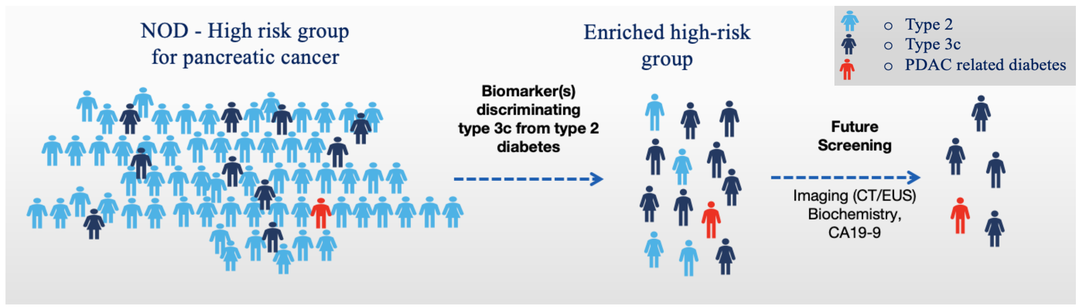
Cost-benefit analysis of biomarker-driven early detection of pancreatic cancer in individuals with new-onset diabetes

Irena Stefanova[1], Nathan Thompson[3], Martyn Stott[1], Lucy Oldfield[1], Robert Hanson[2], Robert Van Der Meer[3], Daniel Palmer[1], William Greenhalf[1], Christopher Halloran[1] and Eithne Costello[1]

[1]Department of Molecular and Clinical Cancer Medicine, University of Liverpool, UK; [2] Liverpool Clinical Trials Centre, University of Liverpool, UK; [3]Management Science, University of Strathclyde, UK

Introduction

- Pancreatic adenocarcinoma (PDAC) is associated with a poor 5-year survival rate of 7-10% and a low incidence (13.3 in 100,000 people).
- Population-wide screening using current modalities is not feasible. However, screening of high-risk groups is recommended.
- By the time of PDAC diagnosis, ~85% of patients have glucose dysregulation and 40-65% have diabetes, the majority of which is new-onset (NOD< 3 years). In effect, NOD is a warning sign for the development of PDAC.
- For 10% of individuals in the NOD high-risk cohort diabetes is a result of pancreatic disease, of which 10% is PDAC-related diabetes.



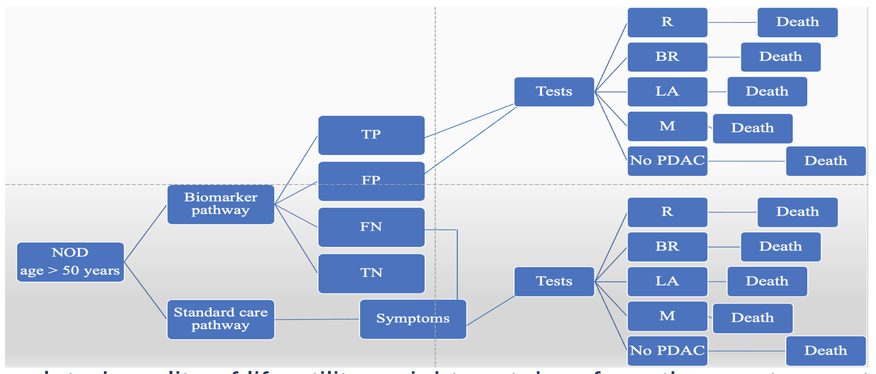
- The United Kingdom Early Detection Initiative for pancreatic cancer (UK-EDI) study is establishing resources and undertaking research aimed at detecting pancreatic cancer in the NOD high-risk group. It is currently investigating plasma biomarker panels which differentiate between type 2 and type-3c diabetes which could facilitate PDAC screening in individuals with NOD.
- Evaluating key factors in a biomarker's value could aid its refinement and development into an economically viable screening solution

AIM: To undertake cost-benefit analysis of biomarker-driven PDAC screening in NOD.

Methods

Markov state-transition decision model:

- assessing the downstaging benefits of new screening policies over a 5-year period
- focused on individuals with NOD >50 years, if screened for PDAC using a novel biomarker signature
- comparison of biomarker-driven screening cohort to standard care pathway

