

A Bayesian Model to Improve Management of Chronic Wet Cough in Primary Care

André Schultz and Steven Mascaro

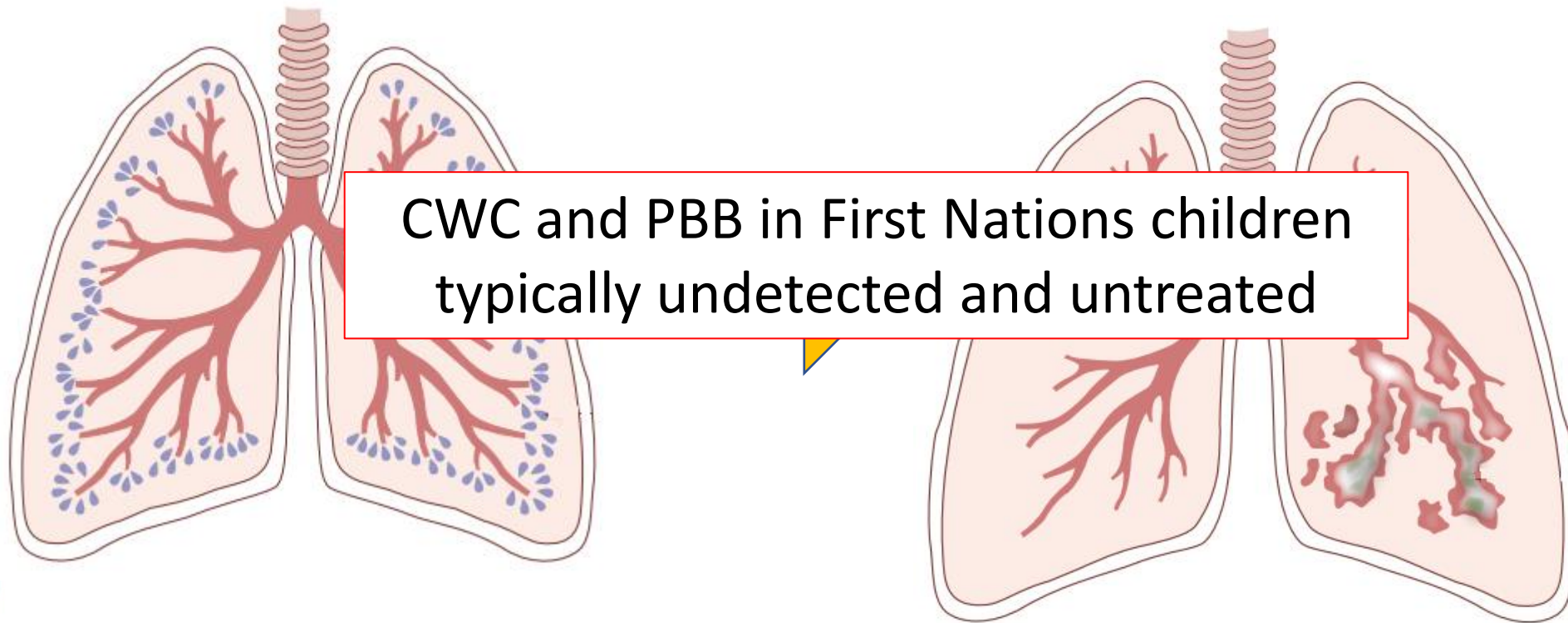
A Powerhouse Partnership

Background

- Chronic wet cough (CWC) in children:
 - often signals infection and inflammation in the lungs
 - often the only symptom of **protracted bacterial bronchitis (PBB)**



Left untreated PBB can progress to permanent lung damage in the form of bronchiectasis



