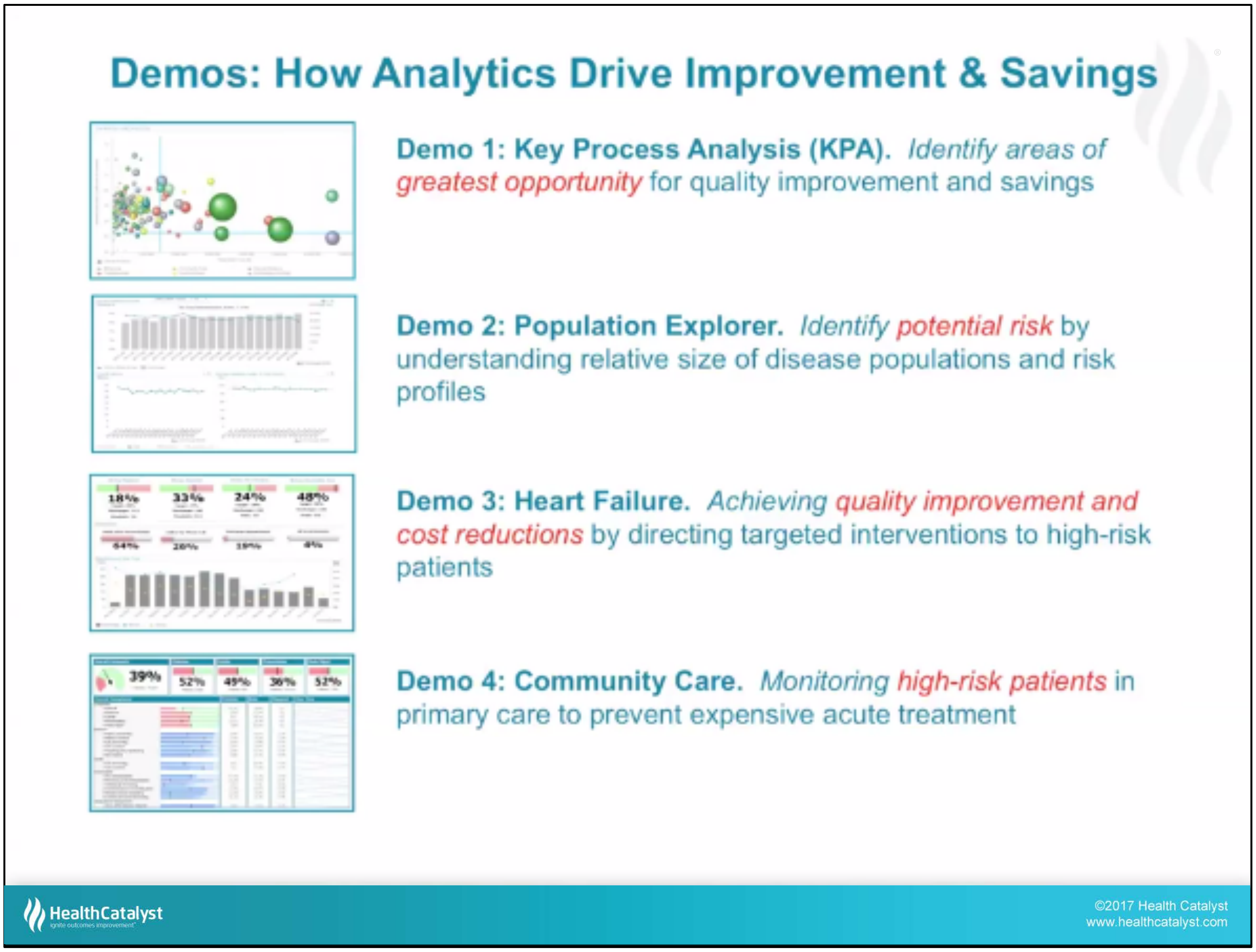
Application Families

Let's turn back to that first application layer. Health Catalyst has three families of applications. First, there are foundational applications. These are applications that are typically implemented very early on in a client engagement. They encourage the broad use of the data warehouse by presenting basic registries, dashboards, and reports. These foundational applications present information across clinical and operational areas. We also have what we term discovery applications. Discovery applications are applications that focus on data mining, hypothesis generation, prioritization, and helping to define populations in need of management. Finally, there are advanced applications. Advanced applications are applications that are used directly to improve care and operations. These applications look at details around process and outcome metrics and provide evidence-based actionable information to improve care delivery and operations. These three categories of applications constitute the Health Catalyst suite of applications.



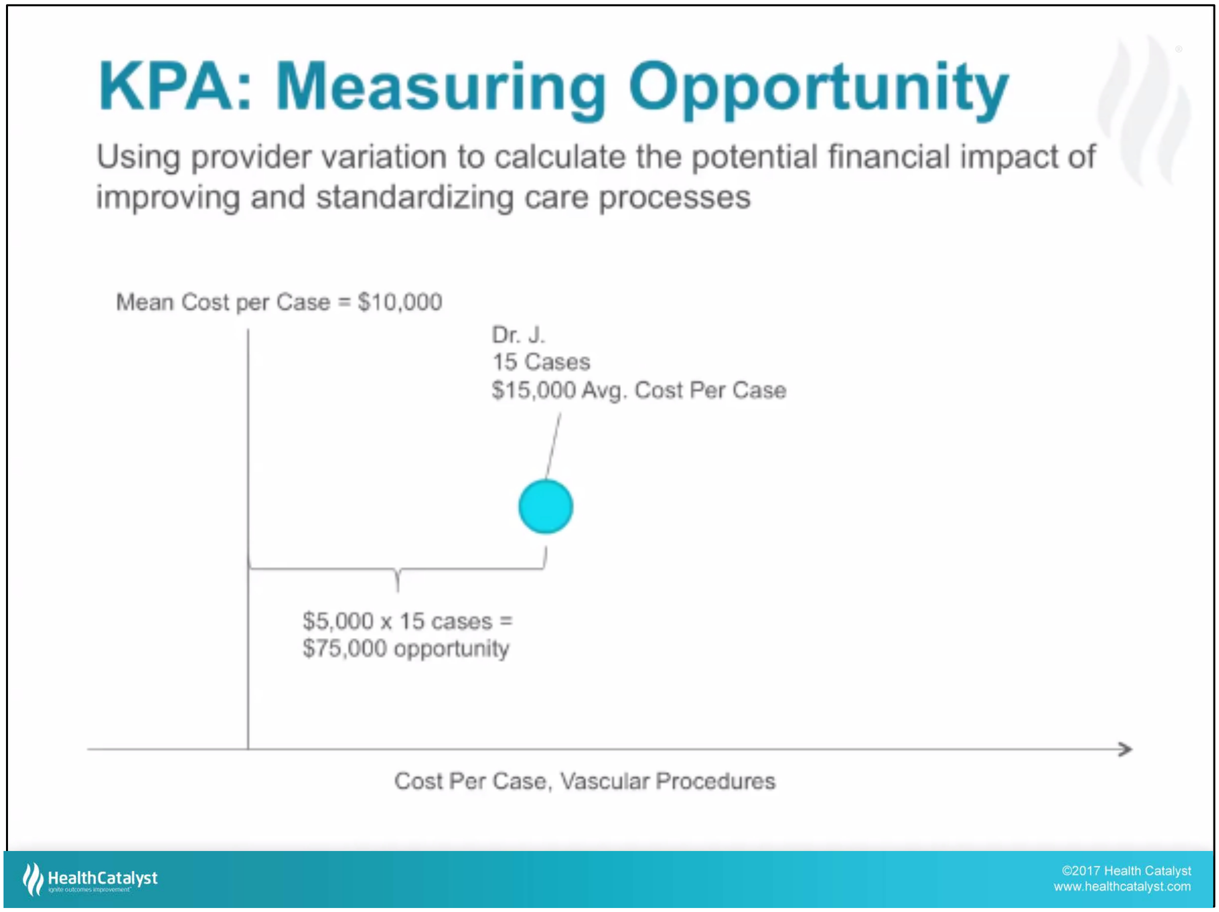
Demos

This slide lists most of the Health Catalyst applications, though not all of them. There are actually more than are shown here. This list continues to grow at a pretty good steady pace. Once again, they are categorized into three categories across the top – foundational, discovery, and advanced applications. I put a yellow star next to the key process or KPA discovery application that I will be demonstrating today. In future webinars, I will also be demonstrating additional applications, including the population explorer and the population suites highlighted or the red stars on this slide. Collectively, these applications provide tremendous flexibility and power to analyze and improve clinical care and operational processes.



Demos: How Analytics Drive Improvement & Savings

The key question is how can data be used to identify opportunities and derive improvement and savings? In the first demonstration today, we will be looking at the Health Catalyst key process analysis tool. The KPA tool is used to identify areas of greatness opportunity for quality improvement and savings. As we discussed during the last webinar, every organization is (34:55) that resource system. Whether it is the improvement or anything else, every organization needs to strive to get the greatest return on its investment for the resources supplied to that endeavor. The KPA tool helps clinicians and operational leaders decide where the greatest opportunities for improving care saving costs are located. The tool uses variation and cost to help hone in on these opportunities. In future demonstrations, we will look at other applications that help us understand potential risk, to understand the relative size of disease populations and their profiles, to determine how to achieve quality improvement and cost reductions by directing targeted interventions to certain high-risk populations, and finally we will look at the Health Catalyst community care dashboard that helps primary care providers monitor high-risk populations of patients in order to prevent expensive acute care treatment. There are many other possible demonstrations of Health Catalyst applications that I could demonstrate for you but these four will help you understand the power of modern analytics tools. I believe that you will find each of these demonstrations informative and exciting. These represent very powerful data-driven ways of delivering care that did not even exist a few years ago.

