
INTAcare
INISIGHT | OUTCOMES | VALUE
The use of AI for health outcomes predictalytics as a foundation for Value Based Healthcare (VBHC)
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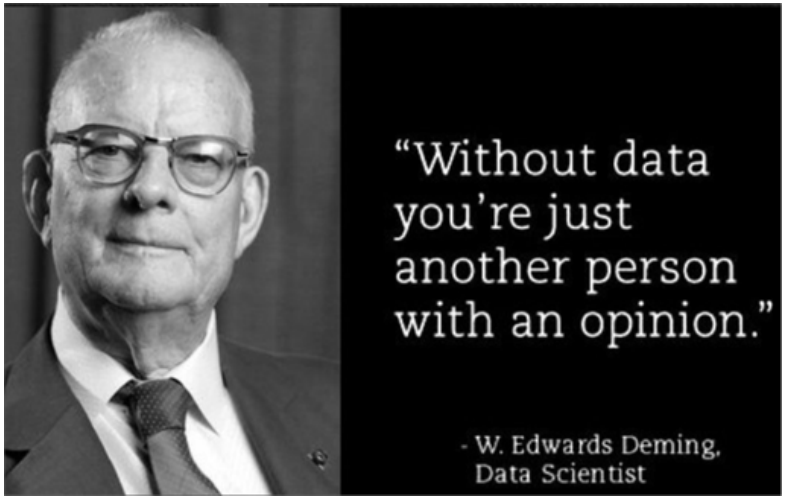
Senior Radiotherapist
- CEO - Intacare International Ltd
- CEO - The Health Value Partnership

Scene setting



Different perspectives on 'benefit and 'value'

The benefit of any medical innovation can only truly be measured by the benefit to the patient, as they see it!

Dr Don Berwick – Advisor, World Health Organisation

When assessing the value of any intervention we must not look solely at whether the patient lived as a result but rather whether they lived (or died) 'well'.

Public Health England

At the beginning of any decision process one must always consider the perspectives of the different stakeholders, and then balance where the value lies for each.

P. Just: PharmD, Senior Principal, Global Health Economics. ICON

- **Payers:** €, QALY, DALY, ICER
- **Hospitals:** Admissions, length of stay, volume of interventions, AEs
- **Clinicians**: OS, DFS, PSF,
- **Patients:** Quality of life, functional ability, emotional well-being, time

Limited Understanding: About how decision are made– what data?

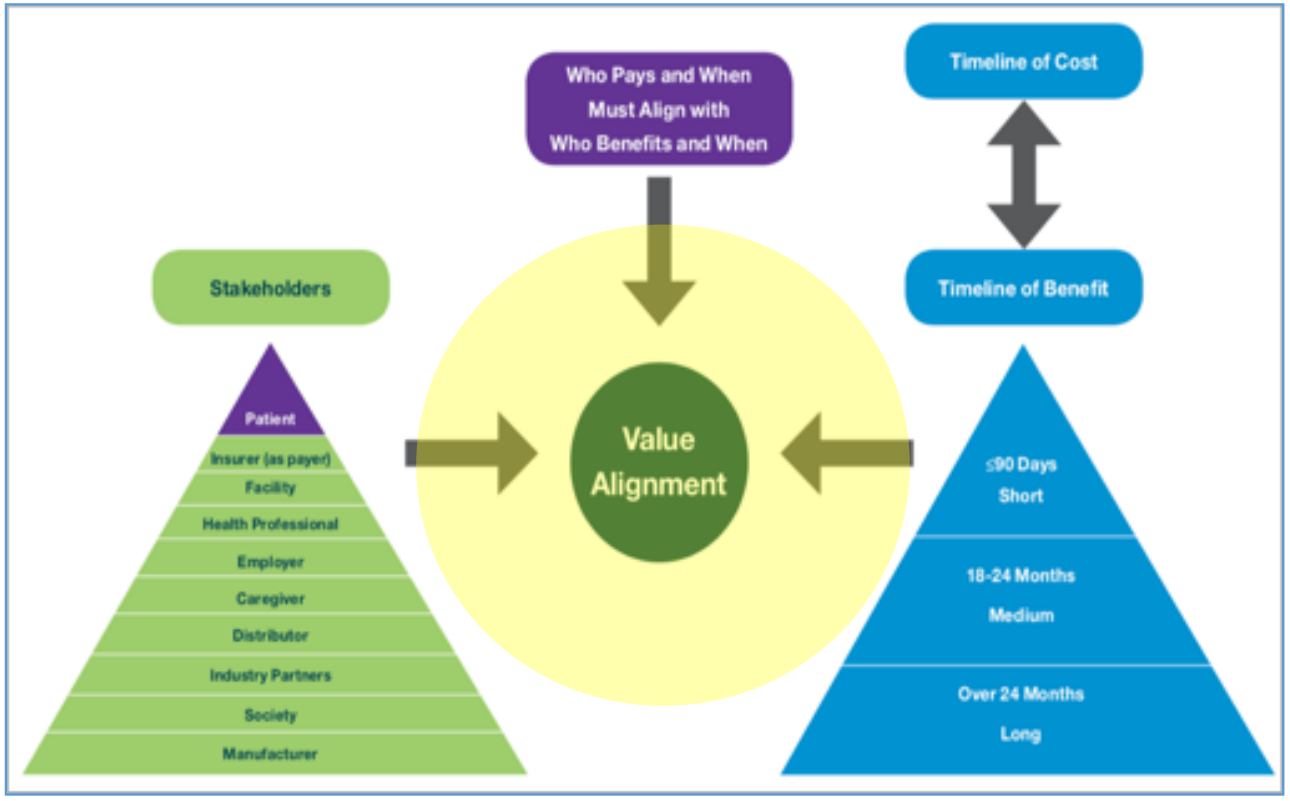
The result: Instability and poor 'value exchange', a cycle of diminishing returns