CWC and PBB in First Nations children typically undetected and untreated

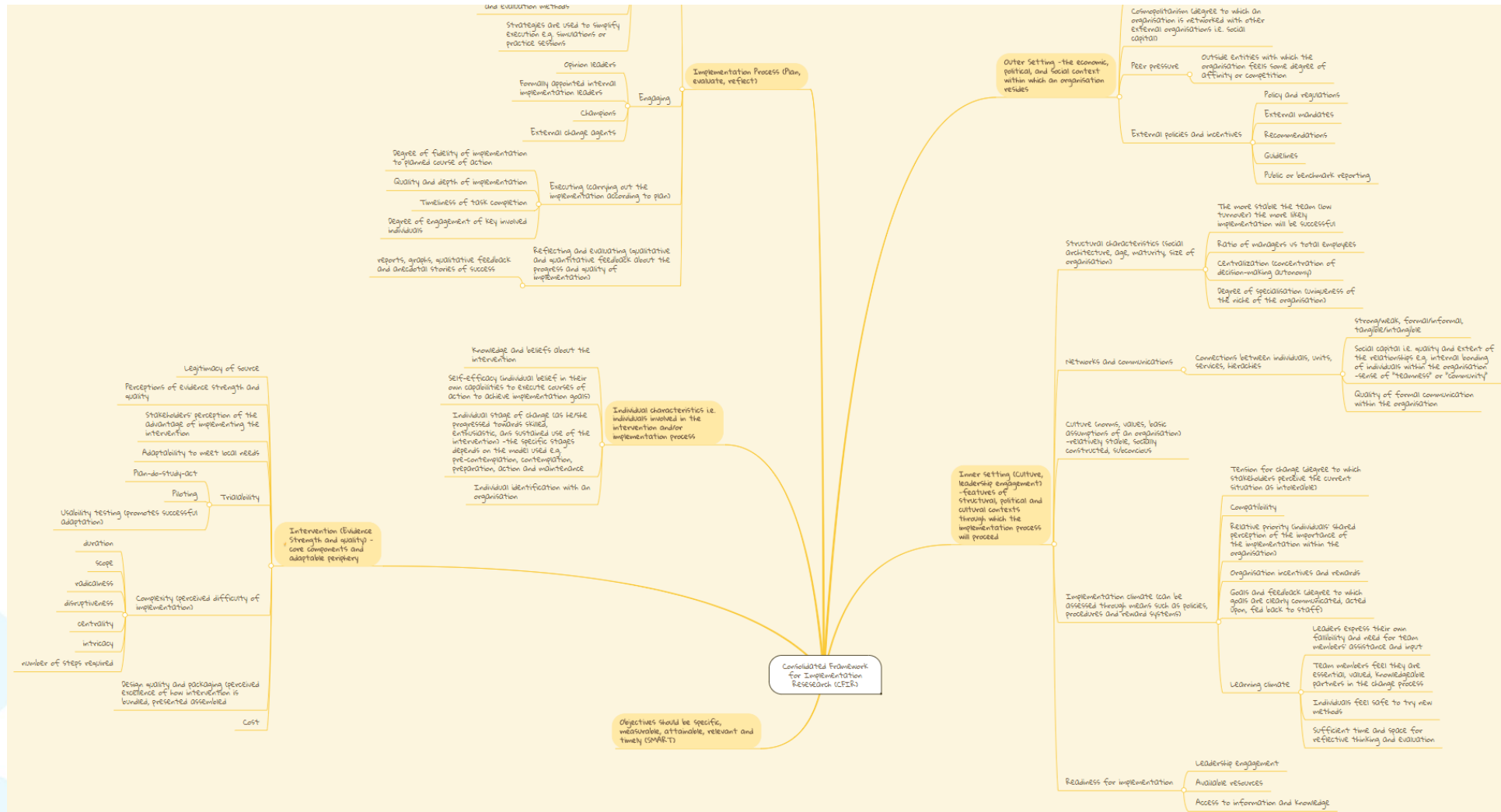
Barriers to timely management of CWC in primary care

