

Executive summary

The global healthcare industry is undergoing rapid transformation by leveraging new technology, data and analytics to achieve better health outcomes at affordable costs. This submission profiles real-life case studies which illustrate how analytics and data sharing deliver measurable health benefits to customers, public sector employees and the Government's bottom line.

The case studies provide examples of what can be achieved. When unpacked, they also provide examples of how the barriers to change are being overcome. These include successfully managing cultural change, protecting privacy rights and securely governing sensitive information. SAS would like to acknowledge that the journeys described have typically been multi-year in nature. Many are still in progress and all have involved multiple service partners to achieve the described outcomes.

SAS recommends developing data and analytic strategies that have a clear line of sight to the organisation's strategy and value/benefits at stake being targeted. With rising service delivery demands, many organisations are reviewing how they can improve the level of collaboration and alignment between business and IT siloes. In contrast with silo or 'point solution' approaches that an organisation may have traditionally taken to their data sharing and analytics roadmaps, a more successful approach would begin by identifying the key business decisions that impact the wider organisational objectives. This organisation-wide view both helps guide and prioritise a sequential and systematic approach to building out analytical insights and capabilities. It also identifies inter-dependencies and opportunities to reuse data and analytical models which can result in significant efficiency and agility benefits over time.

SAS Institute is the largest private global analytics company, with a 41-year history in data analytics software and outcome-driven analytics results services. We assist over 600 government agencies, and work with more than 1350 health customers across 39 countries. We enable our customers to drive service transformations and achieve their strategic objectives by better leveraging digital, data, analytics and evidence-based decision-making. Our approaches ensure data remains secure and compliant during these journeys.

Case studies

Challenge 1 Population health - providing cost effective healthcare with rising demand

NHS faces rising demand for healthcare provision driven by an ageing population. It had limited visibility of how services were being used by different patient segments.

Impact: this limited their ability to identify drivers of cost and to focus improvement initiatives including quality of care on those who needed it most.

Solution A National Commissioning Data Repository was created to form a single anonymised view of care episodes. Datasets from multiple sources were combined covering each point of contact from Accident & Emergency, inpatient record to outpatient and community nurse records. The data was segmented to form patient cohorts with their own service usage patterns.

Example National Health Service, England (UK)

Benefits One segment with a significantly higher use of services on every measure was identified see Appendix, Figure 1. Decision trees revealed common attributes between patients in the segment and trends in the diagnoses of the cohort e.g. combinations of ailments triggering more frequent care. The insights enable NHS to identify opportunities for improvements.

NHS England initially offered the patient segmentation analysis as a free service to the 44 Sustainability and Transformation Partnerships across the UK. Since then further use cases have been built out. Details of NHS England's future plans are available online in its 5-year strategy document.

Challenge 2 Sub-optimal point of care decision making

Providers at the point of care were making diagnoses, recommendations and treatments based on an incomplete view of a patient and their history.

Impacts: sub-optimal patient outcomes, financial inefficiencies, higher risk etc.

Solution Secure, digital access to a holistic view of a patient's history over time was identified as a key enabler to better provider decision making at the point of care. Clinical information from electronic medical records (across systems/providers) is aggregated, cleansed, validated, linked and views over time are produced (HealthConnex).

In its journey NCHD addressed issues such as: data sharing, privacy, trust in data and integration into workflow.

Example North Carolina Health Department.

Note: NCHD is a leading example of a health organisation systematically driving innovative change across its key activities through better leverage of data and analytics.

Benefits Improved efficiencies e.g. reduced rates of duplicative testing - refer Appendix, Figure 2.

Improved diagnosis and treatment by better sharing of identified best practices based on historical health outcomes. More accurate diagnoses & treatments e.g. via improved polypharmacy, allergy awareness, recurrent symptom awareness etc.

Improved care coordination between primary/specialty providers, behavioral health providers and social service providers.

Proactive interventions by providers e.g. GPs able to set up 'alerts' if their patient is admitted to another provider for an issue under management.

Holistic view assists providers where vulnerable patients are unable to accurately recount context of their current care arrangements e.g. those with dementia.

Other comment *"Giving providers access to raw health records added limited value"*

To drive efficient outcomes, information and insights need to be easily accessible and presented in a way that is contextual to the provider's intervention decisions and provides real value to the healthcare decision making process.