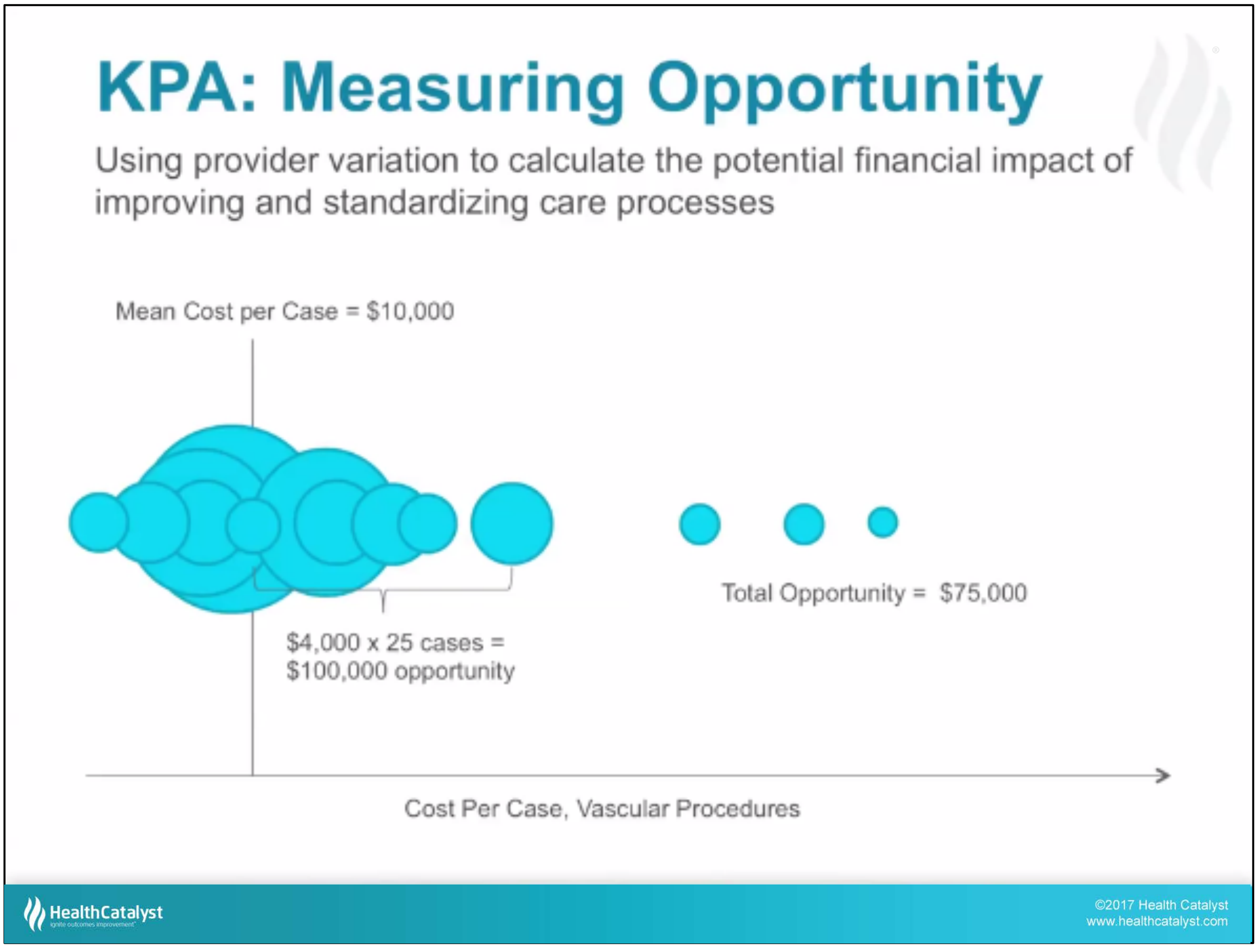


KPA: Measuring Opportunity

Let's (36:21) for how and why we look at variation from an opportunity perspective. The KPA tool is designed for measuring opportunity for quality improvement and cost reduction. This animated slide will help illustrate the point. On the X axis, we have cost per case for the vascular procedures. More costly procedures are going to be on the right.

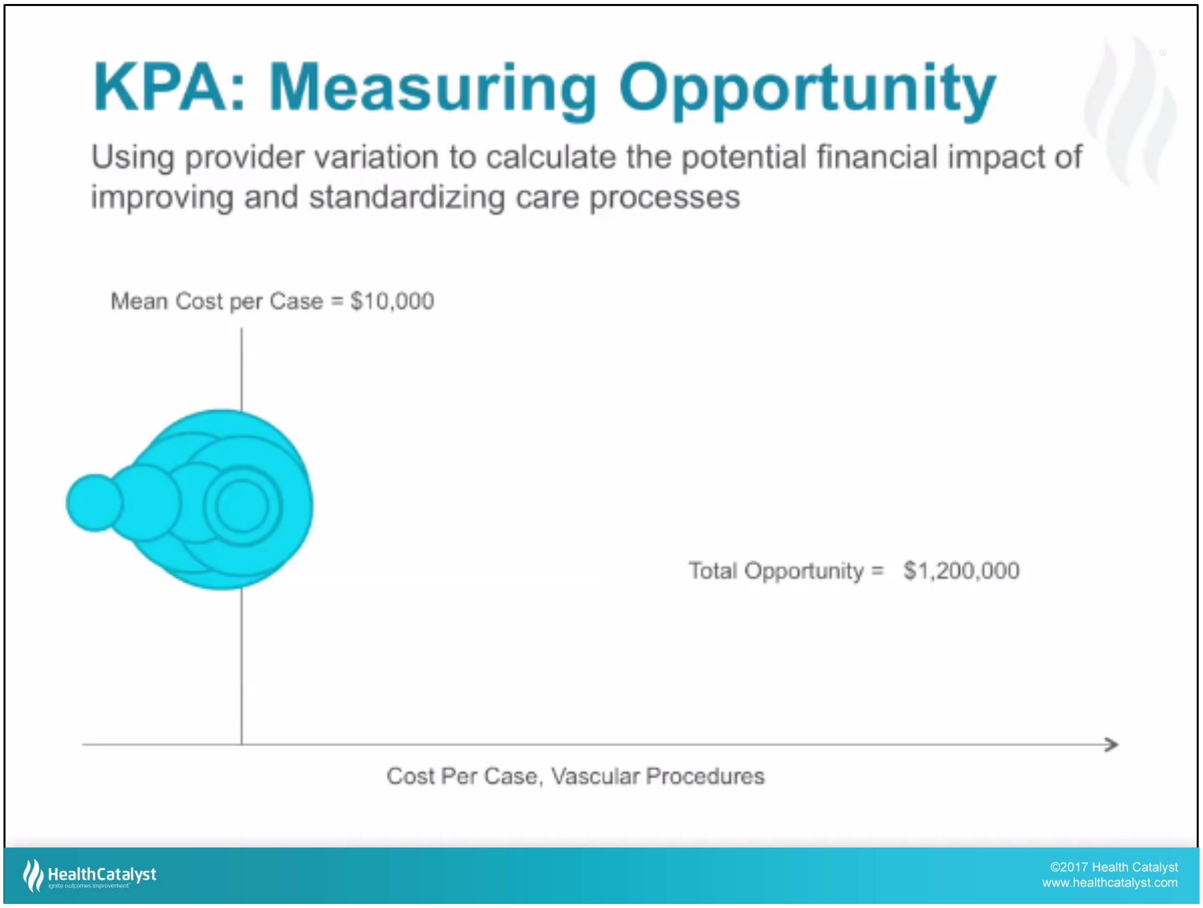
This bubble represents an individual physician. Let's say it's Dr. J, who performs 15 cases of vascular procedures in a year. This graph indicates on average that he performs these cases at about $15,000 average case.

The average cost per case for the organization and among all physicians who do the vascular procedure is about $10,000 per case. That puts Dr. J at about $5,000 above the mean. If we multiply that by 15 cases that he performs, and assume that we can standardize these processes, we have to get Dr. J down nearer to or at least closer to the mean, that would represent a result in potential opportunity to save cost of about $75,000.