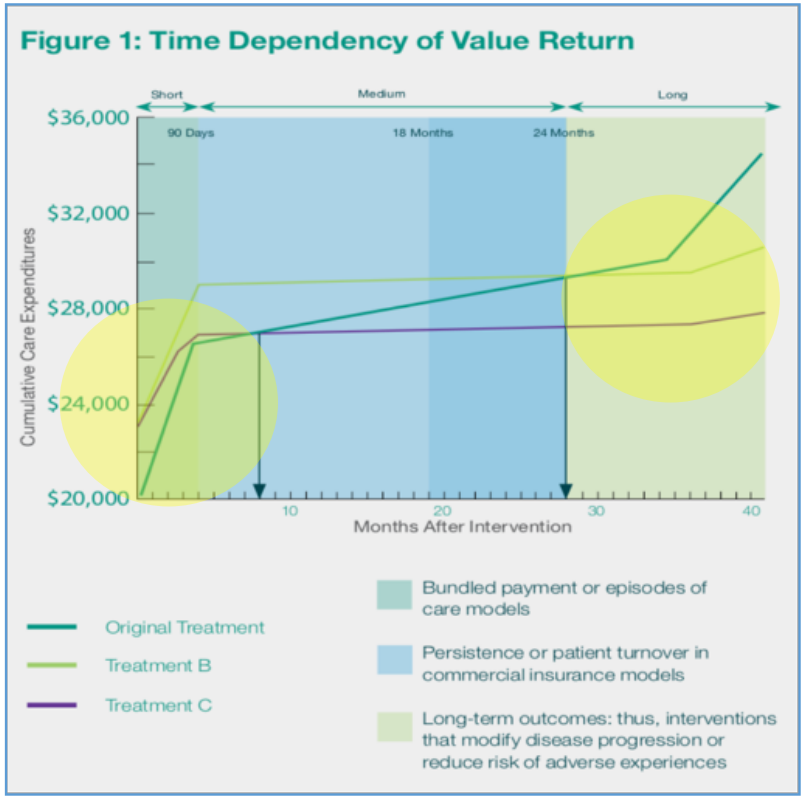
The Data Challenge

Core clinical parameters	
• Demographics	• Personal History
• Co-morbidities	• Presenting symptoms profile
• Diagnosis dataset – time, methodology, accuracy	• Treatment Dataset - Sx, CT, RT, HRT, IT etc
• Regime(s) / protocol(s) incl. Trial e.g. FEC, CHHiP	• Dose, timing, duration, OAR dose, multi-modalities
• Treatment Dataset - Sx, CT, RT, HRT, IT etc	• Regimen(s) / protocol(s) incl. Trial e.g. FEC, CHHiP
• Acute and longitudinal toxicity profiles (RTOG / CTCAE)	• Survivorship data: OS, PSF, DFS , date of death etc
• Adverse event reporting	• Longitudinal health data
Clinical Coding	**Ontologies**
• ICD-10	• SNOMED-CT
Toxicity Scoring	**Clinical Data Systems**
• RTOG, UKONS, CTCAE	• EMR, OIS + AE reporting
Patient Reported Outcomes	**Patient Reported Experience**
• 380 different questionnaire suites	• Numerous
Claims / Cost datasets / models	**Claims Systems**
• UK CCSD, ICS, HRG, QALY, ICER, DALY, QOCRV	• CREST, ClARA, Lorica
Benchmarks - national	**Benchmarks - International**
• PHE (COSD, RTDS, PCDS, NatPatSatQ) + ICHOMs, CODE, SAMS, PIE, others	• OECD – others

