

PSI 2024
CONFERENCE

AMSTERDAM

BEURS VAN BERLAGE
16-19 JUNE 2024



Expert judgement to support a clinical hybrid Bayesian network approach on pancreatic cancer

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Disclosure of Interest Statement:

AlphaTau Medical LTD consultancy



STATISTICS OF PANCREATIC CANCER

Cases

10,452



New cases of pancreatic cancer, 2016-2018 average, UK

Deaths

9,558



Deaths from pancreatic cancer, 2017-2019, UK

Survival

5%

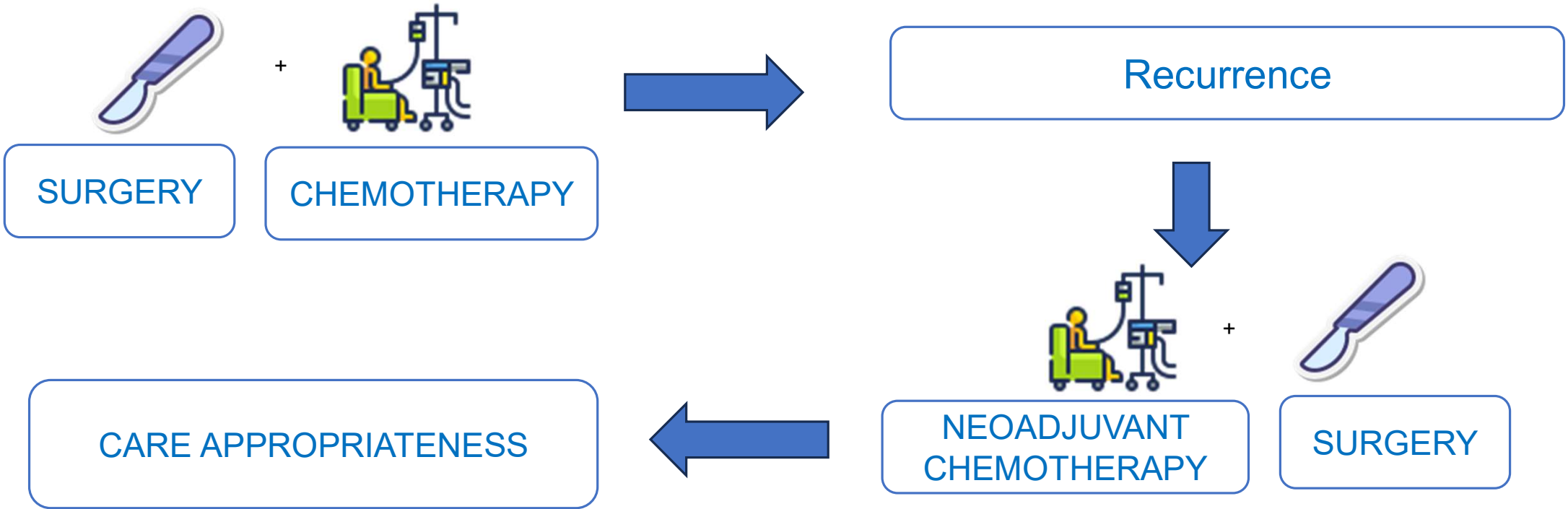


Survive pancreatic cancer for 10 or more years, 2013-17, England



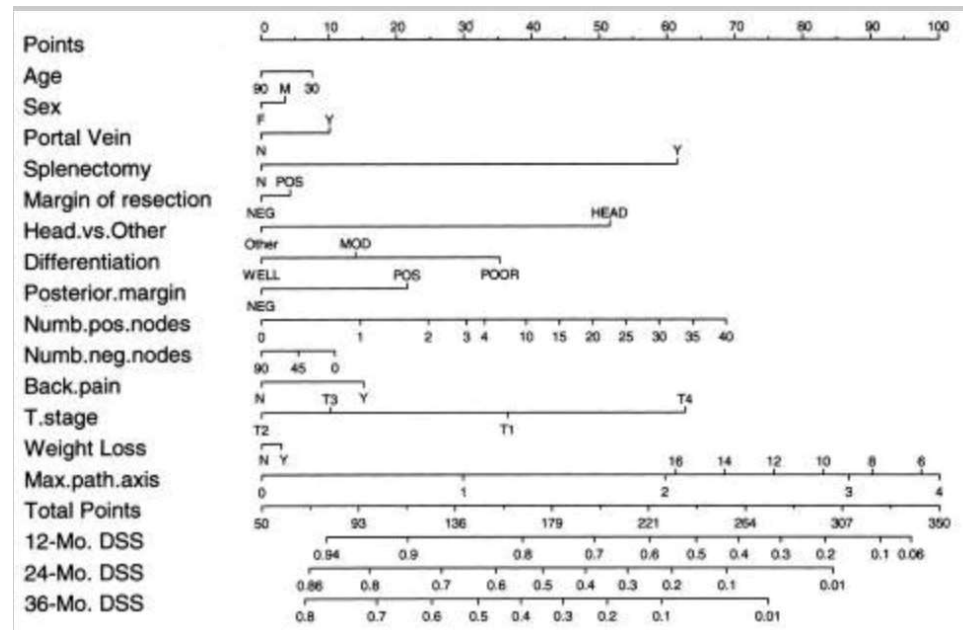
INTRODUCTION

THERAPEUTIC GOLD STANDARD FOR NON-ADVANCED PANCREATIC CANCER



INTRODUCTION

COMMON PROGNOSTIC MODELS



Poor performance → low applicability

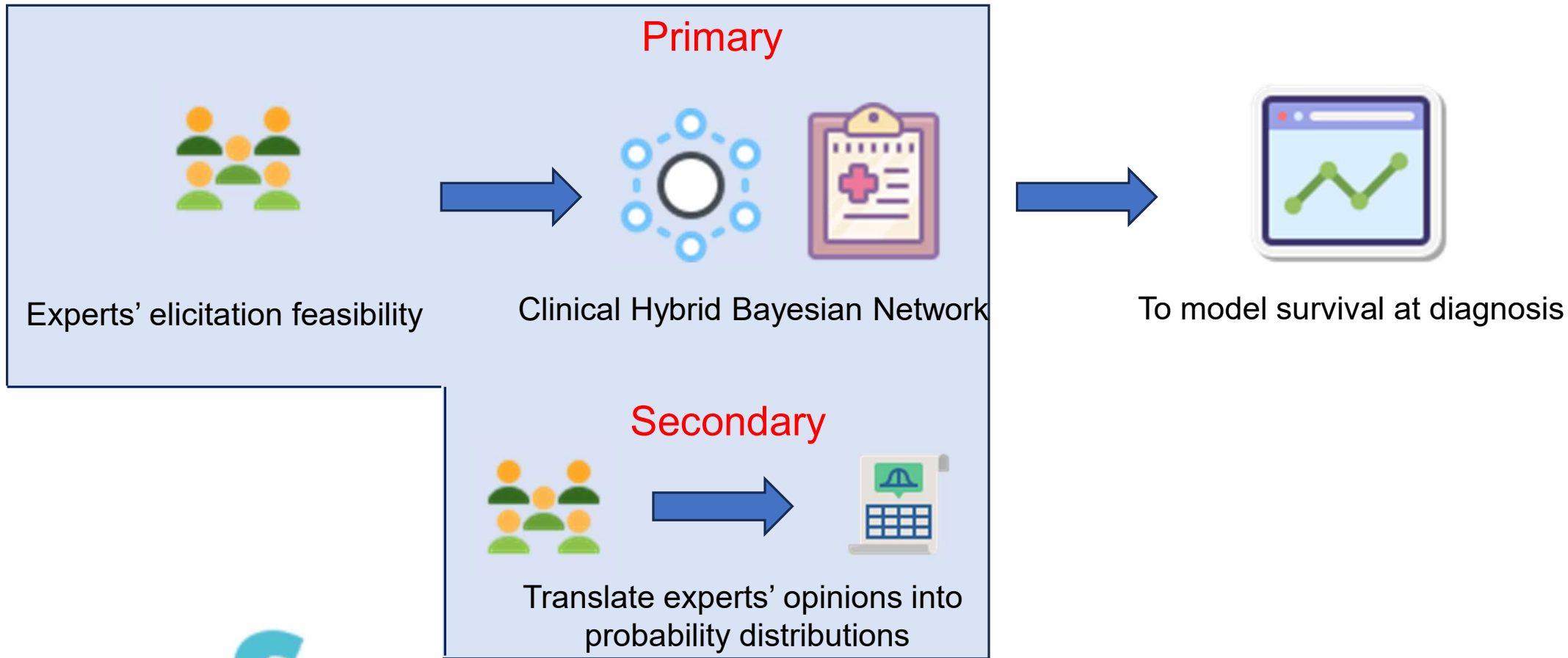
Based on post-operative data, without experts' opinions