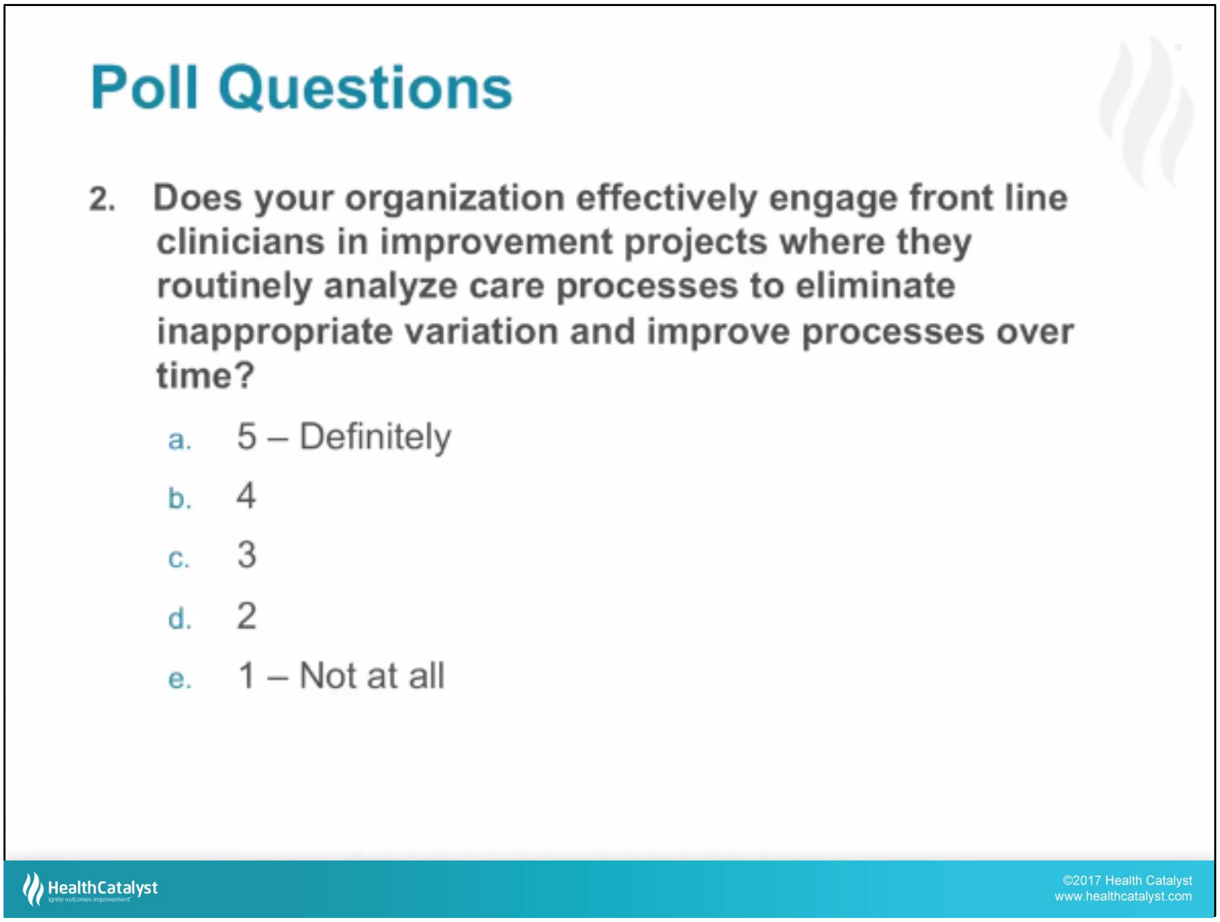
KPA: Measuring Opportunity

So take that physician's cost and move it down to the mean. Similarly, we can perform the same calculation on the rest of the physicians in the organization who are performing that vascular procedure. We might have one physician who is doing 25 cases at $4,000 above the mean. That's another additional $100,000 in opportunity.



KPA: Measuring Opportunity

If we then perform the same calculation on all of physicians who do this procedure, we'll come up with a total opportunity for standardization and quality improvement of about $1.2 million. This is not necessarily an ROI calculator but it's a reasonable yardstick to measure the potential opportunity in different areas and to estimate where we think we can have the most potential of generating savings and improving quality by eliminating unnecessary variation. Of course, in order to really do this type of analysis, we need to jump down to the process level and allow clinicians involved in the process to determine if the optimal process is actually at the $10,000 per case level but this serves as an example on how this process works.



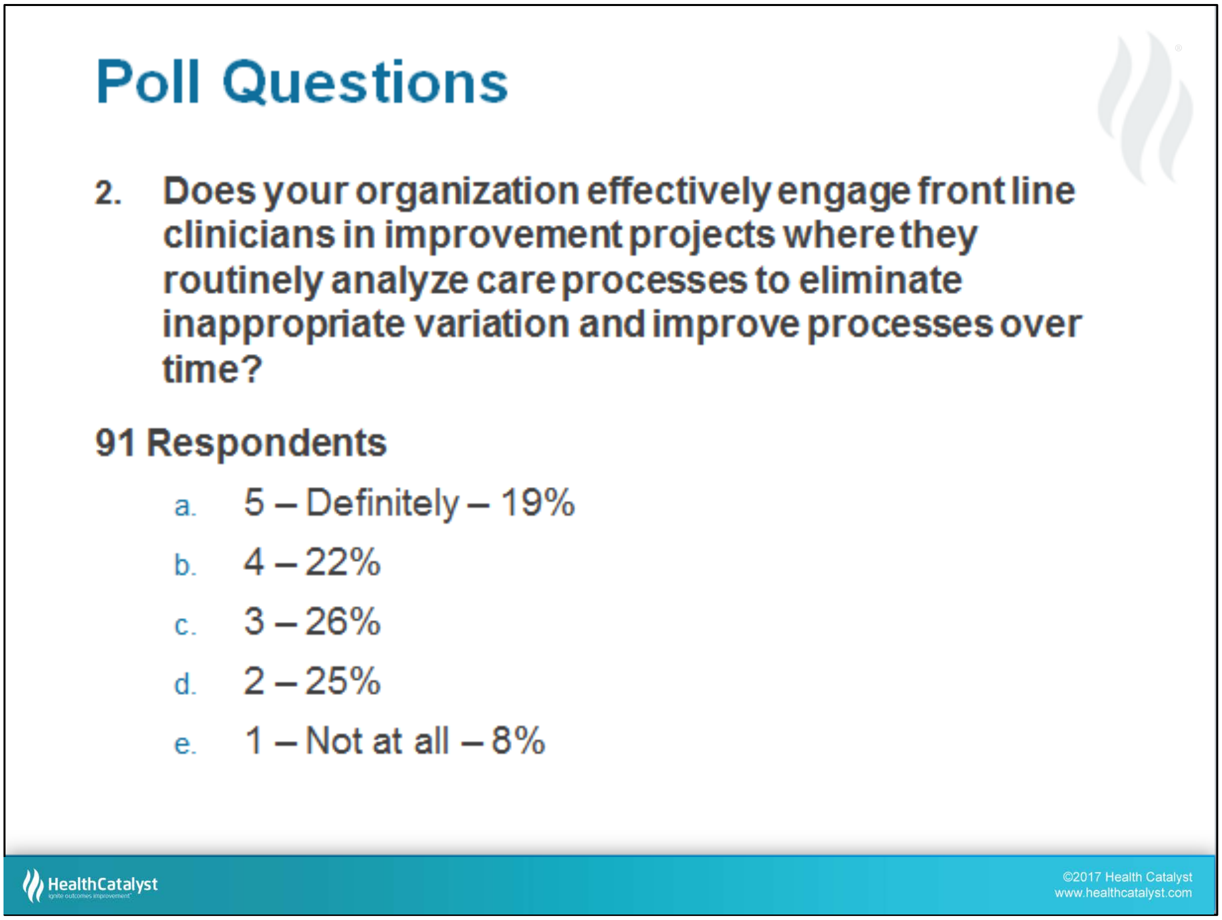
Poll Questions

Does your organization effectively engage front line clinicians in improvement projects where they routinely analyze care processes to eliminate inappropriate variation and improve processes over time?

Now, as I prepare to switch over to the demonstration, let's post another question. Does your organization effectively engage front line clinicians in improvement projects where they can routinely analyze care processes to eliminate inappropriate variation and improve processes over time? Choose between definitely – 5 and not at all. I'll pause.

[Tyler Morgan]

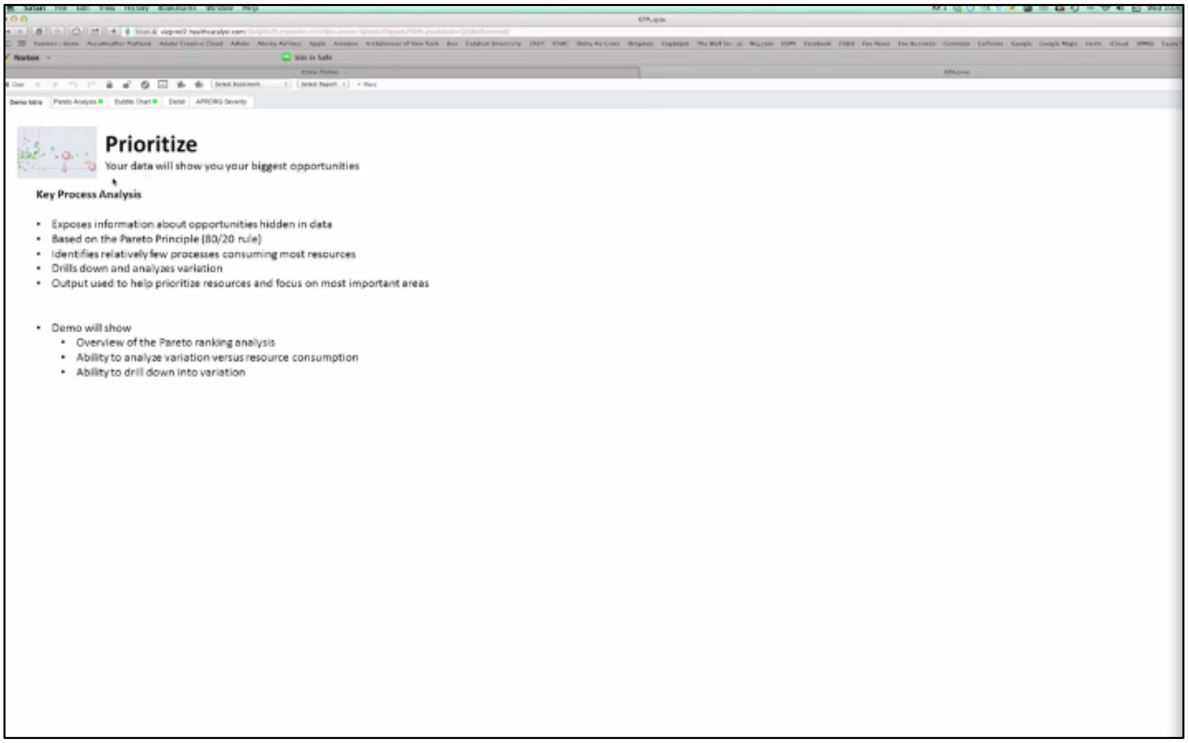
Alright. Dr. Haughom, we've got the poll up. We'll leave that up for a few seconds for everyone to answer. And while you're answering that poll, I'd like to remind everyone that you can ask your questions by typing in your questions in the control panel. We will address those questions during the questions and answers time. Also, I'd like to remind everybody that these slides will be available. We'll send links up to everybody after the webinar. We'll go ahead and close the poll now and share the results.



