Creating an understanding of Population Risk as a driver for health and care utilisation in Value-based Care

Dr Jason Broch, May 2025

Background

Value-based Health & Care is a framework to support Health & Care system can make best use of resources, in order to support the best outcomes and experience for its population.

Value can be thought of as the delivery of the health & care activity that matters most to people per unit resource utilisation.

Value = Outcomes that matter to people
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Resources Used

At its core, value requires agreement about *collective ambition and objectives*. Supported by a methodology that segments the wider population into groups with similar needs (eg children & young people, frail, mostly healthy), there should be clarity about the Outcomes that matter most to people in those subgroups & across them. Working with data and insights, a system should be able to co-produce these measures and ensure that its resources are directed to their achievement.

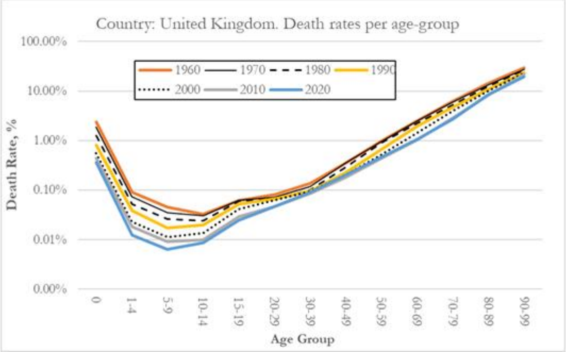
> *The key objective of a Health & Care System is to use its resources in pursuit of the Outcomes that matter to people*

Illness and Drivers of activity

There is increasing evidence that not only genes themselves, but epigenetics, which is the change in the way genes are expressed due to the life experiences of parents, grandparents or indeed multiple generations of a family, is important in development and life course. Along with the environment of the person’s mother during pregnancy; the type of food they eat, their current health, smoking and alcohol habits and things like stress levels, innate risk is fixed early in life.

There are probably more factors than realised impacting the developing brain and body during gestation.

At the end of pregnancy, there are the risks associated with childbirth. Before health & care systems, childbirth was a major cause of both infant and maternal mortality. Unlike some other species, humans are born quite immature and vulnerable. Provided a child, survives the first year of life, then in general, the risk of death each year continues to decrease until adolescence.



The key point is that all the risk conferred by family history, genetics, epigenetics, environmental factors in pregnancy, childbirth, socio-economic factors, education and homelife (amongst others) result in a person's minimum risk of death and morbidity in mid-adolescence. From then on, risk of illness or death increase with each passing day, week, month and year. This may sound a bit pessimistic or fatalistic, however the life choices people make will have ***an impact on the rate of risk change*** and in some cases potentially keep the risk down. Examples could be to not smoke, to keep weight down or more importantly in this age group avoiding dangerous places or activities.

Throughout life, the predisposing risks described above, along with environmental factors, will have effects on the body. In many ways this is the process of ageing. For example, people who naturally have a higher blood pressure will potentially cause more wear and tear to the small vessels in their brain and kidneys. They will also put more pressure on their vessels and heart. It may well be that this effect is amplified by having higher than average cholesterol levels. People with these predispositions are likely to have cardiovascular disease at an earlier age, causing illness or death. Typically, genetic factors mean there is an obvious family history. Another example will be people who have abnormalities in the way their bodies treat insulin; so-called 'metabolic syndrome'. This can cause fertility issues or diabetes over time.

The key point is that the effect of these factors is not only cumulative, but they also compound each other over time. Historically, without a medical system, the cumulative effects would be unnoticed until they caused some degree of symptomology resulting in a diagnosis, indeed many diagnostic names are just a Greek or Latin descriptions of the symptoms of uncontrolled disease. As the disease processes develop, the inherent risk of them presenting in a healthcare setting increase.

The diagnosis 'Diabetes Mellitus' probably dates to 250 BCE and comes from the Greek 'Diabetes' meaning 'siphon' and the Latin 'Mellitus' meaning 'sweet' - describing sweet urine typical of uncontrolled diabetes.

Health & Care systems are generally set up to react to the presentation of ill health, but as is demonstrated, by the point of diagnosis, disease processes are quite advanced. Some health systems have mechanisms to help optimise longer term treatment after diagnosis of an illness. Secondary prevention - optimising medical care of someone with a Long-term condition is a typical part of the UK General Practice contract. The same processes that are used to describe physical health conditions are also applicable to mental health. Whether it is genetic factors, psychologically safe environments or trauma along with environmental factors such as abuse, there is huge variation in human behaviour. This is evidenced by just looking at any group of children in a typical school and recognising how different people can be in the way they act, learn or experience life. Whilst there can be strength in the diversity of thought, some variation can also result in issues with mental health.