Challenge 3 Sub-optimal care – moving from a fee for service model to a customer outcome focused value based payment approach for providers

Local, State and Federal healthcare costs were forecast to rise challenging the state budget. The State performed poorly versus other States on a variety of care measures including avoidable hospital use and cost. The State had limited visibility of: the total cost of care, potentially avoidable costs (such as hospital readmissions and avoidable care), and risk adjusted costs within episodes of care.

Impacts: Without these insights, they were unable to effectively target improvement efforts and optimise their move towards a value based payment approach. This impacted strategies to improve patient outcomes, improve financial performance, lower risk and drive value based care initiatives.

Solution 100,000 Medicaid patient records were analysed over 2 years using episode analytics. Significant change management activities were subsequently involved in driving the insights generated into action.

Example Large State Health Department.

Benefits Over \$110 million of PACs identified. Analyses enabled poor PAC performance to be identified by service type, episode, provider & patient level and compared to risk adjusted, actual and typical costs. In addition to exploring patient/provider utilisation variation – refer Appendix, Figures 3 and 4.

The visibility enabled improved provider benchmarking and accountability discussions.

Challenge 4 Behavioural health – how to re-engage those not in treatment

Many people with mental health issues who should have been receiving treatment were not engaged in any treatment approach. Providers thought the reason for disengagement was because of a conscious choice by patients i.e. 'don't want help' etc.

The Health Department did not know which individuals should be in treatment but were not, how many individuals were in this category and where they were. They did not know if the Department had the right service capability and capacity available in the right places.

Impact: this lack of insight impacted the Health Department's ability to plan and resource programs to re-engage individuals back in treatment. The lack of engagement in the right treatment carried a significant cost both at the level of the individual not being treated and on those who interacted with the individual.

Solution A comprehensive field-based community service initiative (RBEST) was set up with; outreach, engagement, case management, family education, support, and therapy services targeting a challenging, diverse group of adults suffering from untreated mental illness. RBEST aimed to "activate" these adults into the mental health system to receive appropriate services. Individuals were engaged on an average of 6 months, with an average of 16 encounters with staff.

Analytics, using data from housing and other government services, provided a holistic view of the individual and was used to identify cohorts and shape intervention approaches as well as assess how the program impacted activation into treatment.

The data along with anecdotal information provided a holistic picture of the individuals, along with providing evidence-based advocacy for the RBEST initiative.

Example San Bernadino County Health Department (SBC).

Benefits Significant impact on individuals involved including:

- Reduction in hospital admissions by 43%.
- Reduction in hospital days by 37%.
- Reduction in crisis services by 49% and significant increase in routine outpatient services by 288%.

Access to care increased with RBEST. Outpatient services jumped to 96% engagement within 7 days of hospital discharge, compared to 20-25% prior to RBEST.

The drivers of non-engagement were better identified, including, for example, people wanting to be a partner in designing their own treatment, people needing skill and support to navigate the health system, people having their benefits impacted if they received care and so on. This led to changed assumptions and biases of the care providers and better informed how changes could be made to re-engage those individuals.

Challenge 5 How to enable the aged to remain independent and in their own homes

Mildred is a 98-year-old great grandmother who still lives in her own home and cooks Sunday dinner for her family. In the last year, she was hospitalised twice for heart failure. Most individuals in this situation would not be able to return home after a short stay.

Impact: the lack of a real time remote monitoring capability typically results in patients being either unable to return to their homes or in them having extended stays in healthcare facilities. This impacts costs of care, the level of capacity needed within a healthcare system and is typically sub-optimal at a patient outcome level.

Solution Fortunately, Mildred could return home quickly both times due to the ability of her care team to monitor her 24/7 remotely using a wearable. The wearable device wirelessly transmits biometric data to a central interactive patient portal for monitoring and analysis.

Sensors measure changes in weight, pulse oxygen levels and respiration rates which are then combined with contextual data regarding the patient's health and lifestyle to determine the best intervention. Real time alerts can be configured.

Example www.Geneia.com

Benefits Frequent sensor measurements enable fast identification of symptoms that could indicate deteriorating health. Their detection when combined with alerting functionality to primary care providers can trigger earlier lifesaving interventions.

Remote monitoring delivers significant productivity and financial benefits compared to a home visit monitoring model.

The benefit to Mildred of being able to stay in her own home is priceless. Collectively enabling individuals to remain in their own home for longer has broader significant implications given an ageing population.

Other comments As this example illustrates, wearables represent a significant opportunity for health departments to address multiple health issues and deliver health outcomes more efficiently.

Advances in sensing capabilities, combined with streaming analytics and a situational view of the patient offers the health industry the potential to move away from a face-to-face delivery model for everything to a service model that is delivered face-to-face when needed.