Poll Results

Dr. Haughom, it looks like we've got 19% answered at a 5 with definitely, 22% a 4, 26% answered at 3, 25% 2, 8% answered at not at all.

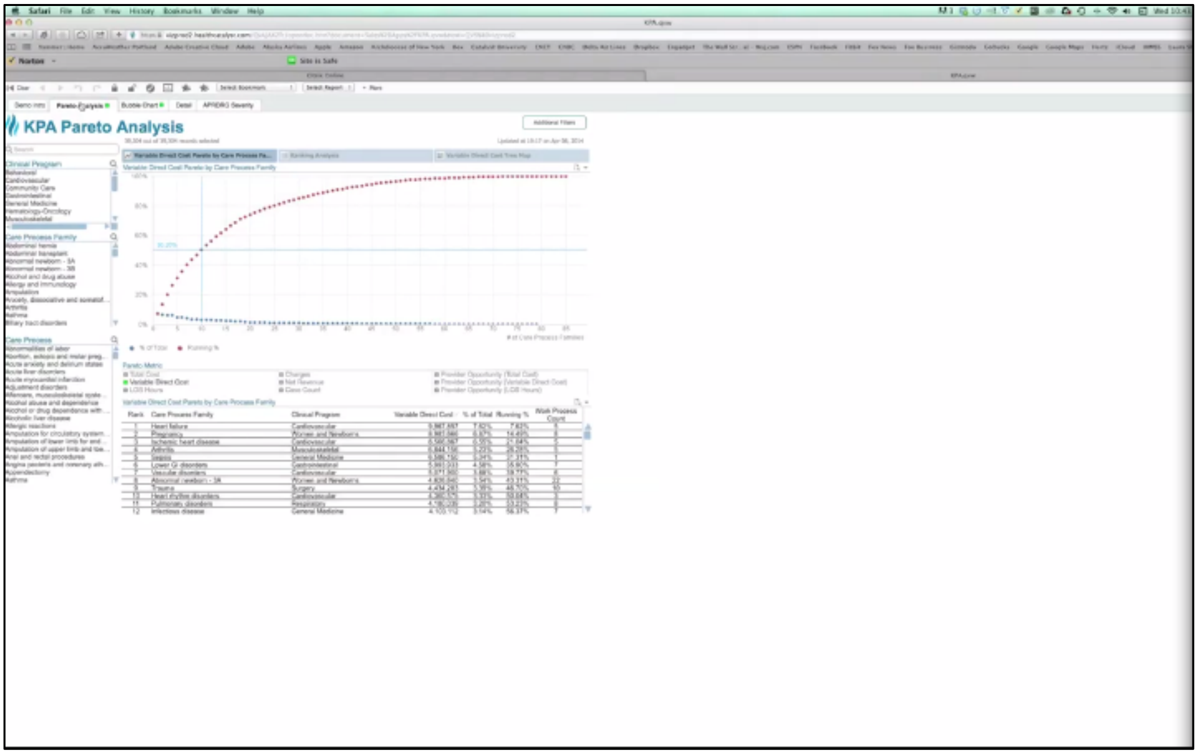
[John L. Haughom, MD]
It's about the kind of range that I would expect over – you know, if you would ask this question 5 years ago, you would have seen a lot more towards the lower end of the range. But we're definitely making progress in healthcare and more and more organizations are figuring this out.



Demo

Okay. Let's turn to the demonstration. Information about opportunities for cost savings and quality improvements is embedded in an organization's data. The Key Process Analysis tool is used to prioritize areas of clinical focus by identifying the biggest opportunities for quality improvement and cost savings.

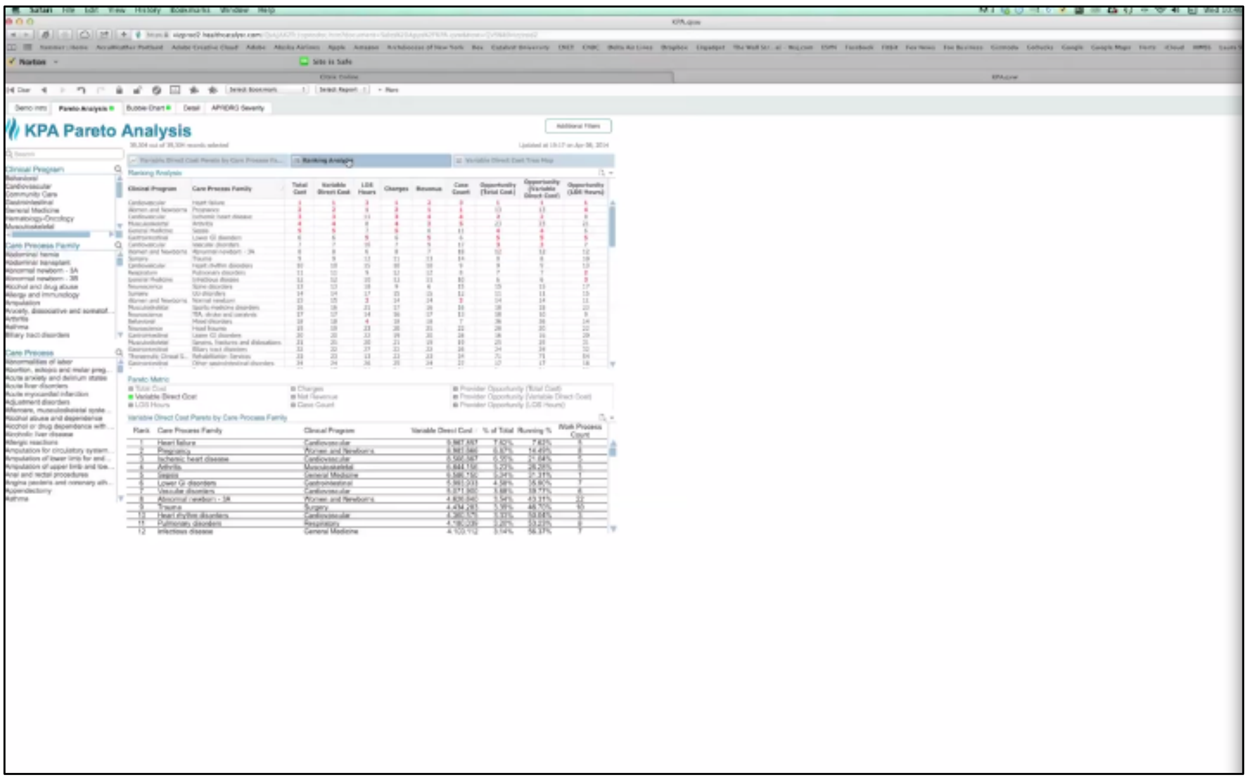
The KPA is based on the Pareto Principle or the 80/20 rule. It can be used to find the relatively few of an organization's care processes that consume most of their resources. It also provides further insight by analyzing the variation in care among these critical processes.