These examples demonstrate that although care is often *Reactive*, there is an opportunity to be *Proactive* also in the response.

All episodes of care have a Reactive & Proactive element. There is greater value in increasing the latter in any encounter to prevent future unplanned activity

Population Risk

When considering a population or a defined segment of that population, it is comprised of lots of individuals with personal, varying risk (or probability) of presenting with a medical problem. People are of various ages and stages of the effects of the predisposing genetic and environmental factors described above. Whilst the interplay of the various risks at an individual level are difficult to establish (although advances is genomics and AI may result in greater personalised estimation in the future), with a large enough sample size (number of people in a population), the net effect of these probabilities (or risks), will result in ***an expected*** outcome or healthcare usage pattern.

*A simple example is that if you roll a fair dice millions of times, despite not knowing what the result will be at each individual roll, you can reasonably **expect** the numbers of 1's, 2's, 3's, 4's, 5's & 6's will be pretty much the same.*

In practical terms, this means that the presentations and health behaviour of a population not only tells something about the underlying risks in that population, but also provides a basis for health & care systems to be able to predict activity going forward. This is borne out by experience too. A lot of health & care activity is predictable, from the number of people turning up in an Emergency Department to the number of Hip replacements that need to be done over a time interval. Furthermore, the statistical tools required are quite basic. It does not require an understanding of individual risk, just an analysis of current trends. Typically, methods such as *statistical process control* (SPC) can be useful here, which plots current activity in a chosen area over time and through simple maths can identify a change in activity due to some new issue or indicate the likely upper and lower boundaries of activity. This can be useful in planning workforce, estates and activity.

In order for risk to be used as the basis for investment decisions in a health & care system, there will need to be the organisational structures, including strategic contractors, aligned incentives and an integrator. The details of those are beyond the scope of this paper, but some of the capabilities required by them to understand and act on risk will become evident.

A mistake health and care systems can make is to view population risk as an entity that is different from risk as defined in any other industry, so it would be prudent to try and define risk from a more generic standpoint and then apply those principles to populations.

ISO 73:2009 defines risk as *'the effect of uncertainty on objectives'*.

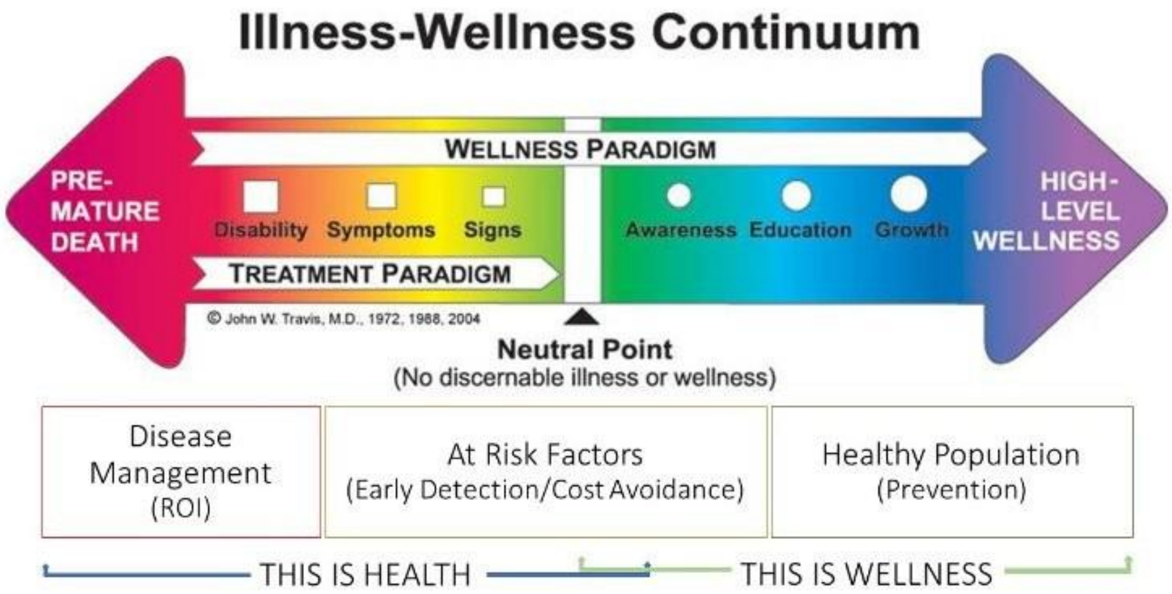
At the heart of the risk is a **'Threat'** that has the potential to cause an **'Impact'.** The impact could be negative or could be positive, in which case the threat tends to be call an **'opportunity'**. The potential for a threat to have an impact is determined by factors called **'Vulnerability'**, if negative or potential for **'Exposure'**, if positive. In a 'Risk Management' approach, the aim is to reduce contact with the threat by putting in **'Controls'** to reduce or plug vulnerabilities (pre-event) or to reduce the impact of the threat if exposure occurs (Post event). Another consideration is that impact is 'contextual'. The impact from the threat posed by a tree which may fall down will be different if that tree is in an unpopulated space as opposed to a crowded area, despite the threat and vulnerabilities potentially being the same.