Brennan, Ann Surg, 2004



INTRODUCTION

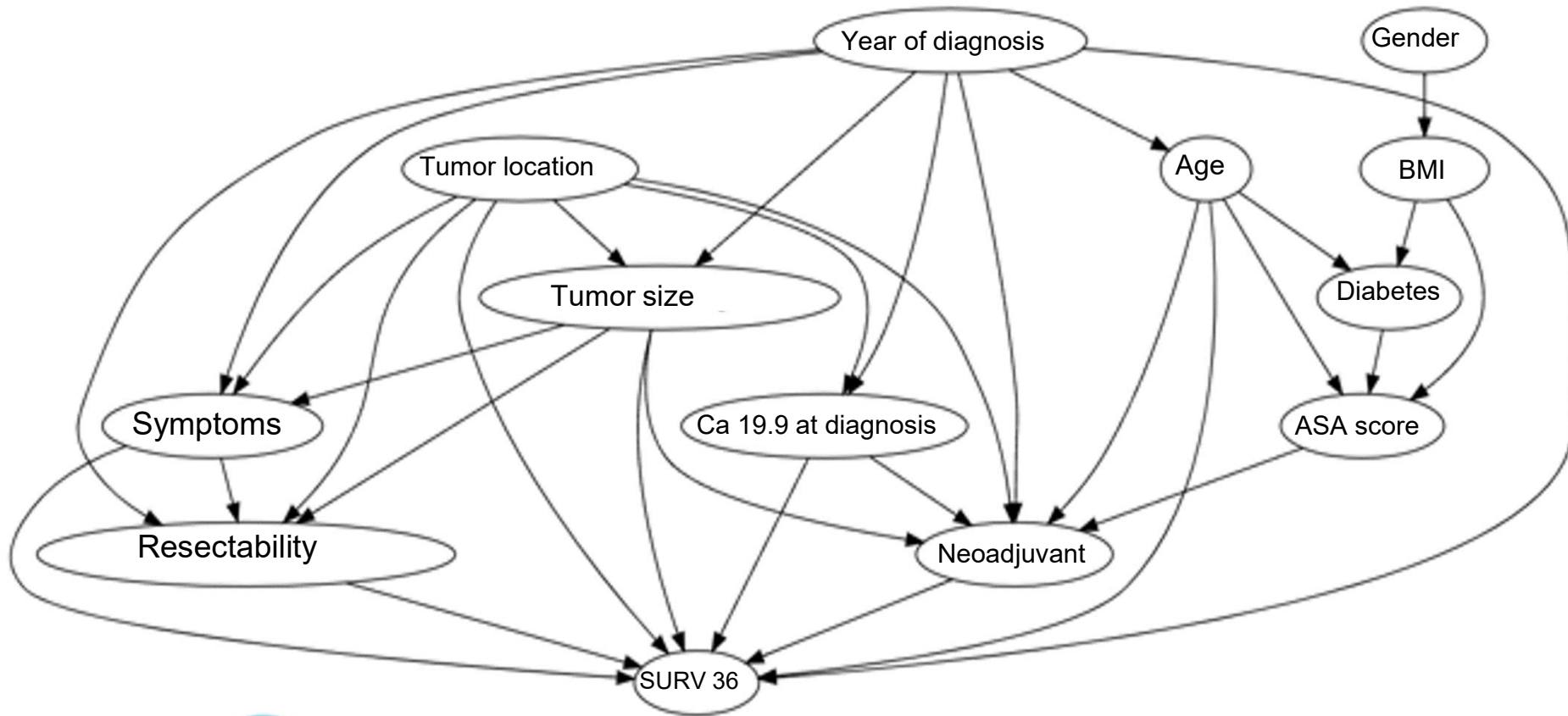
AIM



AIM



CLINICAL HYBRID BAYESIAN NETWORK



R package
"HydeNet"



METHODS

THE **VARIABLES** OF THE NETWORK

12 variables, at diagnosis:



C

Ca 19-9



D

Gender



D

BMI



D

Year of diagnosis



D

Tumor location



C

Age



D

Diabetes



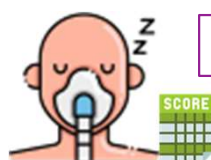
C

Tumor size



D

Symptoms



D

ASA score



D

Resectability



D

Neoadjuvant chemotherapy

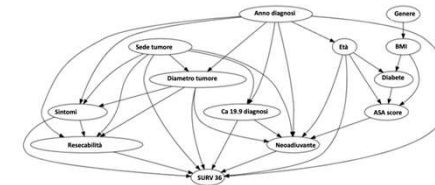
C Continuous

D Dichotomous



METHODS

INNOVATION



The Sheffield Elicitation Framework

SHELF v4

Overview of the Sheffield Elicitation Framework (SHELF, v4)