KPA Pareto Analysis

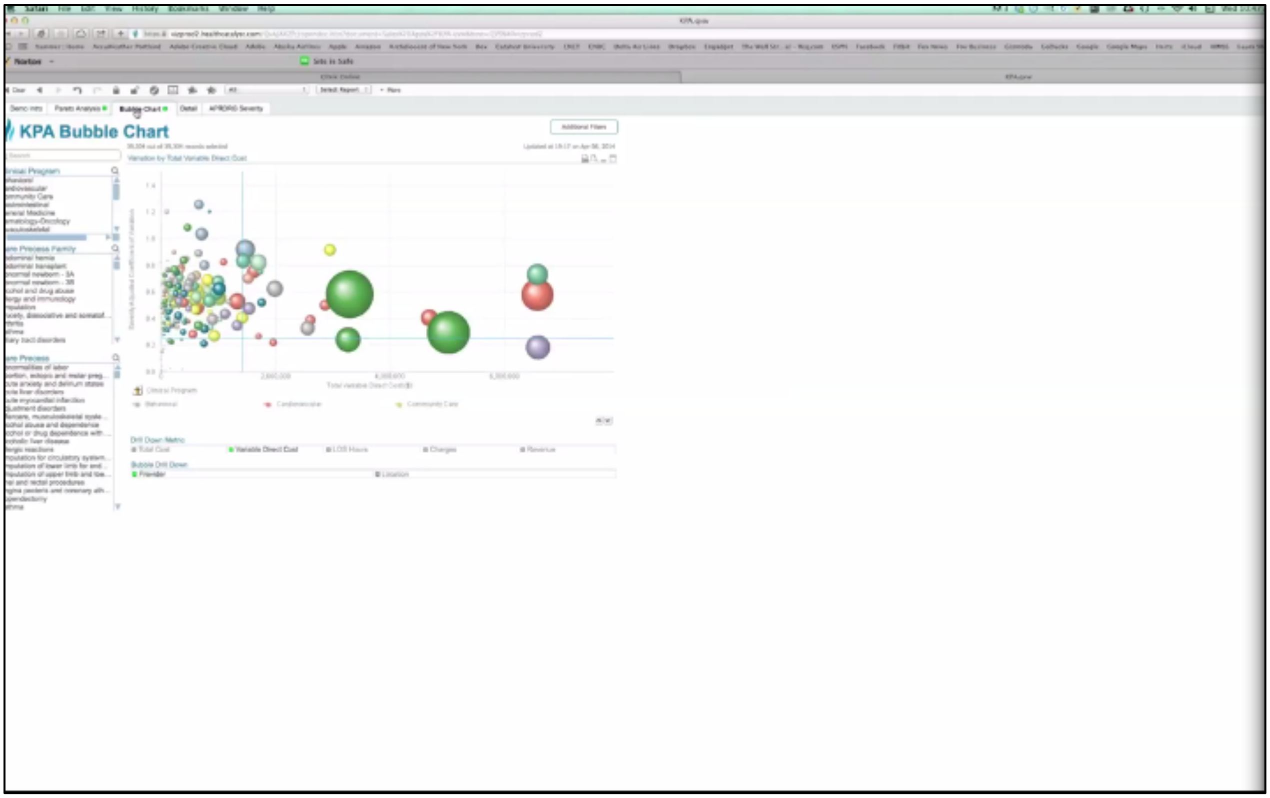
Our analysis here is looking at variable direct cost metrics stratified by care process families that are part of clinical programs that we discussed earlier. These care process families and clinical programs are derived from APR-DRG groupings that categorize care work processes in the categories that align with the way that care is actually delivered as opposed to some administrators that we defined departmental structures. Examples of care process families are shown in this table here, within heart failure, pregnancy, ischemic heart disease, and arthritis. Each blue dot represents one of the care process families. We call that a care process family is the middle part of the clinical integration hierarchy. There are about 85 care process families that comprise the majority of clinical care. These care process families are arranged in descending order from most costly to least costly. The position on the Y axis represents the percent of total direct variable cost that the particular care process family represents. Each red dot is a cumulative running total of each of the blue dots. If we draw a line at the 10 most costly care process families, we see that over 50% of resources are consumed with just these 10 care process families for this organization. This provides us with direction as to where to focus our resources. By identifying the most costly areas of care, we are likely to be able to have the biggest impact by focusing on those areas. If we draw a line in about 23 care process families, (43:09) applies those that comprise about 80% of resource consumption. It would not make a lot of sense investing precious dollars in improvement projects on care process families located in the upper right hand corner, hence the level of variations probably will and the potential cost savings would also probably will. In other words, investment here revealed a much lower return on investment.

On the other hand, investing in improving the top 20 or 25 care process families would create the opportunity to drive on much more unnecessary variation. Improving care can save considerably more cost. In addition to direct variable cost, we can look at several other analytics, including total cost, length of stay, net revenue, and even opportunity cost that we talked about in that animated slide that I just showed you. For the purpose of this presentation we're going to use variable cost because that tends to be a good surrogate for quality of care.



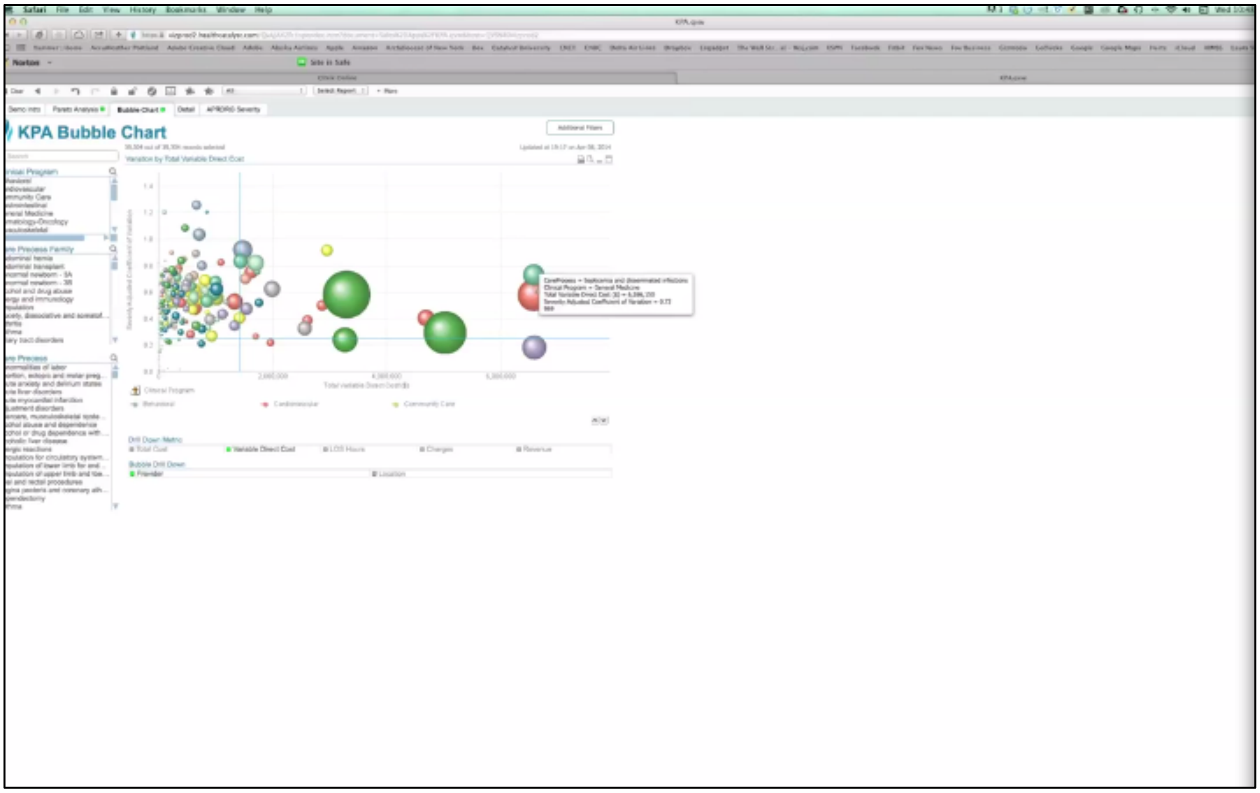
Ranking Analysis

There's also a ranking analysis. The ranking analysis, let's just look at the ranks of all of our metrics side by side. In addition to the variable direct cost, other metrics include length of stay, revenue, case count, and opportunity. A red number means it appears in the top 5 for each metric listed across the top. Any row that has a lot of red is a good area to focus on. When we want to look at variation and there stands some of the causative factors behind it, we can click on the bubble chart.



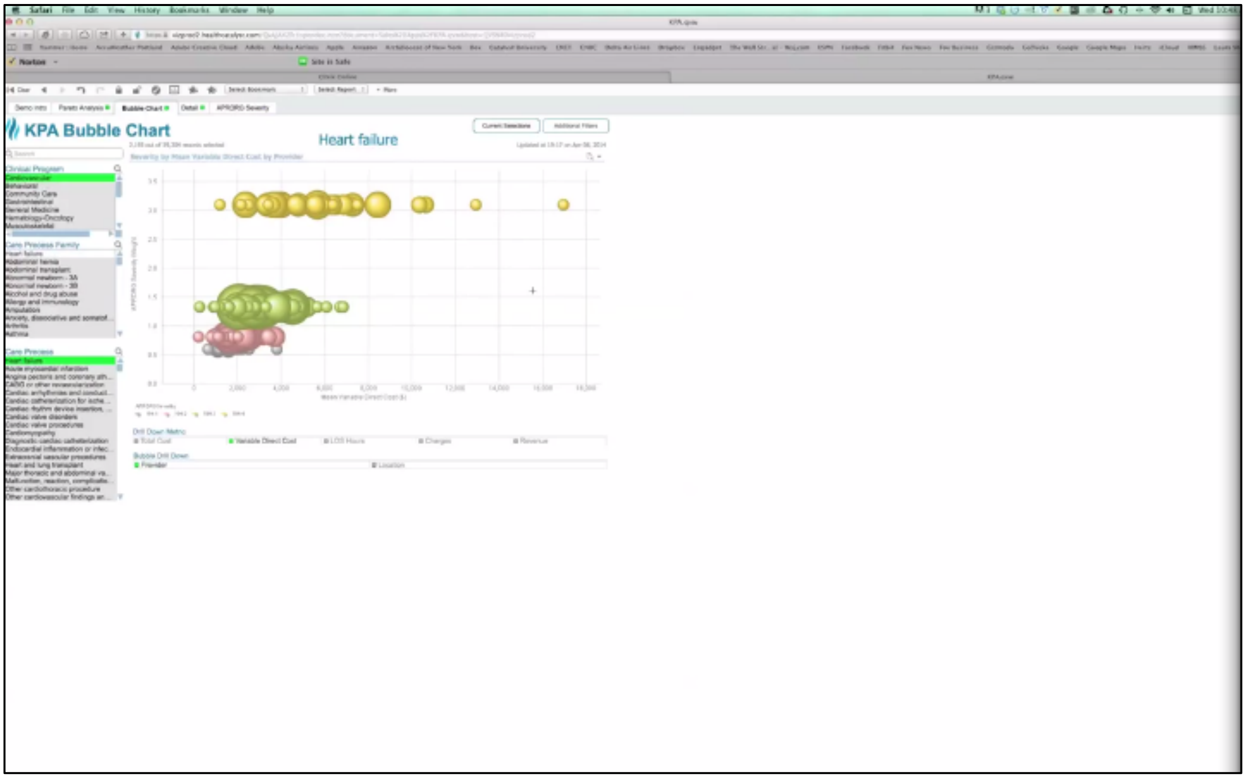
KPA Bubble Chart

This chart plots clinical processes against two axes, the direct medical cost and variation. We're adjusting for severity here. The Y axis actually uses disparity adjusted measure. Clinical processes are a finer grouping than the care process families we discussed on the last screen. We called that care processes are the next level in the clinical integration hierarchy that we talked about in the last webinar. The bubble size represents the case count for that work process. Variation is a sign that processes can be standardized and signifies opportunity for care improvement. We want to focus on the clinical work processes in the upper right hand corner of this chart. These represent highly variable high resource consuming processes. The higher we go on the X axis, the higher the cost, and the higher we go on the Y axis, the higher the variation. These processes in the upper right quadrant reflect the greatest opportunity for quality improvement discreetly to significant cost savings. That's where it's best to focus on our attention to this quadrant in the chart.