In the above, how well does does patients voice REALLY feature?

The Time Challenge





Compared to the standard treatment, both alternatives (treatment B and C) are more costly in the short-term.
But, when evaluated as total treatment cost over time, treatment B is cost saving after eight months - but cost more in total
Treatment C is cost saving beyond two years and gives most return in the long term

Introducing Intacare

The company:

- A clinical AI and data science company dedicated to developing clinical risk prediction solutions that optimise outcomes for multiple stakeholders
- **The patients voice remains central to everything we do**

Aim:

To socialise the science of predictalytics in VBHC

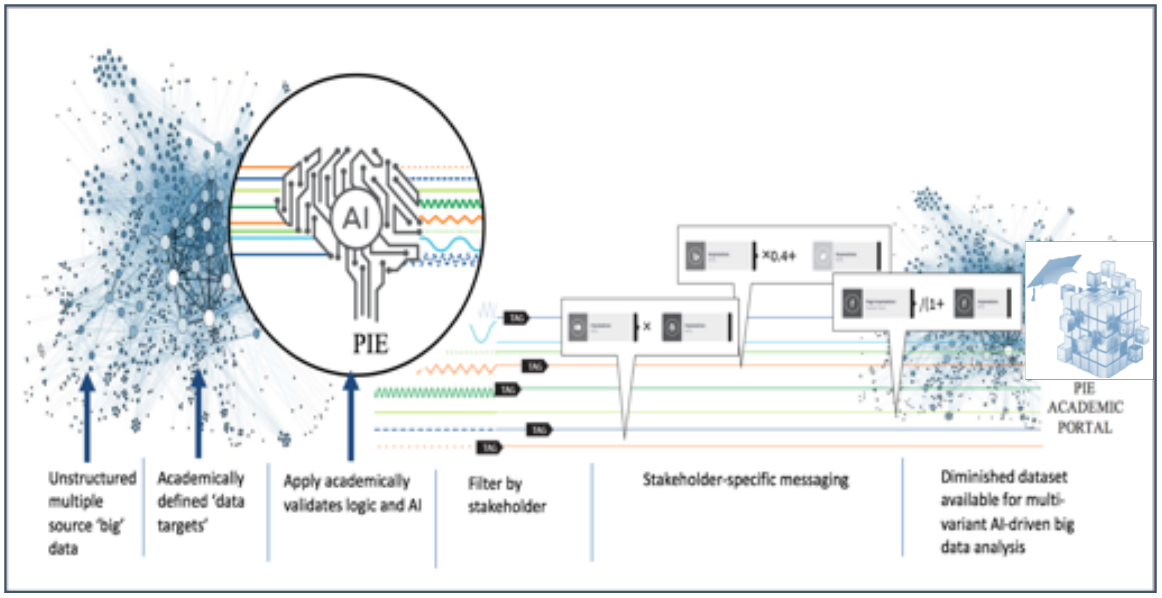
Vision:

- To be the 'google maps' for clinical outcomes – enabling better value navigation by providing a 'value map' that transcends the healthcare ecosystem

History:

- Seven years of academic research (Imperial College London, University of Surrey)
- Three clinical pilots (Royal Marsden, Royal Surrey, Southampton NHS Trusts – partnered with Varian and Macmillan)
- Commercial pilots (GenesisCare UK (10 Sites) + Varian)
- Now linking to the largest insurer in the world and the largest oncology-tech solution in the world

Intacare AI – Predictive Risk and Outcomes Insights Engine (PIE)



Liberate academic knowledge
Identify the data that is both necessary and currently available to enable the application of real world insights for complex decision support, risk assessment, tracking and mitigation and cost/benefit identification.

Target data from multiple datasets
Use AI and machine learning-based system to apply pre-defined academic logic to defined datasets to present risk reports that are tailored to the subscribers needs.