Many Perth-based companies are currently working on wearable health solutions. One is targeting a reduction in post-operative treatment times for knee surgery patients through better monitoring of activity and joint movement and proactive prompts or interventions to improve recovery times. Another is targeting the prevention of unnecessary hospitalisation events by monitoring and alerting patients (such as those with diabetes or chronic colon conditions) about their state of hydration/dehydration. Other examples can be provided on request.

Challenge 6 Service planning challenges and lack of early intervention

New Zealand Ministry of Health (NZMoH) measured the rate of a chronic disease (diabetes) by survey. It was found to be cumbersome, costly and prone to a high error rate. Survey information was frequently inconsistent with GP and hospital records.

Impact: inaccurate information impacted NZMoH's ability to forecast and deploy appropriate programs and care resources into the right locations.

Solution Data from six disparate databases was modelled and integrated. The population was then segmented into cohorts and prevalence factors identified. Models were validated against primary care registers.

Example	New Zealand Ministry of Health (NZMoH)
Benefits	<p>The enhanced model more accurately identified the number of people with diabetes along with a sub-attribute accuracy – age, type, location etc. Refer Appendix, Figure 5.</p> <p>Proactive interventions were enabled through an analytical model which predicted those at highest risk of contracting diabetes. This also improved resource planning and forecasting.</p>

Challenge 7 **How do we address opioid (and other) addictions?**

Australia is the 8th largest consumer of opioid prescriptions in the world. It is showing many of the early markers evident in the current opioid crisis hitting the USA. How can Australia avoid continuing down the same tragic path?

Massachusetts Department of Public Health (MDPH) had 2,000 deaths from opioid abuse in 12 months. It had limited visibility of the causes and effects of this multi-layer problem. It wanted to understand; why are people starting, why do they continue, how many, who, where?

Impact: this lack of evidence-based, holistic knowledge impacted MDPH's ability to design effective targeted solutions addressing the different issues.

Solution	<p>In the case study jurisdiction, legislation was enacted to link data across government departments to enable a holistic view of the individual, and better guide policy development and programmatic decision making.</p> <p>Over twenty disparate datasets were linked and analytically segmented and modelled.</p>
----------	---

Example	Massachusetts Department of Public Health (MDPH)
---------	--

Benefits	<p>Analytics drove clear insights informing policy and intervention plan development.</p> <p>Baseline statistics showed over 4% of persons aged 11 and older had Opioid Use Disorder, over 65,000 had Nonfatal Overdoses, and those who received 3 months of prescribed opioids were 30X more likely to die from an Opioid Related Overdose within 5 years. Refer Appendix Figure 6.</p> <p>Timeline and influences showed the length of time between the stages of opioid use at an individual patient's perspective i.e. from initial use of prescription medications to fatal overdose. Seven at-risk populations were identified including the homeless, veterans, and individuals diagnosed with severe mental illness.</p>
----------	--

APPENDIX

NHS England's NCDR screens are continually being updated and a direct request to NHS England is recommended should the Panel wish to view current screenshots.

Conceptual screenshots based on similar work are highlighted below to illustrate the type of capability being introduced into NHS England.

The sample view below enables healthcare planning users to easily identify patient segments with a significant dependency on the healthcare system. Drill down screens enable service delivery efficiency to be assessed alongside patient outcomes and performance outliers to be identified. The combined suite of screens enables users to identify strategic, operational and/ or clinical opportunities to drive improvements in service delivery.

The screen below shows mental illness sufferers by service type. The box size represents the number of sufferers, box colour represents the level of health department expenditure.

By selecting different tabs, users can easily access and analyse trends by segment, social factor analysis, protocol adherence, cost etc. Clicking on a box unlocks further drill downs/ insights.