KPA: Bubble Chart

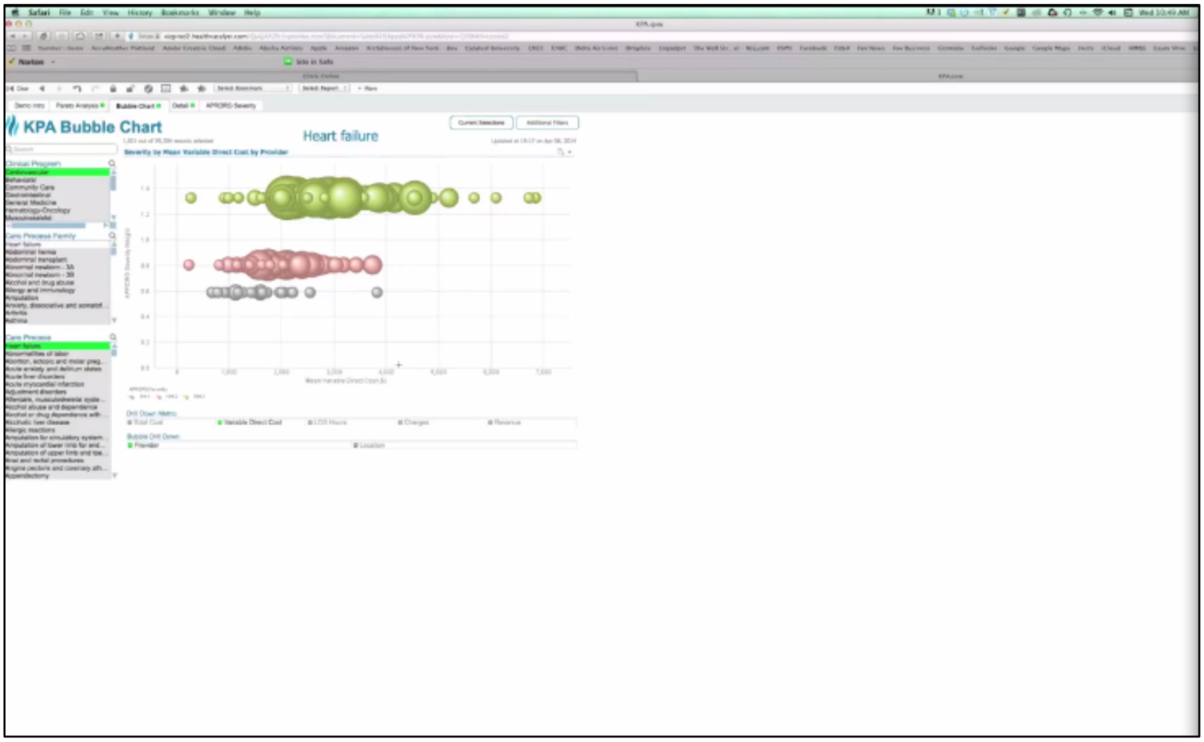
If we hover over the chart, we could see which care process it represents. This is septicemia, this is heart failure. Let's drill in the heart failure and use that as an example.



KPA Bubble Chart: Heart Failure

This chart shows more detail about variation of the treatment of heart failure. Each bubble represents an individual physician. One of those physicians is Dr. J that we talked about in the animated chart. The position on the X axis is the mean variable direct cost per physician in each severity category. Position on the Y axis represents severity. Thus, the yellow bubbles higher up on the chart represent the most severe cases. We expect to see variation at the top of the chart among the yellow bubbles. These are the most severe cases. Among these stations, there are likely more complications and probably more comorbid conditions. In general, there are more clinical decisions that need to be made and variability should be expected among these complex cases. However, as we move down in severity, down the chart, we would expect less variation among less severe simple cases. The bubbles should be more on top of each other.

Let's take a look at these more simple cases.



KPA Bubble Chart: Heart Failure

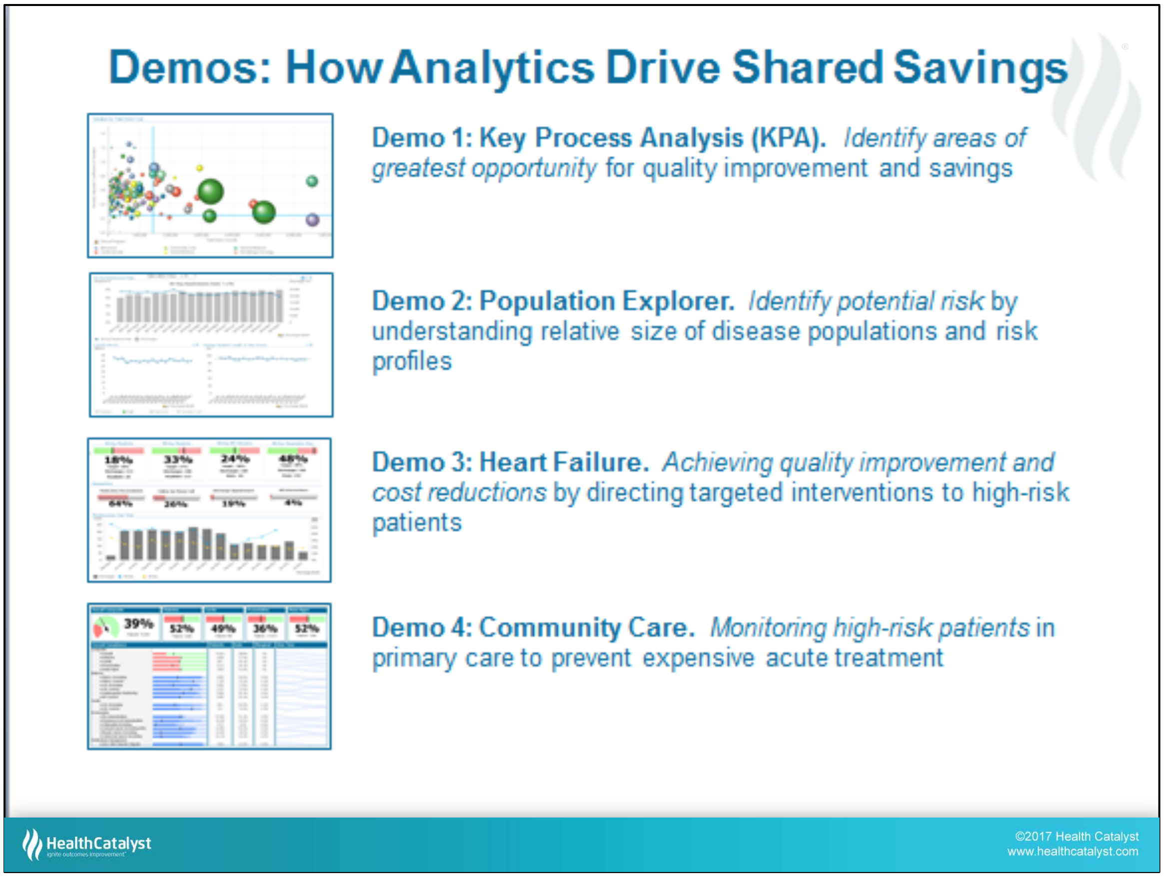
We can see that in this case even for the lower severity cases, the green, pink and grey bubbles, there's significant variation. Among the green bubbles, we see a cluster at about $2,000 per case and the physician's rate up to $4,000 and even up to $7,000 per case. There's also significant variation among the pink and grey bubbles, which represent even less severity. This tells us that for this particular organization, the heart failure is a good place to start. It is high volume, has considerable variation, and consumes a lot of resources. There should be great opportunity for both standardizing care, improving care, and reducing cost among these less severe cases. We call – this is individual physicians caring for individual patients. So this is important work. For each bubble that is above the mean in each category, what would it mean if we could standardize processes, not move toward the mean? That calculation represents an opportunity to recoup some of the costs associated with variation and is the concept behind the opportunity metric we discussed previously.