Federated learning
Provide a secure cloud-based SaaS risk engine to interact with third-party data collection suites and analysed data to elicit dynamic decision aids to put these at he finger-tips of the decision makers

Patient-Centricity
Simplifying patient reported outcomes and making them diagnostic and dynamic

Precision
Superior clinical decision support and insights built from the latest evidence

Prediction
Predicting events, eliciting better value across the ecosystem for value-based reimbursement and performance incentives

Value
Defined value outputs optimized for Value-Based Healthcare and cost transparency

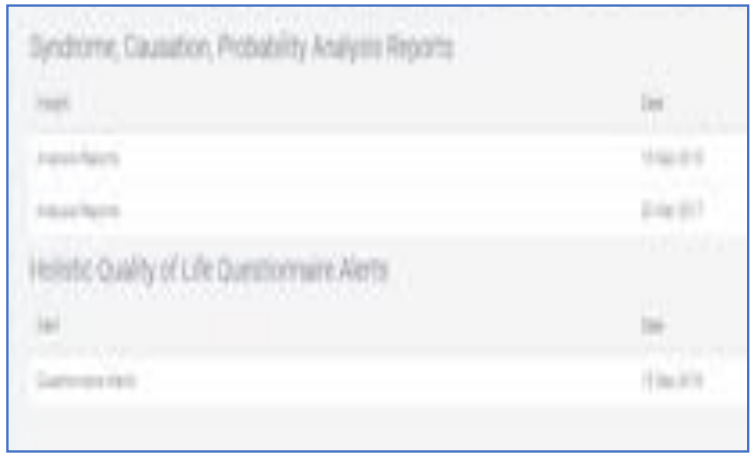
Intacare AI – Academic Programme 1:
Cancer Dynamic (diagnostic and predictive) PROMs

Question: **What is the most comprehensive holistic PROM that correlates with late effects**

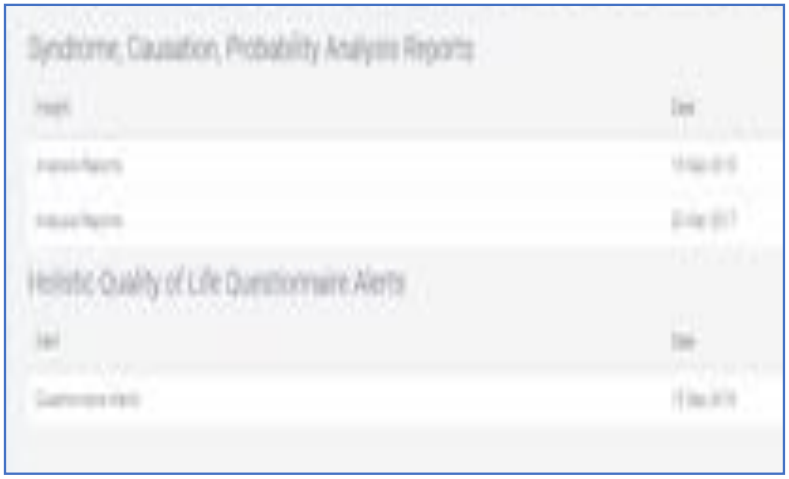
Identify: Most comprehensive symptoms toolkit that covers key holistic domains**:**
Symptoms, psychosocial, vocational, spiritual / Quality of Life (Rotterdam)
What symptoms are missing

Process: Combined 380 PROMs tools.
Correlated PROM with patient characteristics + clinical data + toxicity data
Identified what symptoms are most indicative of a clinical event
Academically and clinically validated = 19

Develop: A new, hybrid and all encompassing toolkit with a new, more meaningful presentation structure (Intacare SAMS):
- Correlates with late effects prediction
- Validated for clinical and academic use.