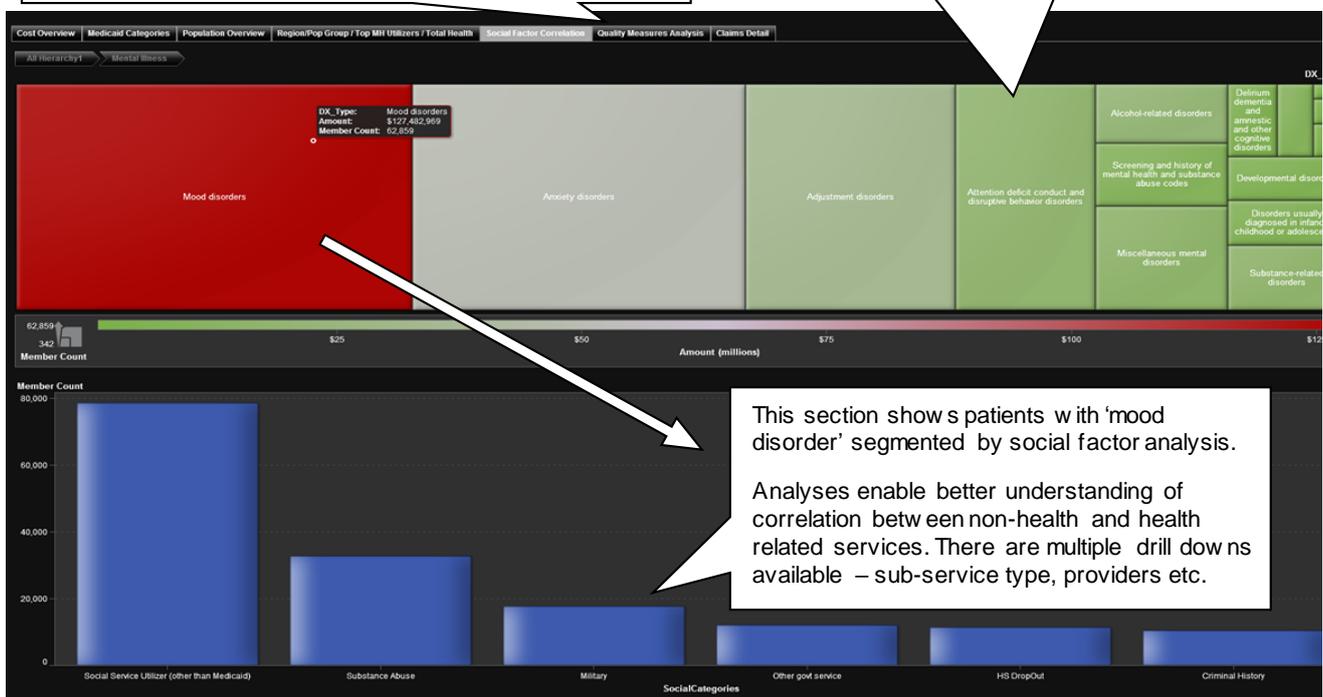
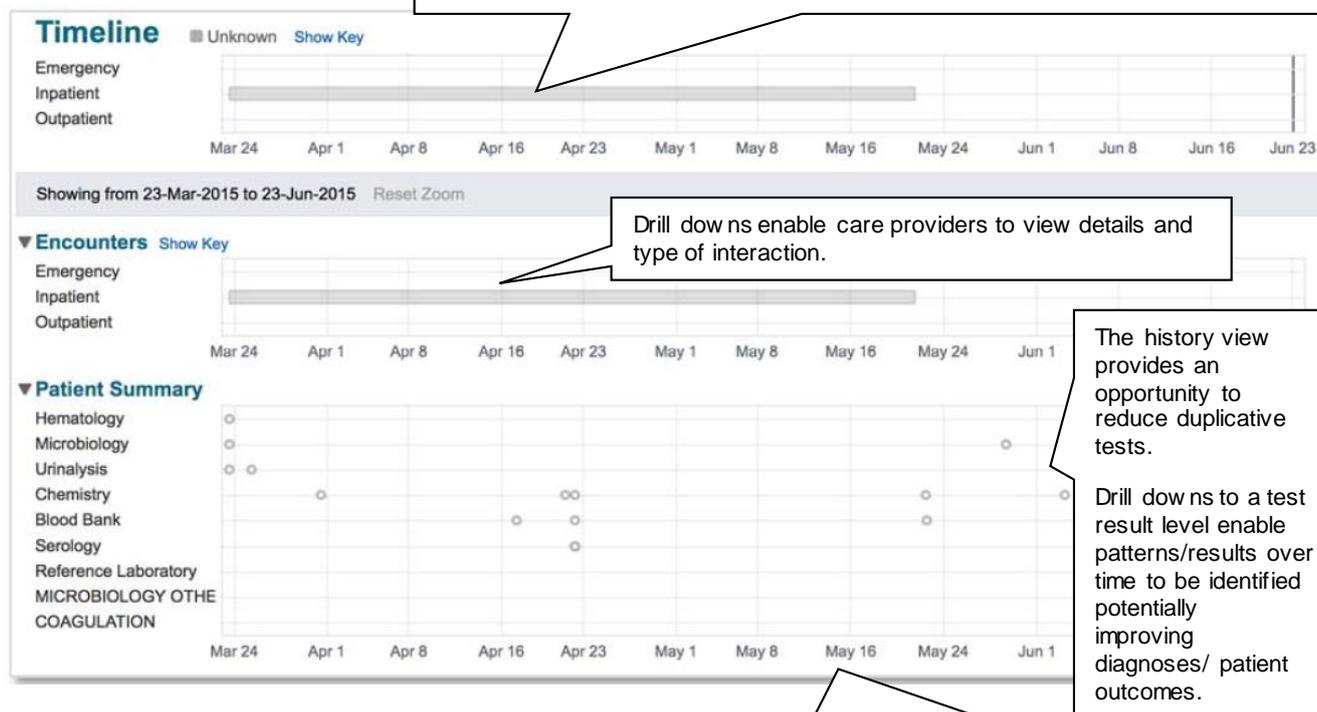