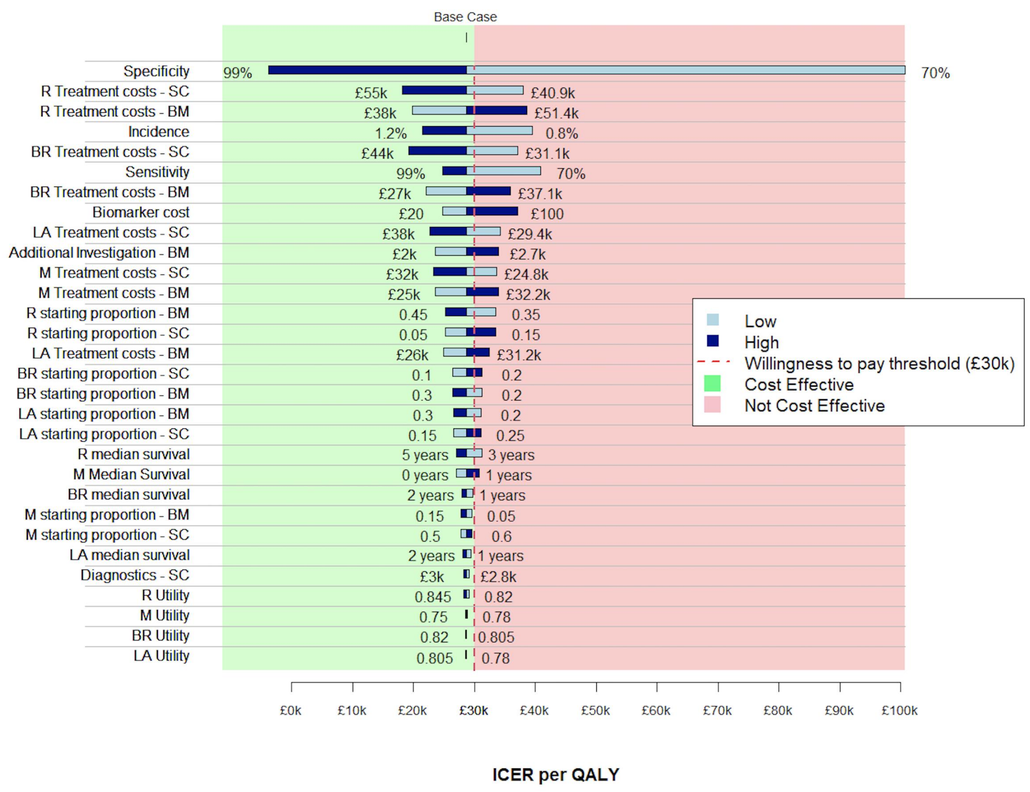


- Health-related quality of life utility weights - taken from the most recent literature
- **Average treatment costs for each health state** - taken from NHS Cost Collection 2021-2022 and recent literature. Included are the cost of operation, intensive care stay, physiotherapy, diabetes care, chemotherapy (neoadjuvant and adjuvant, endoscopy/interventional radiology services, dietitian care, palliative care and hepatobiliary and oncology appointments.
- **Calculation of:**
  - Incremental cost-effectiveness ratios
  - Net benefits
  - Willingness-to-pay threshold per Quality-Adjusted Life Year (QALY) of £30,000.
- One-way and multi-way sensitivity analysis, to allow for parameter uncertainty and determine critical factors for cost effectiveness.

Results

- Biomarker-driven screening for PDAC in NOD can be cost effective (costing £28,617.33 per QALY), provided that:

1. Screening is targeted at high-risk patients with NOD (1% risk threshold group)
2. Biomarker performance is high (sensitivity and specificity at 90% or above)
3. Biomarker costs are sufficiently low (around £45/test).
4. At least 35% of PDAC cases detected through screening have resectable-stage disease.
5. Most influential factors were: biomarker specificity and sensitivity, incidence in target population and restctable PDAC treatment cost.



Parameter		Estimate	Range
Treatment costs (Standard care Pathway)	Resectable	£47,581	£40,856 - £55,091
	Borderline-resectable	£37,187	£31,088 - £43,939
	Locally advanced	£33,398	£29,369 - £37,687
	Metastatic	£28,418	£24,802 - £33,231
Treatment costs (Biomarker Pathway)	Resectable	£44,203	£37,815 - £51,375
	Borderline-resectable	£31,947	£27,217 - £37,143
	Locally advanced	£28,505	£25,855 - £31,217
	Metastatic	£28,418	£24,802 - £32,231
Diagnostic tests	Biomarker cost	£45	£20 - £100
	Standard Care (SC)	£3,087	£3,068 - £3,106
	Additional tests (BM)	£2,363	£2,289 - £2,438
Health Utilities	Healthy	0.86	0.85 - 0.87
	Resectable	0.83	0.82 - 0.845
	Borderline-resectable	0.81	0.81 - 0.81
	Locally advanced	0.798	0.78 - 0.81
	Metastatic	0.762	0.75 - 0.78
	Death	0	0 - 0
Biomarker performance	Sensitivity	90%	70% - 99%
	Specificity	90%	70% - 99%
Incidence in target population		1%	0.8% - 1.2%
Discount		3.5%	3% - 4%
Population starting state proportions	Resectable	10% -> 40%	5-15% / 35-45%
	Borderline-resectable	15% -> 25%	10-20% / 20-30%
	Locally advanced	20% -> 25%	15-25% / 20-30%
	Metastatic	55% -> 10%	50-60% / 5-15%
Median survival (in years)	Resectable	3.73	2.92 - 4.53
	Borderline-resectable	1.4	1 -1.75
	Locally advanced	1.3	0.75 - 1.83
	Metastatic	0.4	0.24 - 0.55

Future direction

UK-EDI will continue to progress its resource building (including NOD cohort and questionnaire data) in parallel with developing its biomarker pipeline to facilitate biomarker-driven screening of NOD for PDAC. Cost benefit analysis will be a consistent key component of this work.

Conclusions

- Cost-benefit analysis plays an essential part in biomarker discovery because it informs key stake holders regarding relevant factors in biomarker value. This is essential component of their translation into a real-world practical application.
- Screening the high-risk NOD group for PDAC becomes cost-effective when an optimal biomarker signature can be selected.

Acknowledgements

We are grateful for the support provided by Cancer Research UK, Pancreatic Cancer UK, Liverpool ECMC, and TRANSPAN COST Action CA21116 (European Cooperation in Science and Technology) for funding to attend this conference.

Collaborations

This work is undertaken in collaboration with Management Science at the University of Strathclyde (Glasgow, UK) and the UK Early Detection Initiative for pancreatic cancer (led by Liverpool).