When it comes to understanding what is causing variation, we really need to build subject specific solutions. For example, causes for variation in heart failure are very different from causes in variation for pregnancy. Catalyst provides a library of subject area data marts that address deeper questions about variation on a per care process family level. As you observe these presentations of data, think for a moment about the power you see in these visualizations. We are effortlessly moving through tens of thousands of records and it's very easy to identify meaningful patterns in the data. In this case, it is about 40,000 records, but it could be 4 million records. It doesn't really matter. This represents a huge step forward for improvement teams and organizations and there's no real reason why end users, including clinicians and operation leaders couldn't do this. This is self-service analytics.

Ten years ago, when I requested data on a specific area or process, I would wait days to weeks and I would generally get a tabular report with several pages of pros and cons of data. Sometimes they would be at an Excel-generated chart as well. But what you see here is far more powerful and usable.

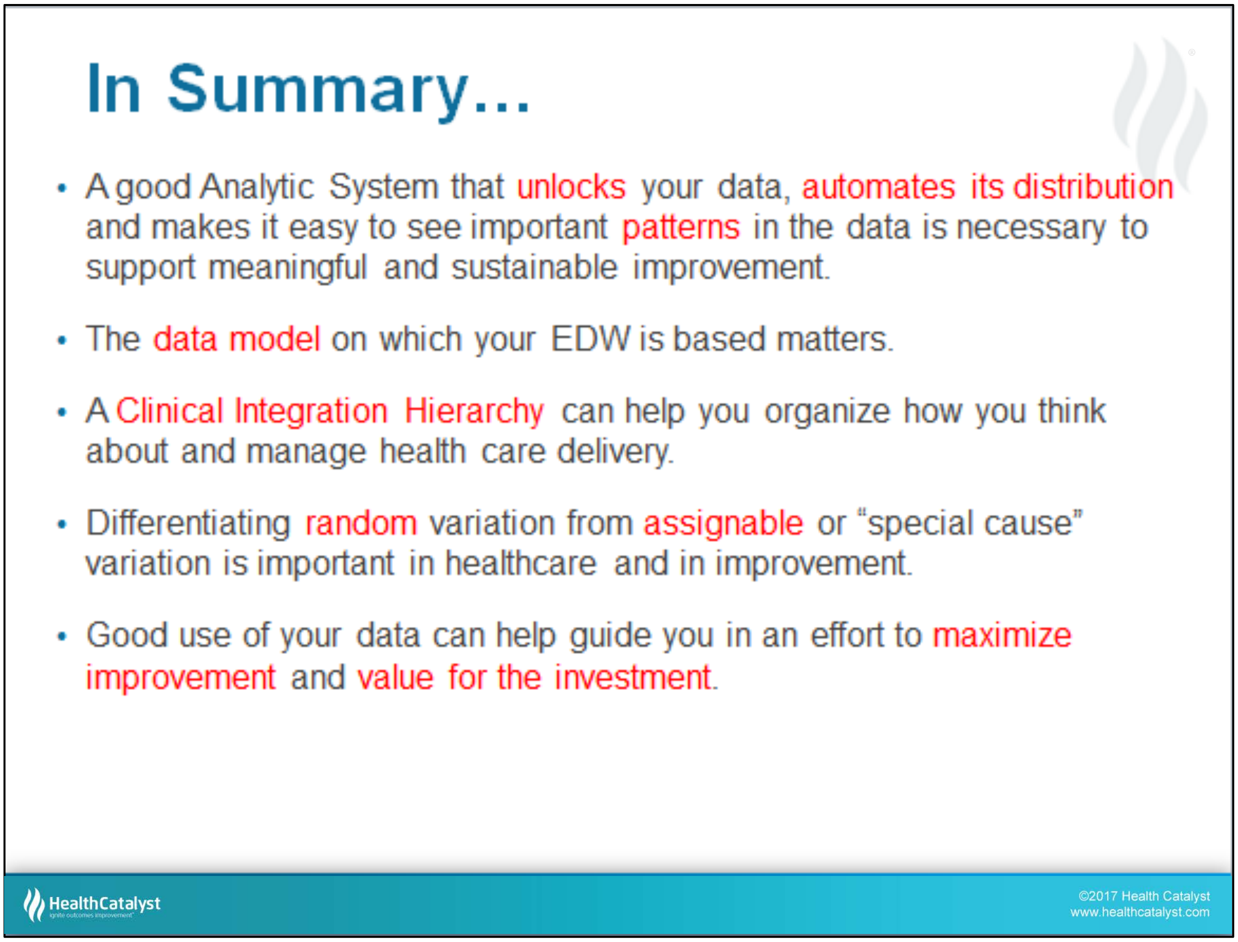
So you've seen now how the KPA tool is used to identify high resources, high variation processes. This effort information is generally used to prioritize resources and can be a major factor in deciding which projects to tackle first. The important point is that the output of the KPA is meant to guide decisions, not to make decisions. There are many reasons to choose to focus on a clinical area, such as resource consumption and variation. But there are also the human elements. One department may have staffs that are ready to improve, the other departments, they will not. These factors are all part of a subjective readiness assessment that only each client can understand. The KPA's method (51:11) the subjective readiness with actual data.

Prior to the webinar, Alec Chadwick offered the question as to whether this approach could be applied to different care provider types and to different specialists like pediatrics. The answer is yes. We customize the hierarchy regularly and provide tools and guidance on changing a hierarchy to fit an organization's needs.



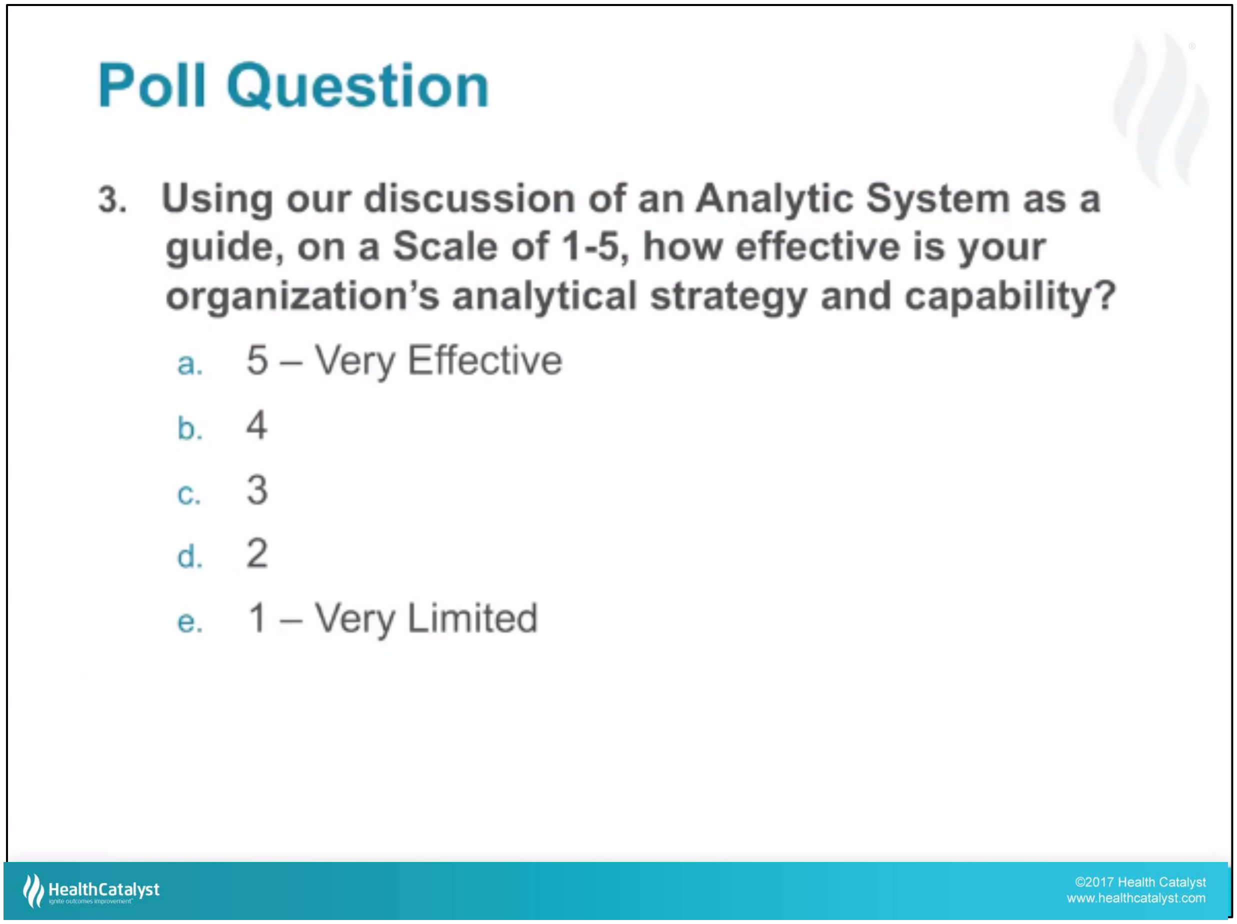
Demos: How Analytics Drive Shared Savings

Okay. That completes the demonstration. As indicated, I will be providing you additional demonstrations in upcoming webinars which I think you'll find equally powerful. Each will illustrate how this approach and these tools can be used to effectively manage population health.



In Summary…

In summary, a good Analytic System that unlocks your data, automates its distribution and makes it easy to see important patterns in the data is absolutely necessary. The data model on which your EDW is based really does matter. A Clinical Integration Hierarchy can help you organize how you think about and manage healthcare delivery. Differentiating random variation from assignable variation is important in healthcare and in improvement. Good use of your data can help guide you in an effort to maximize improvement and maximize value for your investment in improvement.