Figure 1 Sample Healthcare Utilisation Analysis view – similar to views available in NHS England's NCDR

HealthConnex care providers can see a visual representation of patient encounters over time and any concurrent encounters taking place.

Drill downs enable users to see details and documentation associated with each encounter.



Drill downs enable care providers to view details and type of interaction.

The history view provides an opportunity to reduce duplicative tests.

Drill downs to a test result level enable patterns/results over time to be identified potentially improving diagnoses/ patient outcomes.

Other sample clinical use cases

Alerts (separate screen) can be set up to automatically notify providers if the patient has a new encounter with another healthcare provider e.g. GP alerted if a patient on blood pressure medication is admitted to hospital.

Other potential planning and/ or operational use cases

Enhanced leverage of the underlying data could enable additional actionable insights enabling: improved performance management from service delivery insights, improving service demand forecasting, PAC identification, improved patient segmentation e.g. health system 'super-users' etc.

Figure 2 Improving point of care decisions – holistic views. Sample timeline and interaction view

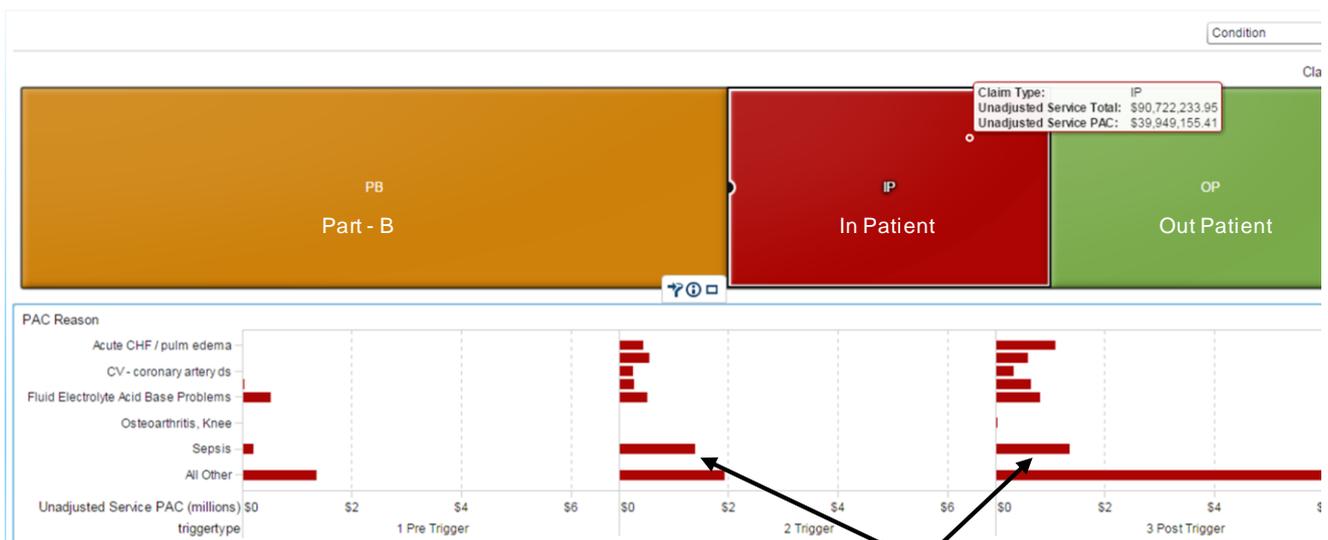
Sample potentially avoidable complications analysis view – similar to the case study cited.

The size of the coloured boxes is proportionate to the cost of that claim type versus total claim costs. Cost data is based on actual provider billings.