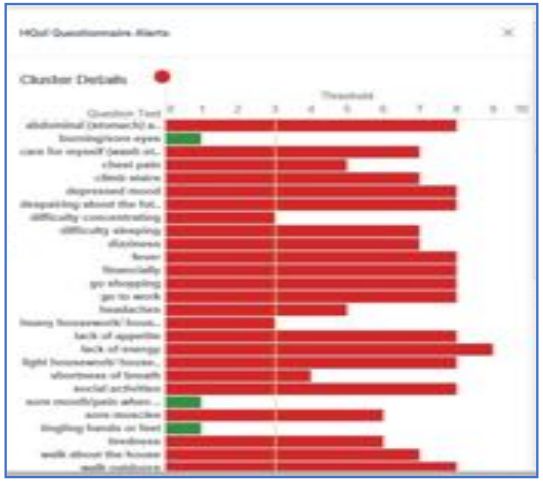


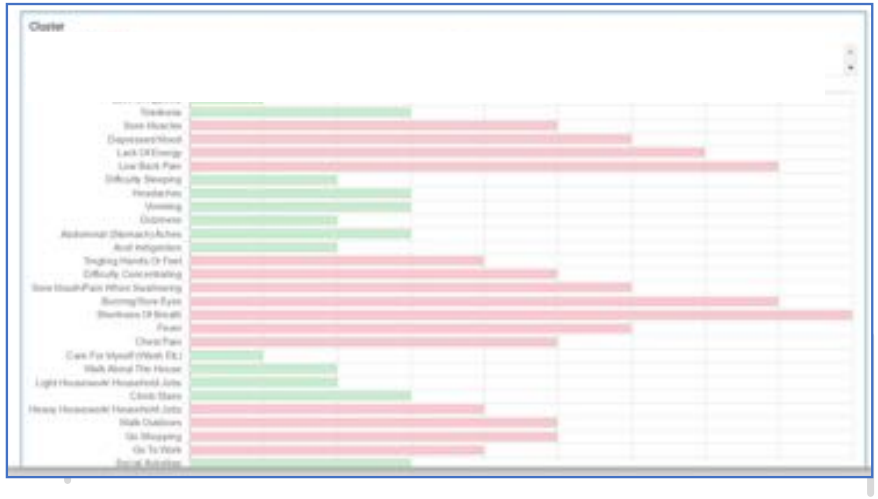
Intacare AI – Academic Programme 1:
Cancer Dynamic (diagnostic and predictive) PROMs



Presents:

- Specific symptom severity – Heatmaps
- +/- trends
- Cancer-specific symptom clusters , breaches
- Identifies early sign of recurrence
- Identifies risk and early signs of critical events





Intacare AI – Academic Programme 2:
Cancer late effects prediction models (predictalytics)

Inception: **What are the data that are associated with a late effect risk / presentation. How to target these data to predict future events**

Assess: Academic literature (100's of evidence level I and II papers) relating to toxicity and late effects

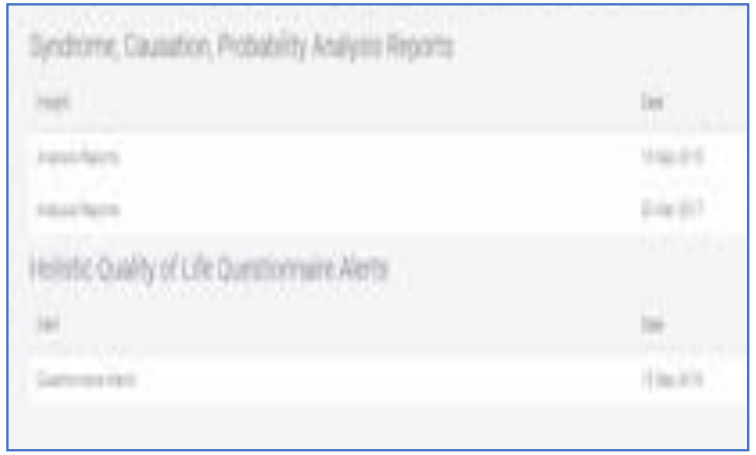
Analyses: Disparate datasets and targets defined data (precision data)

Filters: Data into international ontologies and coding structures (ICD etc)

Correlates: Patient characteristics + clinical data + utility data + toxicity data + Patient Reported Data (PROMs) + Patient Satisfaction Data (PREMs)

Identify: The symptoms assessed in the report, importance use
Patient characteristics + clinical data + toxicity data
Determine what symptoms are most indicative of a clinical event

Develop: A new, dynamic, late effects prediction and state change assessment model