As can be seen from this definition, there are three key areas that need clarity:

1) Clarity on Objectives
2) Level of uncertainty
3) The context

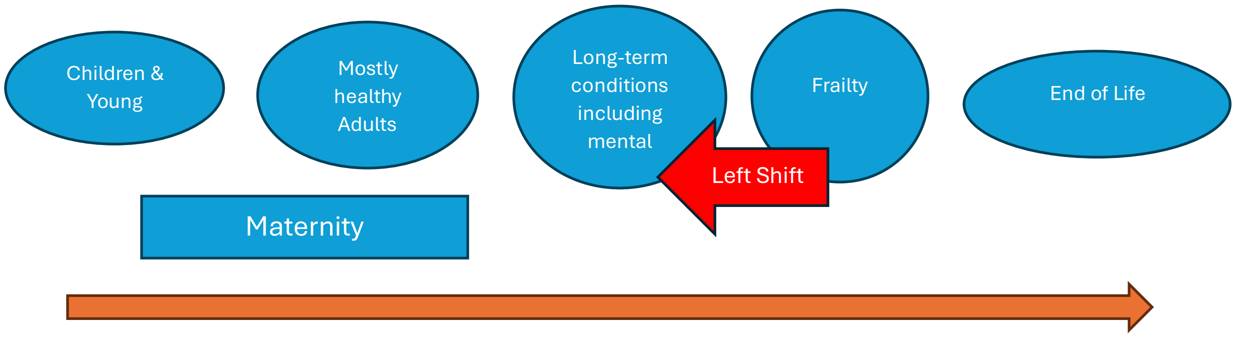
The World Health Organisation defines:

'Health is a state of complete physical, mental & social wellbeing and not merely an absence of disease or infirmity'



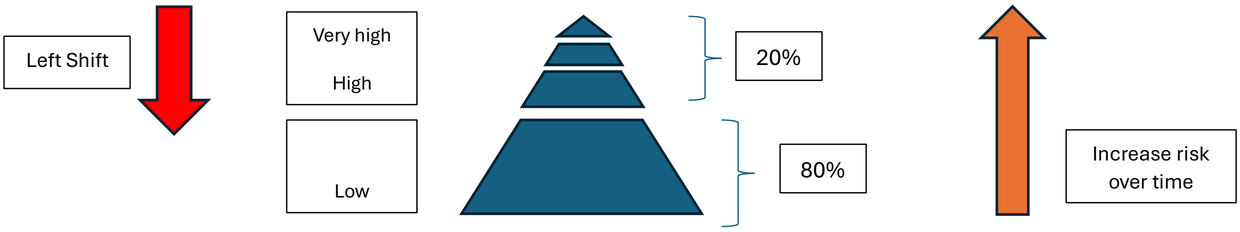
In terms of objectives and outcomes that a health and care system develops, there is obvious overlap between a wellness agenda and treatment agenda. In risk terms, the highest possible level of wellness will equate to lowest level of risk. If we accept that a treatment paradigm is usually more expensive and that what matters to people is ‘wellness’, then consideration should be given on how much of an emphasis is placed on the wellness agenda and where the line is drawn. Consideration also needs to be given as to the resource constraints and where on the illness-wellness continuum is the optimal ambition. This is totally in-line with a value-based agenda, where defined ambition should be defined in a group of Outcomes that matter to people. This implies that these ‘markers of success’ should be co-produced with people.