Alternate views e.g. by number of claims can easily be configured with year on year comparisons.

Sub-drill downs enable results to be viewed by type, individual provider or patient level etc.

Users are also able to configure specific ad-hoc claim cost analyses e.g. all claims over \$200k.



Drill down of 'In Patient' PAC performance

Analysis highlighted 'Sepsis' as a major contributor to In Patient Potentially Avoidable Costs.

The State Health Department has a multiyear program targeting a reduction in sepsis. The program has effected a number of policy changes and improvements in recognition, diagnosis and treatment protocols.

Figure 3 Sample view of Potentially Avoidable Complications (PAC) drilldown by claim type

Sample provider performance benchmarking view.

This view enables users to benchmark PAC performance by provider for a range of conditions over different time periods. Best practice performers can be identified as well as any under-performers.

In examining best practice or under-performance, drill downs enable performance visibility to be viewed down to the individual patient case level i.e. users can view if the provider's best practice performance or under performance is systemic or potentially distorted because of a poor-quality data point. Users can build business rules and exclude cases that fall outside of certain parameters.

User engagement in design is key to ensuring that there is a sufficient granularity of information to make it easy to drive actions.

Visibility of performance enables best practices to be identified and anonymised data to be shared with providers to identify performance opportunities. Many health departments are now leveraging PAC performance in their provider performance agreements.

A range of other PAC performance views by Provider can easily be accessed on other tabs.