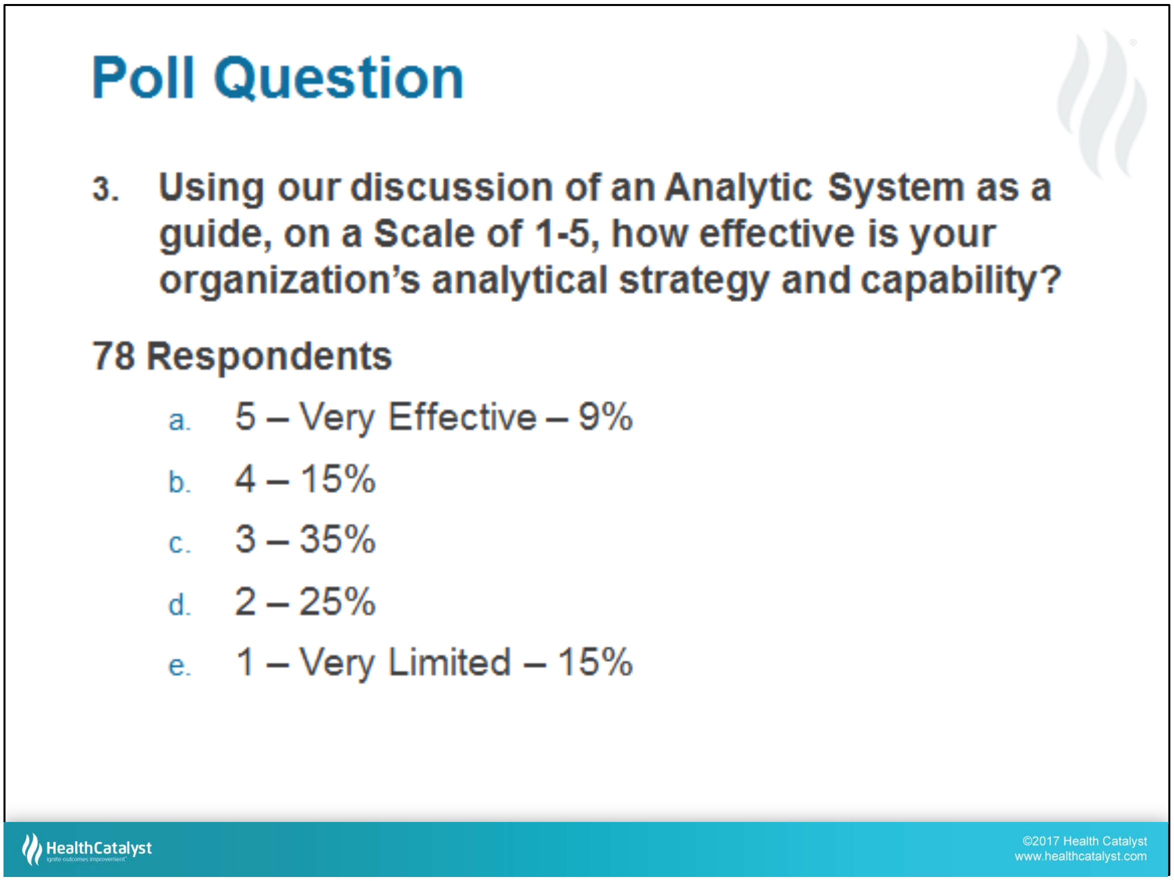


Poll Question
Using our discussion of an Analytic System as a guide, on a scale of 1-5, how effective is your organization's analytical strategy and capability?

It's time for the final poll question. Using our discussion on an Analytic System as a guide, on a scale of 1 to 5, how effective is your organization's analytical strategy and capability? I'll pause there and allow people time to answer.

[Tyler Morgan]
Alright. We have that poll question up. I would like to remind everybody, you can ask your questions by typing in those questions into the control panel. We will address those. Also, we have had a lot of individuals asking and showing some interests in Dr. Haughom's previous webinars. We would like to say, in addition to being able to access Dr. Haughom's free eBook on Health Catalyst website, you can also go to the webinar section of our Knowledge Center and there we have archived all the recordings and transcripts of all previous webinars that Dr. Haughom has presented.

We'll go ahead and close this poll now and let's share the results.



Poll Results

Dr. Haughom, it looks like 9% answered 5 -very effective, 15% answered 4, 35% 3, 25% answered 2, and 15% answered 1 or very limited.

[John L. Haughom, MD]
Thank you for responding. What that basically shows is that in healthcare, we have room for improvement, but it's going to be an exciting journey and it will be a lot of fun for all organizations to go down this road and particularly for clinicians who are interested in their improvement.

Analytics Summit 2014: Transforming Healthcare Through Analytics

Okay. Briefly, I just want to mention the Analytic Summit that Tyler talked about at the beginning. This is going to be an extremely exciting event with a lot of very high-powered keynote speakers and many useful breakout sessions. There will be 22 sessions and covering 5 different categories. So I would encourage people to go on to the Health Catalyst website and consider attending that conference.

Thank You
Upcoming Educational Opportunities

Also, before we go to questions, we would like to briefly discuss upcoming educational opportunities I mentioned. The book is now available in its entirety for free. We have an upcoming webinar by Dale Sanders on Late-Binding ™ Data Warehousing. He's going to provide an update and Dale's presentations are all outstanding and then I mentioned the summit.

So let's jump on into questions here.

QUESTIONS AND ANSWERS:

QUESTIONS	**ANSWERS**
What is the most useful data to analyze for small practices and for large practices?	You know, I don't think it varies. You're still going to want to look at those clinical opportunities that have the highest degree of variation and the highest resources or consumption and generally that's going to be the things we all know, heart failure, diabetes, asthma, wherever your practice is, it's the common chronic disease that tends to consume the greatest degree of resources. And we have population suites

	that look at all those chronic diseases. So it's applicable to a group basically of most (58:19).
How are organizations applying techniques on handling the variances in clinical terminology and normalizing it into a single common verbiage or code of binding for analysis?	Yeah, that is a challenge because, as implied by the question, we haven't really gotten to a point where we completely standardize our terminology. But Catalyst does supply a terminology that we use. So essentially Catalyst clients can understand that terminology, at least understand what the definitions that we use are. So it's a good question and you know, I do think healthcare can steadily migrate to a common terminology over the next few years, though we're not quite perfectly there yet.
What tool or system is used to develop cost components? If an organization is currently using a DSS, like EPSI, can those costs get utilized in Health Catalyst? And if they don't have a DSS system, does Health Catalyst have a module to develop costs?	As I said on the slide about the data models for EDWs, we do have ways of connecting to most common systems. To be honest, I'm not sure about that particular one. So if you want to email me, I could check on that particular one, but that is a common system. So I suspect we do but, you know, as we get new clients and discover a new system, we develop links to those new systems bringing the data in. So even if it's not there, we have ways of building that for clients that become part of Catalyst list.
When we speak of the mean, do we mean the arithmetic mean, the geometric mean, or the median?	We're probably talking more the median, although theoretically you could define it the way you want, but I think we're talking in most instances in clinical care the median.
What methods or assumptions do you use to attribute care in cases of group care, such as a prenatal delivery postpartum care?	I'm not sure what you mean by attribute there, so I'm struggling a little bit with the answer. So, what means do we use to attribute care…Well I guess I'll take my best shot in what I think the question means, and that is that as we pull data in from an electronic health record into the data warehouse, we use coding systems that are very very common to help us analyze the data and the data warehouse. That's things like ICD9 and soon the ICD10, CPT, and things like and coding systems like that. And generally we can categorize care fairly easily by using our terminology and using our coding schemes that are generally in use.
Clarification on the previous question, specifically attributing that care to a single position.	Oh that's fairly easy because you remember I mentioned early in Late-Binding ™ in the webinar last month, that means that in early binding, we prefer Late-Binding ™ in healthcare because it's so dynamic at the frontend where care is delivered. At the back end, as we pull data in, there are a few things that we want to early bind. One is the provider number. Most organizations, their electronic health records have a

	provider number. So it's fairly easy if that's found early to identify providers who are involved in the patient's care.
When analyzing patient safety events, many PSIs and HACs are rare events with low statistical reliability. How are process controls used with this type of data?	Well that can be a complicated question, although I did it in my prior role when I was a senior vice president for quality and patient safety, we did have some experience tackling that, and we had implemented and automated the global trigger tool, and that allowed us to identify categories of harm for patients and we had about 2 million patients in the record and in our electronic health record at that time. So the sample size is a pretty good size, and we could identify categories of harm. And then we made an educated guess on different categories of harm that would impact any specific instance of a type of harm and large improvement projects for those categories. The end result was we had a pretty substantial drop in overall harm, that was over 10% drop across the health system that span over three states. So there are ways around it but as the question points out, it points out the sample size, things like that. There are some that are just so rare, that it gets very very difficult and you just have to do the best you can to implement measures that you think will prevent the harmful event.

[Tyler Morgan]
Okay. It looks like that's all the questions that we have for right now, Dr. Haughom. Thank you very much.

So before we close the webinar, we do have one last poll question. We'd like to know how interested you are in the demonstration of Health Catalyst Solutions. We'll leave this up for just a few moments. And while you're answering this, we'd like to let you know that shortly after this webinar, you will receive an email with links to the recording of this webinar, the presentation slides, the poll question results, and we will send out the names of the winners of the Summit ticket giveaways.

We'll go ahead and close this poll. And I would like to say thank you very much. On behalf of Dr. John Haughom, as well as the folks at Health Catalyst, thank you for joining us today. This webinar is now concluded.

[END OF TRANSCRIPT]