In order to develop this approach to risk, it is clear that the information required about the population needs to be richer than reactive activity patterns; that is reducing the uncertainty, reduces the risk. Increasingly, tools like Population health management, risk stratification and predictive analytics are being used, but the results are only as good as the data used and interpretation to create useful information. The analytical techniques are usually based around grouping populations into population segments of people with similar characteristics / needs and then understanding the risks within those segments. The segments can represent a life course or progression of increasing risk as in the example below.



Another way of looking at a population is based on overall risk levels. A risk lens can be applied at any level, whole population or within a segment. There are two elements to understanding risk. A snapshot of the absolute risk based on data, but also and perhaps more useful is cohorts with rapidly increasing risk, so that interventions can be targeted to prevent progression to the top of the risk in a segment or moving populations back to the previous segment – this is commonly called **'Left Shift'**.

Risk at any level will follow a similar pattern, but the risk-lens can be depicted as a pyramid.



The picture demonstrates that those who will be presenting most in health & care, and therefore responsible for most use of resources, probably only represents 5-10% of the overall population, but who they are changes as the risk progresses in the other 90-95% over time and the sickest people inevitably die. An additional factor to consider is that as population size increases and people live longer, the actual number of people in that 5-10% also increases.

Many in the top 20% are known to the health & care system, as they have recorded diagnoses, will be treated for long term conditions, require additional services or present as a series of crises, whereas those at lower risk remain quite anonymous.

When looking at vulnerabilities, perspective is very important. Risk of illness of utility of health and care services will be determined by some elements of risk that are amenable to change with the potential interventions at a systems disposal and some that are not. Obviously, the innate genetic and epigenetic risks (for the most part) are a fixed vulnerability. The other elements of risk include social determinants of health (SDOH). Some of these may be 'hardwired' through epigenetics, but some may be amenable to change. Key wider determinants include education, social and community context, economic stability, neighbourhood & environment and access to healthcare. There are key aspects to this that are effectively proxies for deprivation. SDOH manifests in a couple of obvious ways. People from more deprived areas tend to live shorter lives, whilst at the same time living a greater amount of time (in both absolute and proportional terms) in ill health, such that their lifetime cost of care is higher and their representation in healthcare activity is higher. Whilst tackling poverty cannot be the responsibility of a Health & Care system, elements like access to healthcare such as screening is. Equity of access does not necessarily mean universal services. Access could be determined by the ability to attend due to work commitments. An equitable screening program may need to look at more focussed or work-place schemes in a deprived area when compared to a less deprived area. It may be about access through use of different languages or giving due regard to different language or cultural requirements. These factors need to be part of the risk consideration.

A consideration when assessing risk in a population, is that we often use retrospective data, in order to understand areas amenable to intervention. For example, looking at Respiratory admissions and presentation patterns or characteristics in the previous year to help identify new cohorts proactively. The difficulty with this approach from an inequality perspective is that there may be missing data, due to people from more deprived areas who have already died or did not present until the very late stages of illness. Another approach could be to take a prospective look using areas of health economics and actuarial methods, in the same way an insurance company would do to understand potential care utilisation or need and death over a prospective future period. There is no single way to determine risk, but it requires multiple analytics techniques that are brought together to understand the story.

Predictive approaches also have another element that makes them less reliable. It often involves using population-level data and applying it to an individual. If we work through a simplified example, we can see where some of the assumptions may fail.

Looking at current activity, we can see that those presenting may have a group of similar characteristics (eg age, BP, cholesterol, activity level). Tracking back to a bigger population of 100 people with those characteristics, we could see that 10 of them presented with a poor outcome in a time frame and we conclude that an individual with those characteristics has a 10% risk of that poor outcome in the same timeframe. Although this is a reasonable approach to predict activity resulting from that population, the assumptions do not work as a measure of impactable risk for a few reasons:

1) *There is nothing to suggest that the actual individual risk is equally distributed across the population identified, as it will be more complex that just having the characteristics.*
2) *Risk is dynamic, so it will change all the time in those individuals.*
3) *The identified link is a correlation, not necessarily causation, so we cannot conclude impact by targeting interventions.*