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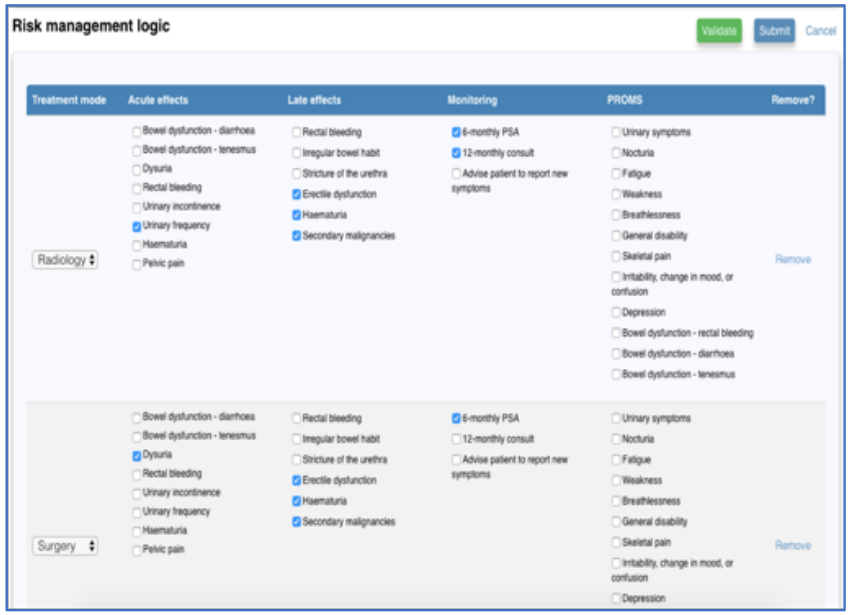
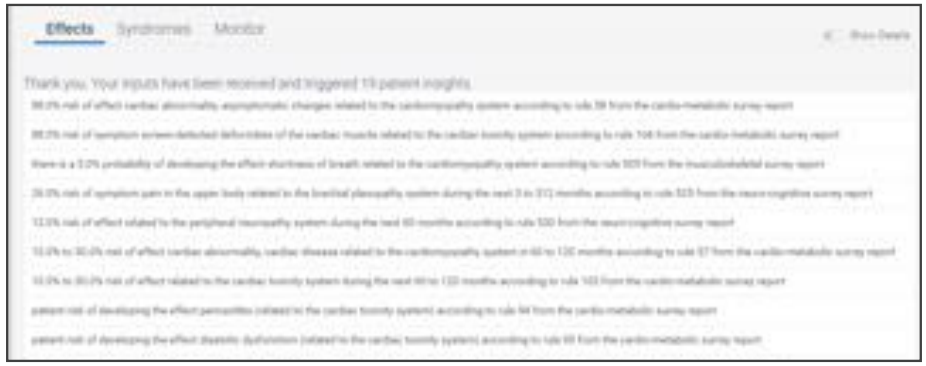


Presents:

- The probability of late-effect (syndrome) e.g. cardiac, respiratory syndrome
- Identifies the associated / contributing risk factors
- Predicts the % probability of and time to occurrence
- Predicts the presentation e.g. myocardial infraction
- Proposes a monitoring plan e.g. monthly BP + weight +, 6-monthly MUGA LVEF
- Provides a link to the supporting evidence that the rule(s) was derived from



Case Study: Research Programmes
Simplifying Long-form PROMs & Predictalytics

Royal Marsden NHS Foundation Trust, UK: - **6-yr Prostate Brachytherapy multiple PROMs analysis (complete)**
Royal Surrey NHS Foundation Trust, UK: - **5-years Colorectal Cancer multi-PROMs analysis (July 2019)**
- **5-years Prostate multi therapy data analysis (July 2019)**

Aims:
- Assess the correlation between treatment characteristics (dose etc), patient characteristics (age), patient's own perception of health
- Patterns in symptoms presentation against time, the individual and their treatment characteristics
- Identify symptoms that are typical in this cohort and indicate toxicity and declining Quality of Life
- Map to Predictive Insights Engine for late effects correlation

Royal Marsden Review:

Final Cohort analysed:	94 men who had been treatment with prostate brachytherapy between 2006 – 2013 (mean age: 64-yrs)
PROMs data:	EPIC, FACT-P(v4), IPSS, Fulham questionnaires (full or partial) at baseline, 6-months, 1, 5, 6 years
Treatment system data:	Age at treatment, Total Target Dose D100 (Gy), Target dose D90 (Gy), Rectal Volume (cm3), Rectum dose D100 (Gy), Urethra volume (cm3), Urethra dose D100 (Gy), Number of needles, Number of seeds
Key Missing data:	Patient stage and grade

Analysis:

1. PROM response timeline
2. Features importance
3. Cluster longitudinal analysis of correlating factors and response
4. Effect on other parameters