Experts' elicitation process → synthesis and transformation into distribution's probabilities of judgement on variables without a unique threshold or reference value

Oakley & O'Hagan, 2019

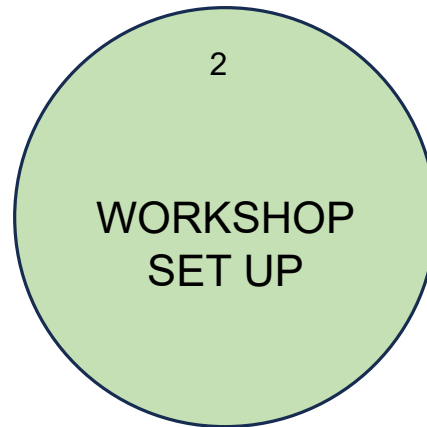
METHODS



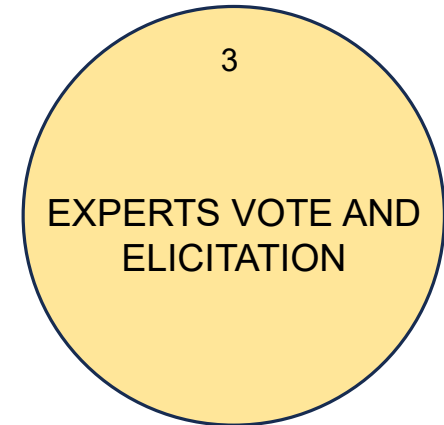
« SHELF » (SHeffield ELicitation Framework)



- Selection



- Training
- Quantities of Interest (QoIs)
- Evidence dossier



- Priors
- Priors' discussion
- Experts' consensus about priors
- Documents



METHODS



TWO PHASES WORKFLOW



Experts' Host Institutions:

University of Pennsylvania, Philadelphia, *USA*
Kansai Medical University Osaka, *Japan*
University Auckland, *New Zeland*
University Hospital in Heidelberg, Germany, *Europe*
Sunnybrook Health Sciences Centre Toronto, Ontario, *Canada*
Tata Memorial Center in Mumbai, *India*
Massachusetts General Hospital Boston New England, *USA*
University of Cincinnati UC College of Medicine, *USA*
University of Glasgow, Glasgow, *UK*

METHODS



ELICITATION DETAILS

R SHELF package

Quartile Methods to represent the distributions elicited by the experts

Evaluation of the best distribution for each variable of interest

Identification of the best compromise to define the pooled distribution (around the minimum-maximum and median values)

Graphic and tabular presentation of the results



METHODS

Nodes	Type of prevalent distribution (number of experts with prevalent distribution/number of experts)
Ca 19.9	T (6/8)
Age (years)	MirrorlogT (4/7)
Tumor size(mm)	MirrorlogT (8/8)
Gender	LogT (6/9)
BMI	LogT (6/9)
Year of diagnosis	LogT (5/9)
Tumor location	MirrorlogT (6/9)
Diabetes	Normal (6/9)
Symphoms	MirrorlogT (5/9)
ASA Score	LogT (9/9)
Resectability	mirrorlogT (7/9)
Neoadjuvant Chemotherapy	mirrorlogT (6/9)