*From a health system management perspective, many studies have shown that if you treat a cohort to lower BP of Cholesterol, then there should be a resulting reduction in poor outcomes. That is the risk **of the population** can be impacted by a population intervention targeting individuals. It is an important distinction as we deliver healthcare at a person-level, but a key consideration is that it's a numbers game. We can calculate that if we treat a certain number of the 100 people (numbers needed to treat) then we* *can reduce poor outcomes from 10 to maybe 5. We don't know which of the 100 people are the right people to treat and there is even a possibility that for some individuals, we increase risk (eg side effects from medication), but the numbers tell us that we will improve outcomes overall.*

The Value of the intervention will be different depending on perspective. From a purely Value for money perspective, it could be about weighing up the cost of treating as many as the 100 over a period of versus the cost savings of reducing the costs of the poor outcome by 5. At a population level, Value could be a representation of the wellness of the whole population (100 people) when taking into account how resources are being used. At an individual level, it is more difficult. One could say that as a member of the a defined population the risk of a poor outcome is halved, but as we have seen that may not be true. Assessing personal risk could potentially improve and some are really clear even without major analytics - if you have deteriorating renal function due to poor compliance with medication for diabetes and obesity, your risk of dialysis could approach 100% over a period of time. Improving your wellbeing and reducing CKD progression will benefit you, but it is hard to quantify – we can only really measure population effects in terms of absolute risk, despite a clear logic for an intervention and demonstrable improvement of individuals' metrics. Another example of progress is genetic testing. In terms of stroke prevention in a high-risk group, a population-level intervention may be the use of antiplatelet drugs, such as Clopidogrel. We have population data to demonstrate this as a good intervention to reduce overall population stroke risk, however we also know that 10% of individuals have genetics that mean they have no benefit at all from Clopidogrel. Pharmacogenomic testing offers the opportunity to personalise treatment in a way to that may impact individual risk more.

For clarity:

1) Population risk can only be measured at a population level
2) Population risk can be managed through population interventions, delivered at individual-level.
3) Individual risk can be impacted, but cannot be usefully measured.
4) Individual risk will vary across an identified population and over time, but some newer genetic tests may be able to personalise the potential benefit / disbenefit of a population intervention.

Some analytic techniques will identify groups of a population with patterns of activity that suggest a rapidly increasing risk eg presenting more in a care setting, or blood metrics. Whilst these techniques may help identify people, for whom interventions may be more valuable, the above still holds true, in that the resulting population (even if named individuals) are a population nonetheless, with the inherent variability as described.

Although this is true for the measurement of individual risk (or actually the potential threats), we can describe some of the factors in a qualitative fashion. An example may be a person with COPD or child with Asthma living in a damp house. Multiple admissions can be correlated with this environment and we can show a high level of causality by removing them from the environment or improving it. Personalised interventions like improved housing, access to food or employment (Maslow's needs) will improve outcomes for that individual and that can be evidenced in the change of that individual. Personalised interventions can be expensive and resource intensive and there is a question about how many people would need to be treated in this way to have an impact on overall population risk and data.

A key ambition of systems is to be able to scale as much personalisation as possible and identify the right intervention for the right level of risk. Risk stratification and Population health management have been used to categorise the risk level. Those at medium risk (maybe multiple long-term conditions such as Diabetes) can often be best managed with simple scalable interventions (care programmes), such as expert training courses in diabetes management or following an algorithm to improve Hba1c / BP. When these fail or if people are in a higher risk group, such as requiring several admissions, the response needs to be more personalised, as the non-quantifiable elements of risk become increasingly important in their presentation (Case Management). Often the difference between these 2 risk groups is not purely related to the advancement of their underlying medical condition, but the wider non-medical determinants (eg carers, family, housing). As we have seen earlier, even low risk and medium risk individuals have complex dynamic risk progression and because most stratification techniques uses activity, as a basis for measurement, there is a question about how create scalable personalisation approaches earlier in risk progression. An example may be that a person presenting with a stroke or dementia, whilst requiring high quality reactive care, is also identifying a family of people with related genetic / environmental risks, yet we do not routinely have family-focussed interventions in physical healthcare, despite it being an approach used in addiction and those in the criminal justice system. This is likely because the level of threat to other family members is perceived as more immediate.

Organisational risk in the context of population risk

The purpose of this document so far, has been to define and discuss the nature of risk at an individual and population level in relation to both understanding potential impact of preventative community strategies and as a cause for health and care activity.

It has the potential to be the common currency across health & care systems and if it can be developed to be used in that way, then any organisational risk should be able to be related to population risks. This could be important, as it will form a common framework, by which partnerships of providers can focus their limited resources collectively with a common benefits realisation methodology. Currently, organisational risk management has the potential to be too narrow in its perspective and can drive a focus on operational efficiency and increasing capacity around points of failure, rather than also collectively focussing on the true drivers of unnecessary activity.