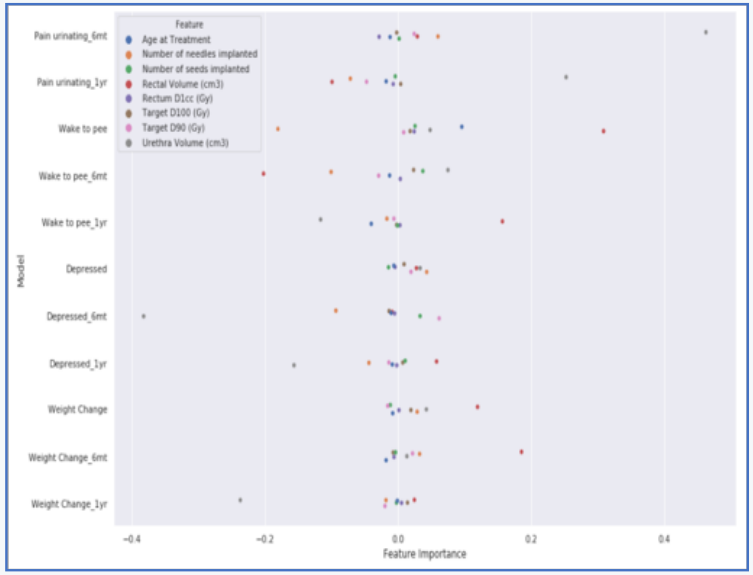
Symptoms	Correlation
↑ depression at 1 year Persistent depression	Number of needles, rectal vol, urethra vol, pain
Potency decline	Age, number of needles, urethra vol
Weight change at 6 months, 1 year	Age, potency decline, pain, depression
Pain (general)	Rectal vol, depression
Pain urinating	Urethra vol, depression
Nocturia at 1-year	Number of needles, urethra vol, depression

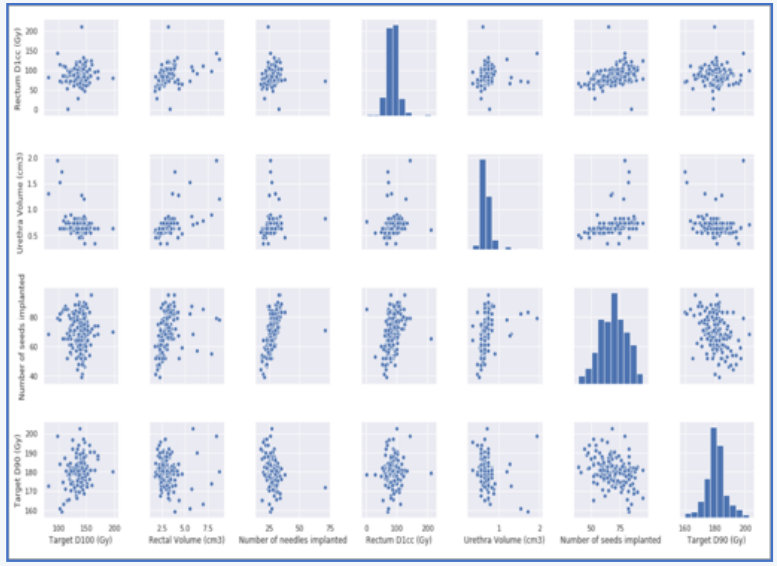
Predictive modelling - How will patients will answer PROM at each timepoint and what features are important

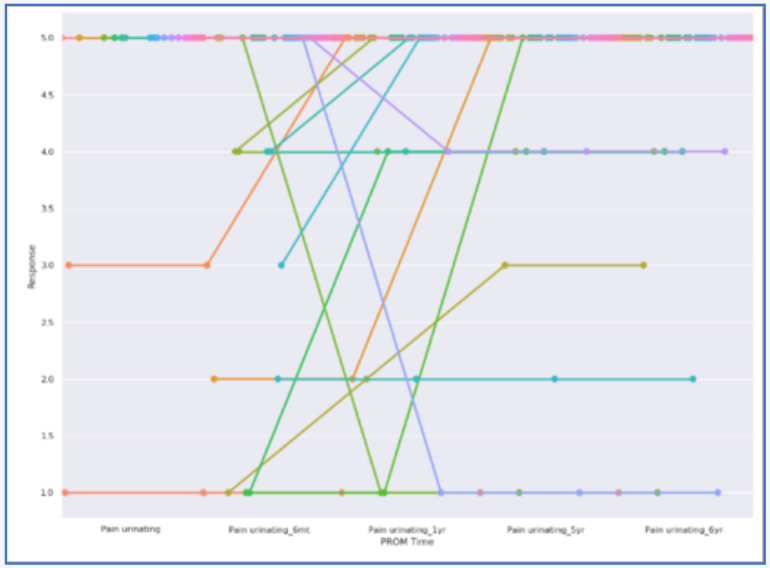
(Support Vector Regression with mean squared error (low = well performing)