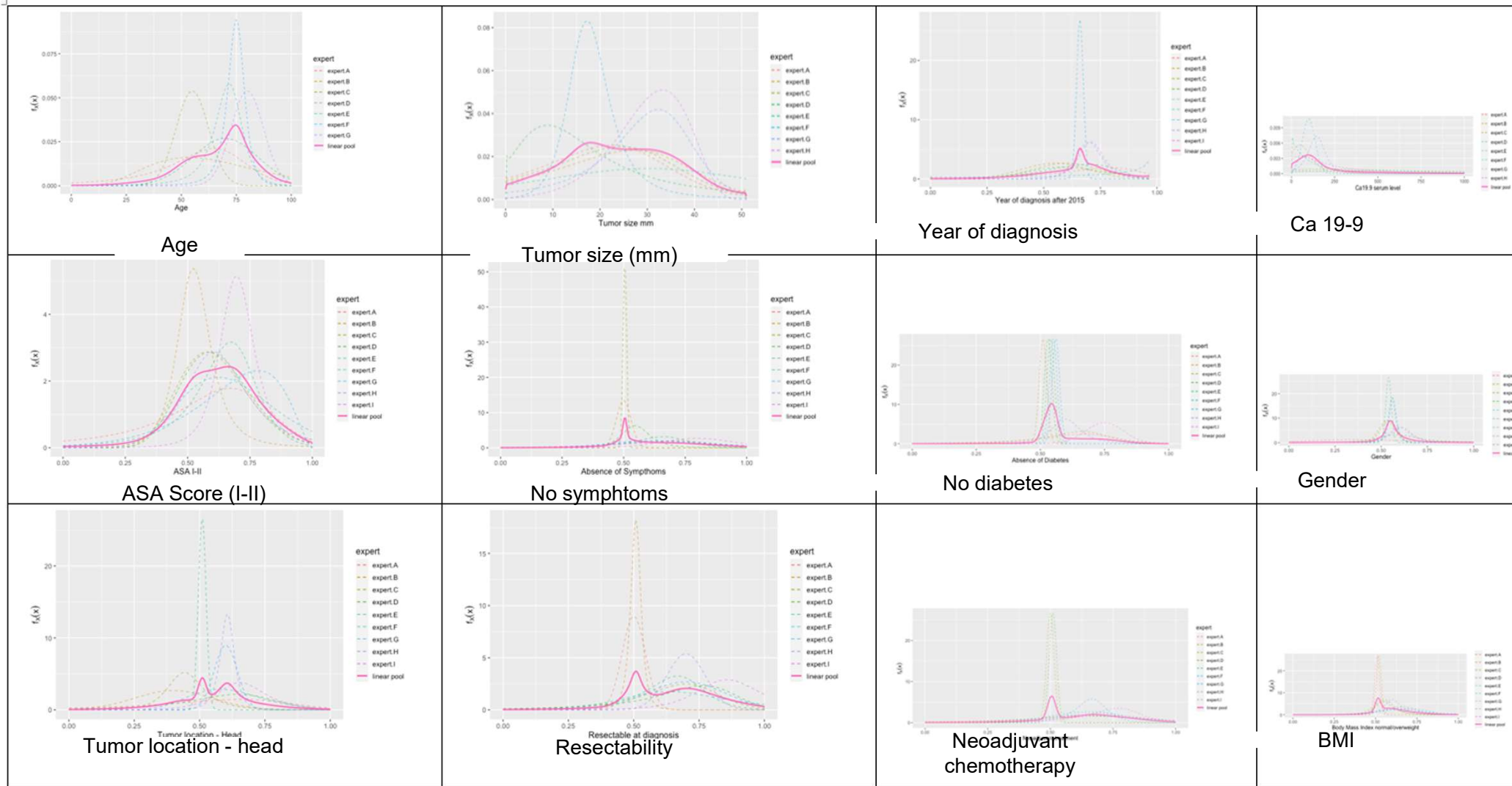
POOLED DISTRIBUTION

Linear distribution with mean and standard deviation

Beta distribution with α and β

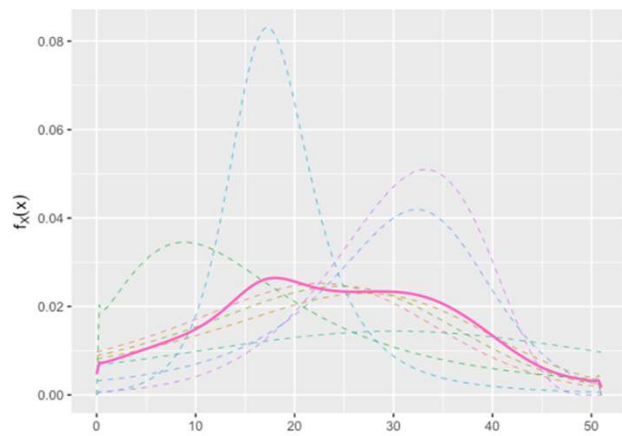
RESULTS



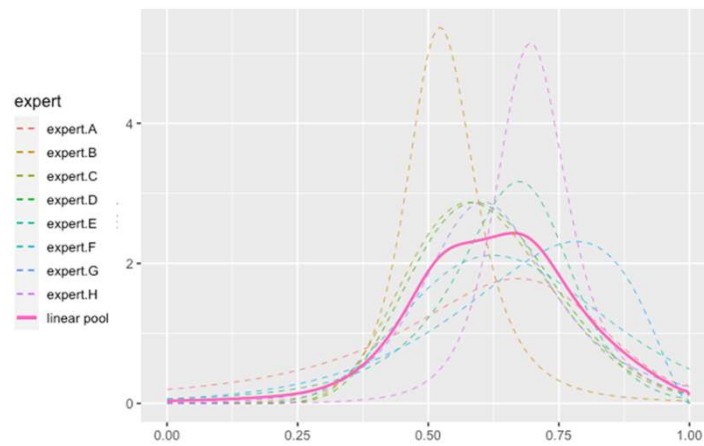


RESULTS

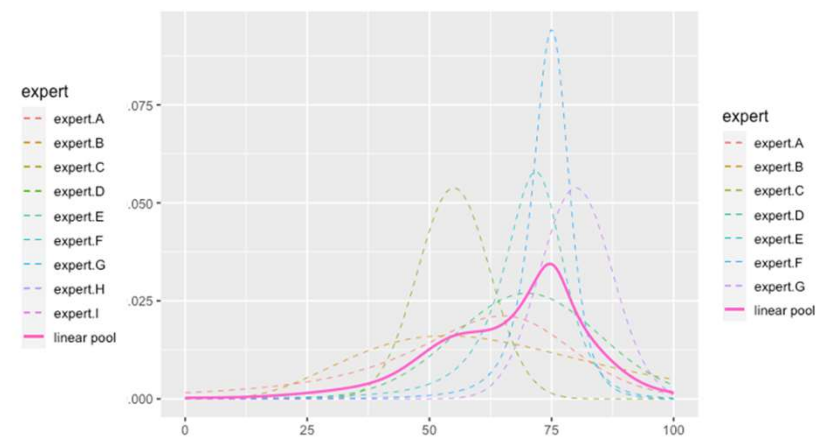
DISCREPANCIES ON POOLED DISTRIBUTIONS



Tumor size (mm)



ASA Score I-II



Age



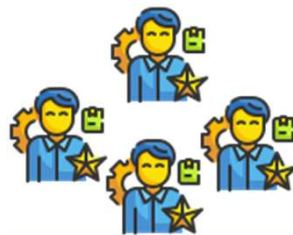
RESULTS

DISCUSSION

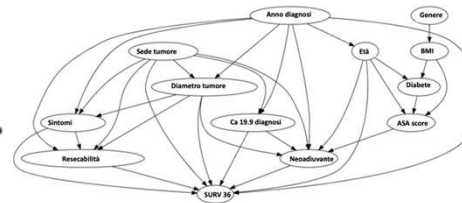
Decision-making in oncology may be troublesome in case of weak evidence



First time



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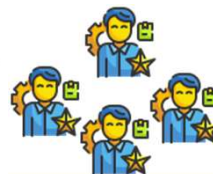


To overcome the limitations of current pancreatic cancer survival prediction models

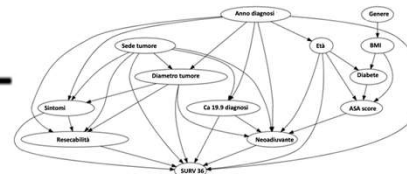
Points	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Sex	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Portal Vein	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Splenectomy	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Margin of resection	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Head vs Other	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Differentiation	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Posterior margin	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Number of nodes	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Number of lymph nodes	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Back pain	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
T fatigue	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Weight Loss	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Max path axis	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Total Points	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
12-Mo. DSS	0.98	0.95	0.92	0.88	0.85	0.81	0.78	0.74	0.71	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.40	0.37	0.34	0.31	0.28	0.25	0.22	0.19	0.16	0.13	0.10	0.07	0.04	0.01
24-Mo. DSS	0.96	0.93	0.90	0.86	0.83	0.79	0.76	0.72	0.69	0.66	0.63	0.60	0.57	0.54	0.51	0.48	0.45	0.42	0.39	0.36	0.33	0.30	0.27	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00
36-Mo. DSS	0.94	0.91	0.88	0.84	0.81	0.77	0.74	0.70	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.40	0.37	0.34	0.31	0.28	0.25	0.22	0.19	0.16	0.13	0.10	0.07	0.04	0.01	0.00



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LIMITS and FUTURE DEVELOPMENTS

➤ Performed remotely (COVID; incompatibility of experts' time zones)

➤ Experts were unfamiliar with formulating technical opinions in the form of distributions or probabilities



➤ Evaluation of model performance and clinical applicability of the network (external datasets)



CONCLUSION

Thank you for your attention!



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