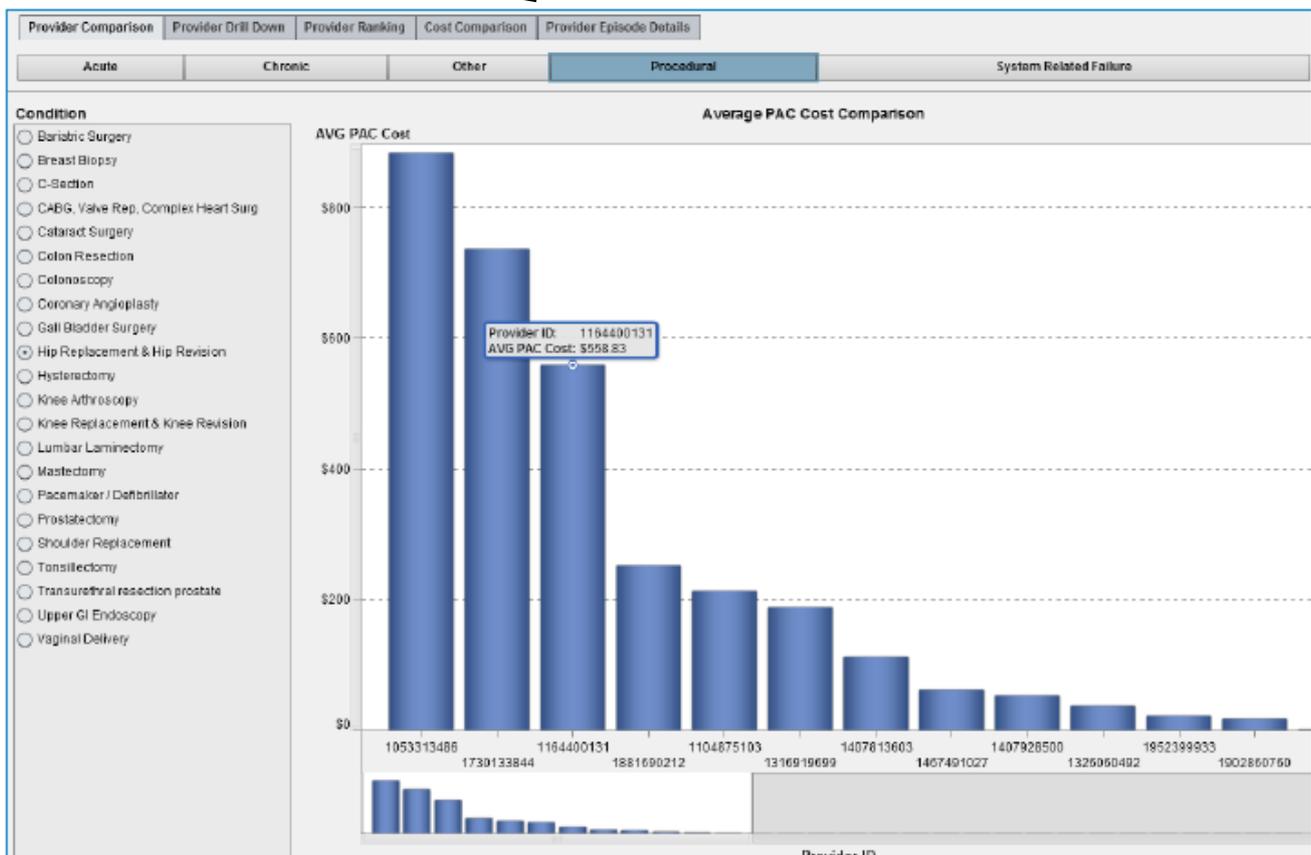


Figure 4 Sample 'Provider' PAC performance view by condition

The graph highlights the importance of monitoring and managing the performance of analytical models. Recent improvements to the model, lowered estimates for the number of diabetes sufferers.

Deploying analytics requires analytical workflow practices that are different to those found within Business Intelligence or reporting teams. As an organisation increases its analytical capability, it may have multiple inter-dependent analytic models (e.g. 200+) to be monitored and managed efficiently. Whilst not a day 1 requirement, scalable model management capabilities are required when analytics maturity reaches a certain threshold.

The Register provides detail at lower levels of granularity e.g. location, race, age, type of diabetes, trend over time etc. These are being deployed to better inform policy decisions.

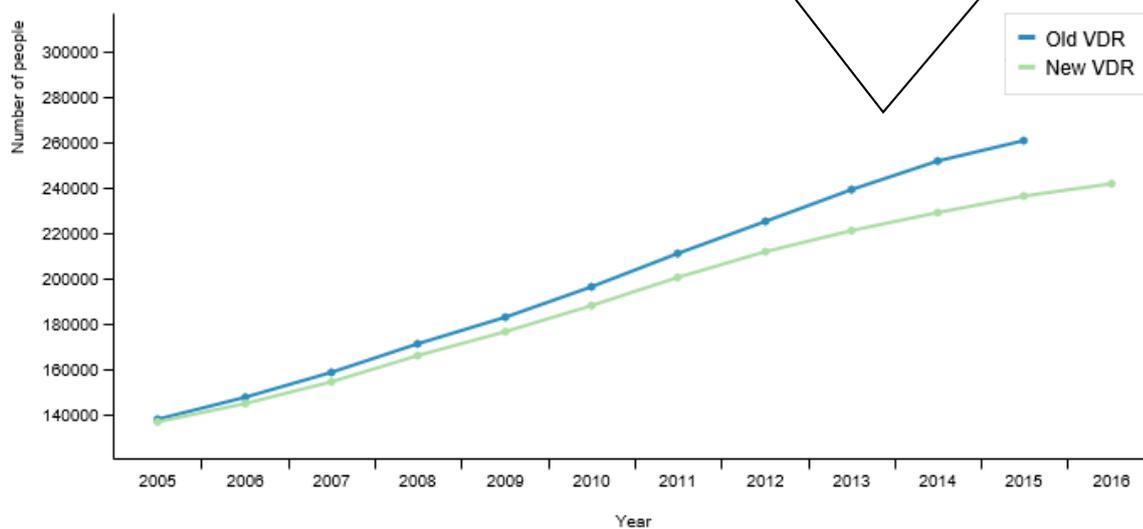
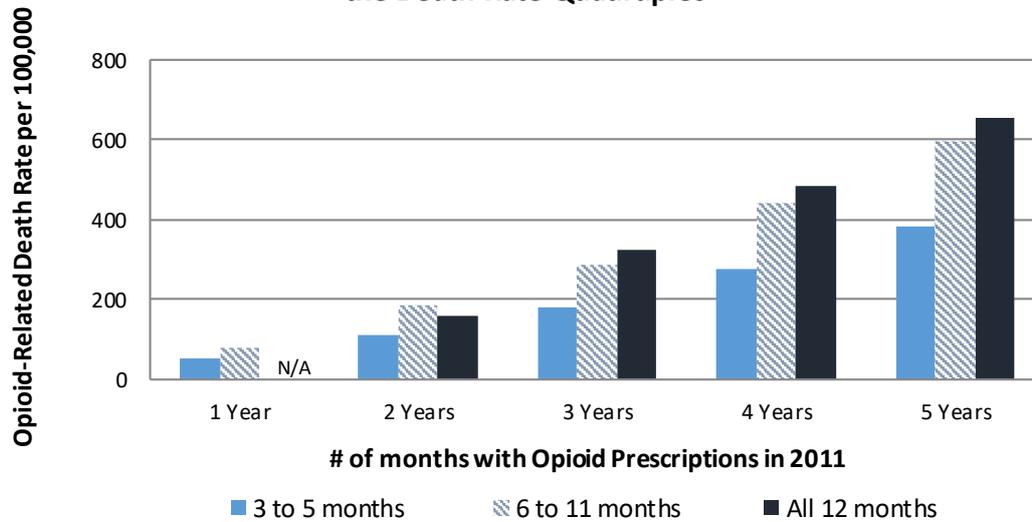