Future Analysis:

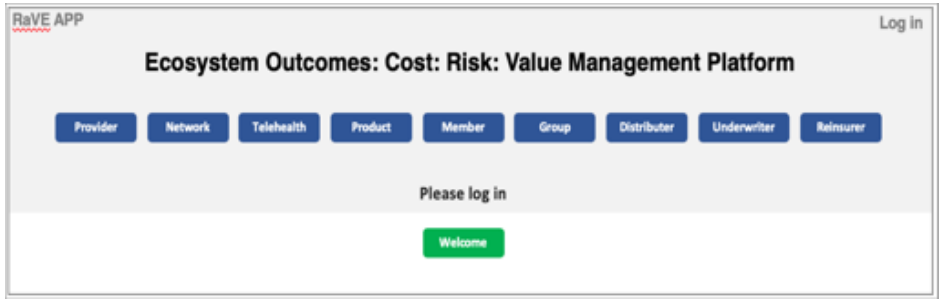
1. Stage and Grade correlations
2. Analyse subset of patients who feel their pain gets worse over time
3. Run targeted PROM against new PROM Protocol using EORTC-QOL PR25 to further develop predictive model







Intacare AI – Dynamic Risk and Value Engine (RaVE)



Aim:

- Provide a multi-sided digital QOCRV insights platform
- Improve consumer and provider risk profiling
- A secure medium of exchange for healthcare outcomes and value-based payment communication
- A machine learning platform for identifying unwarranted variation, fraud, waste and abuse

Analyses:	Disparate claims / cost datasets
Filters:	Data into standardised coding - coding (ICD / HRG / CCSD…)
Correlates:	Patient characteristics + clinical data + utility data + toxicity data + Patient Reported Data (PROMs) + Patient Satisfaction Data (PREMs) + cost / claims (by code)

Produces:

- Bespoke targeted ‘risk insights’ to our subscribers
- Using standard industry health-economic measures e.g. Quality Adjusted Life Years, Daly Adjusted Life Years, ICER, Relative Live Value, Relative Risk, Utility and utility cost.

Case Study: Cost of Cancer Analysis

PMI providers (1 x New Zealand, 2 x UK): Typical Spend GBP £300m - 400m, NZD $17m

Aims:

1. To determine the 'total cost of cancer', root cause of costs, establish mechanisms to assess, predict and mitigate cost risk
2. Establish Outcomes Based Commissioning Model for Targeted Commissioning from high performers

Process

1. Assess historic claims data (5-yrs) – what are patients/ hospitals/ clinicians claiming for
2. How do these claims relate to typical toxicity / co-morbidity profiles
3. What are the characteristics of individuals – treatment-related / patient-specific - correlate with PIE
4. Where were they treated, by whom and with what (appropriateness)
5. Run some value models (QALYs, ICERs, DALYs, TDABC, total cost of claim/ life, time, clustering's, Relative Life Value/Risk

Results:

- 1795 code narrative variations (standard CCSD model = 33)
- Wide variation in claims – areas of significant suspected fraud, waste, abuse and unwarranted variation
- £44-56m in savings (UK): 14% savings (excl. operational efficiencies)

Next steps:

- New 'quality and value assurance' model mandated to all hospitals - includes PROMs and PIE dataset.

Summary

- **The patients voice is diagnostic and predictive**
- **Captured via PROMs / PREMS and toxicity datasets**
- **Align our perspectives on ‘benefit and ‘value’ – ecosystem value exchange**
- **Standardize our datasets – ensure PROMs / PREMs etc are central**
- **Include correlation between clinical, patient reported and cost/ utility data (transcending views)**
- **Identify root cause of value erosion – evidence based best practice?**
- **Evolve the models for predictalytics (proactive not reactive care) – let AI do the heavy lifting**
- **Socialised e.g. via ICHOMs**
- **Observe, learn, optimise, repeat…**

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Thank you

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