The principle here is that inherent population risk drives all activity. An example could be the risks associated with metabolic syndrome. In well people, it may not present with any illness, but could be apparent through signs of obesity and will usually be associated with a family history. Even with this risk, at this stage, people would be counted as low risk, as they would appear less in the data. Low risk people are harder to identify and effectively will be part of a 'Mostly well' population group, as a bucket capturing people not showing any specific risks in the data. In many ways this sits in the world of Public Health. As this progresses, it will manifest with issues such as menstrual issues, fertility issues, diabetes & Cardiovascular disease. As these are identified, then we have mechanisms to deliver preventative strategies around cardiovascular risk and they will present more in General practice and other community settings (eg pharmacy). Further progression can see strokes and heart attacks, which will present in hospital and may even require longer term input if the result is frailty. By this stage, people are seen as higher risk in our data and are consuming more activity. By preventing progression admission is more likely, longer stays are more likely and if the inherent population risk around this is too high and poorly controlled, then the risk will be experienced in hospital settings as people in corridors, high attendance rates and raised numbers of people with no reason to reside, as there complex needs become less medical in an end of life phase. There will be increased need from community services and also social care. The key point is that sometimes risk registers focus on these points of failure, which means organisations can try and manage these through optimisation of the systems they use to manage the failure, rather than taking an integrated approach to understand the progression of risk across populations and identify more valuable methods of reducing the failure. Further example are long waiting lists, when the focus may become on optimising a knee surgery offer, rather than thinking about medical optimisation, prehab and rehab as the key parts of the pathway, with surgery there only for those that need it and are ready for it. Although these examples are firmly in physical health space, the same picture is true in SMI with progression resulting in out of areas placements, which in themselves become the focus.

By taking a clinical view of population risk as a driver of activity, integrated systems can take a Value-based approach to ensure that resources are deployed at the right point in progression of that risk, balancing the optimum amount of proactive versus reactive care. Only through this common approach, can ambitions across providers be aligned and each partner be accountable for a clear contribution towards managing the shared risk. Incentives and risks can be distributed across a system in line with this, in order to deliver clear measurable benefits.

Value-based approach

The value-based health care framework encourages the view that the underlying population risk and therefore the predictable activity can be changed by the correct interventions. This could be achieved by a better understanding of risks affecting the system and requires good integrated data.

When planning services in Healthcare systems, there are a few principles of risk that can be easily forgotten.

1. Since genetic factors are really important in progression of disease and risk, the presentation of an individual requiring reactive care also presents two opportunities.
    a. To increase the proactive element of their care episode – presentation may not be endpoint of their risk, so consideration of aspects of care that can help reduce risk and future presentation are paramount.
    b. The fact that an individual presents in need of reactive care, may identify a family with similar genetic predispositions. A major failing of many healthcare systems is not recognising the opportunity presented to explore possible family interventions to reduce risk of presentation of other family members in the future. This point is even more significant, when one considers that many preventative interventions require behaviour-change, and these are more likely to be successful when supported by family. (How easy is it to eat biscuits or chocolate just because they were in the house?).
2. Presentations are often thought of in terms of the diagnosis, such as Myocardial infarction or stroke, however the underlying disease processes are often similar across groups of diagnoses with common genetic dispositions and risks. Shifting the focus on to proactive management of risks from the different diagnostic perspectives could offer a real opportunity to mitigate future risk in a more cost - effective integrated manner.
3. Risk / disease progression happens over a long period of time. Dealing with the consequences of unmanaged risk tends to be more expensive and involves episodes of shorter duration, notwithstanding potential care costs. Preventative strategies, conversely, are aimed at managing a dynamic risk and therefore may be required over a longer period-of-time, but on-the-whole should be less expensive.

In a value-based approach, care resources are directed at interventions or activities than manage population risk across the population groups in a way that all partners are clear of the value they are adding and have accountability for that. Care can in part be thought of as a process with resources being consumed and outcomes being delivered. In this context, by understanding contribution of any asset or resource, integrated provider systems can develop a better understanding of the value of wider supply chains. Examples may be the lifetime value of an MRI scanner, value of a specific drug or even digital enablement. The key point is that understanding population risk can drive a shared ambition, a shared understanding of risk/benefit and should shape procurement strategy.