Figure 5 Diabetes trends. NZ Virtual Diabetes Register. Number of estimated people with diabetes in New Zealand

Within 1 Year After Receiving 3-Months of Prescribed Opioids, the Death Rate Quadruples



- Data Sources**
- Public Health
 - Medical Claims & Hospital
 - MassHealth
 - Mental Health
 - Public Safety
 - Jails & Prisons
 - Other Law Enforcement
 - DHCD (Homelessness)
 - Veterans' Services
 - Service Flags
 - Aggregate (Town, Zip, etc.)

With a complex array of data sources integrated, Massachusetts Department of Public Health has been able to provide granular e.g. segment level or social factor level etc. insights better informing changes to policies and protocols.

Ongoing annual reporting enables the impact of policy changes to be tracked and evaluated for success.

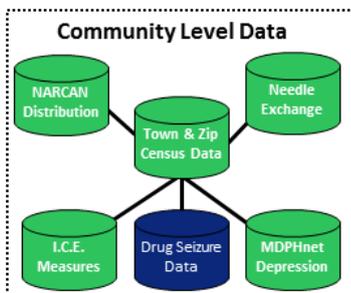


Figure 6 Bringing insight to the prescription of opioids and the importance of an ongoing monitoring system. Further details of the analysis can be found at: <https://www.mass.gov/service-details/chapter-55-overdose-report>

CITATIONS

Challenge 1 NHS England

https://www.sas.com/en_gb/customers/nhs-england.html

<https://www.ardengemcsu.nhs.uk/services/commissioning-support/nationalcommissioningdatarepository/>

<https://www.ardengemcsu.nhs.uk/services/commissioning-support/risk-stratification/>

NHS England Strategy

<https://www.england.nhs.uk/ourwork/>

NHS England 5 year plan

<https://www.england.nhs.uk/wp-content/uploads/2017/03/NEXT-STEPS-ON-THE-NHS-FIVE-YEAR-FORWARD-VIEW.pdf>

Sample Depth of change approach

<http://www.necsu.nhs.uk/wp-content/uploads/2016/03/XtraXDataXServicesXforXCommissioners.pdf>

Challenge 2 North Carolina

<http://www.ncmedsoc.org/nc-health-information-exchange-is-now-nc-healthconnex/>

Figure 2 screenshot

https://files.nc.gov/hiea/documents/files/nc_hiea_primary_provider_user_guide_august2017.pdf

http://ncep.org/wp-content/uploads/NCHHealthConnex_Infographic_Print.pdf

<https://hiea.s3.amazonaws.com/s3fs-public/documents/files/nc-hiea-16annrprt.pdf>

<http://www.nc-council.org/wp-content/uploads/2012/11/Combined-Presentations-Community-Council.pdf>

Challenge 3 Available on request

Challenge 4 San Bernadino

<http://wp.sbcounty.gov/dbh/mental-health-services/adults/rbest/>

<https://letsgethealthy.ca.gov/innovation-challenge/recovery-based-engagement-support-team-rbest/>

https://www.sas.com/content/dam/SAS/en_us/doc/event/analytics-experience-2016/there-no-health-without-behavioral-health-sanbernardino.pdf

Challenge 5 Geneia

<https://www.sas.com/fit/news/press-releases/2015/october/internet-of-things-pbls-vegas.html>

<https://www.geneia.com/products-services/at-home-remote-monitoring>

Challenge 6 New Zealand Ministry of Health

<http://www.health.govt.nz/our-work/diseases-and-conditions/diabetes/about-diabetes/virtual-diabetes-register-vdr>



<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4330200/>

https://www.sas.com/en_nz/customers/new-zealand-ministry-health.html

Challenge 7 Massachusetts

<https://www.mass.gov/service-details/chapter-55-overdose-report>

<http://blog.mass.gov/publichealth/wp-content/uploads/sites/11/2016/12/Chapter-55-compressed.pdf>

https://www.sas.com/en_us/whitepapers/ia-data-analytics-combat-opioid-epidemic-108369.html