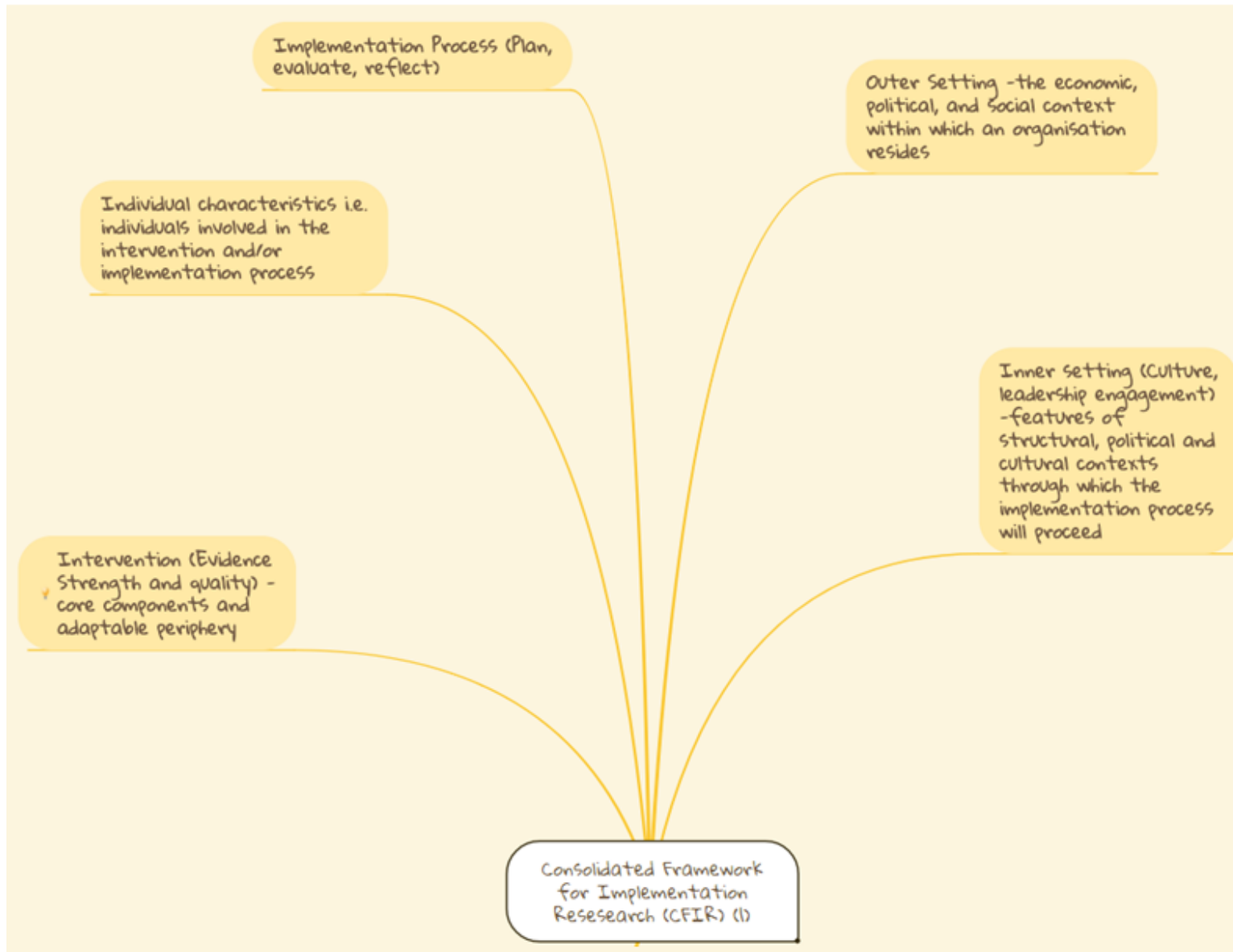
Clinicians	Knowledge and understanding of CWC
	Knowledge of guidelines
	Beliefs
	Priorities vs other demands
	Confidence in managing CWC
Health system	High staff turnover
	Lack of doctors
	Acute care clinic models
	Lack of cultural security
	Lack of continuity of care with same doctor
Parents/carers	Paucity of information provided in culturally secure way

Enablers to management of CWC

Clinician knowledge and priorities	Add questions about cough to 715 checklist
	Updated easy to follow guidelines
	Flow diagram summarising management
	Regular training on CWC
	Train AHWs, nurses, physios to screen
Health system	MDT management for Aboriginal children at risk
	Ability to follow-up same patient
	Electronic decision support
Parents/carers	Health literary information resources

Consolidated Framework for Implementation Research (CFIR)





Barriers to management of CWC can be successfully overcome with implementation science

- Implementation process results in healthier children

[Education and Clinical Practice Original Research]

CHEST

Recognition and Management of
Protracted Bacterial Bronchitis in

Check for updates

7 core components of complex implementation strategy...very resource intensive!

BACKGROUND: Chronic wet cough in children is the hallmark symptom of protracted bacterial bronchitis (PBB) and if left untreated can lead to bronchiectasis, which is prevalent in Indigenous populations. Underrecognition of chronic wet cough by parents and clinicians and underdiagnosis of PBB by clinicians are known.

RESEARCH QUESTION: We aimed to improve recognition and management of chronic wet cough in Aboriginal children using knowledge translation (KT), a methodologic approach that can be adapted for use in Indigenous contexts to facilitate effective and sustained translation of research into practice.

STUDY DESIGN AND METHODS: A mixed-methods KT study undertaken at a remote-based Aboriginal primary medical service (February 2017 to December 2019). Our KT strategy included the following: (1) culturally secure (ie, ensuring Aboriginal people are treated regarding their unique cultural needs and differences) knowledge dissemination to facilitate family health seeking for chronic wet cough in children, and (2) an implementation strategy to facilitate correct diagnosis and management of chronic wet cough and PBB by physicians.

RESULTS: Post-KT, health seeking for chronic wet cough increased by 184% (pre = eight of 630 children [1.3%], post = 23 of 636 children [3.6%]; $P = .007$; 95% CI, 0.7%-4.0%). Physician proficiency in management of chronic wet cough improved significantly as reflected by

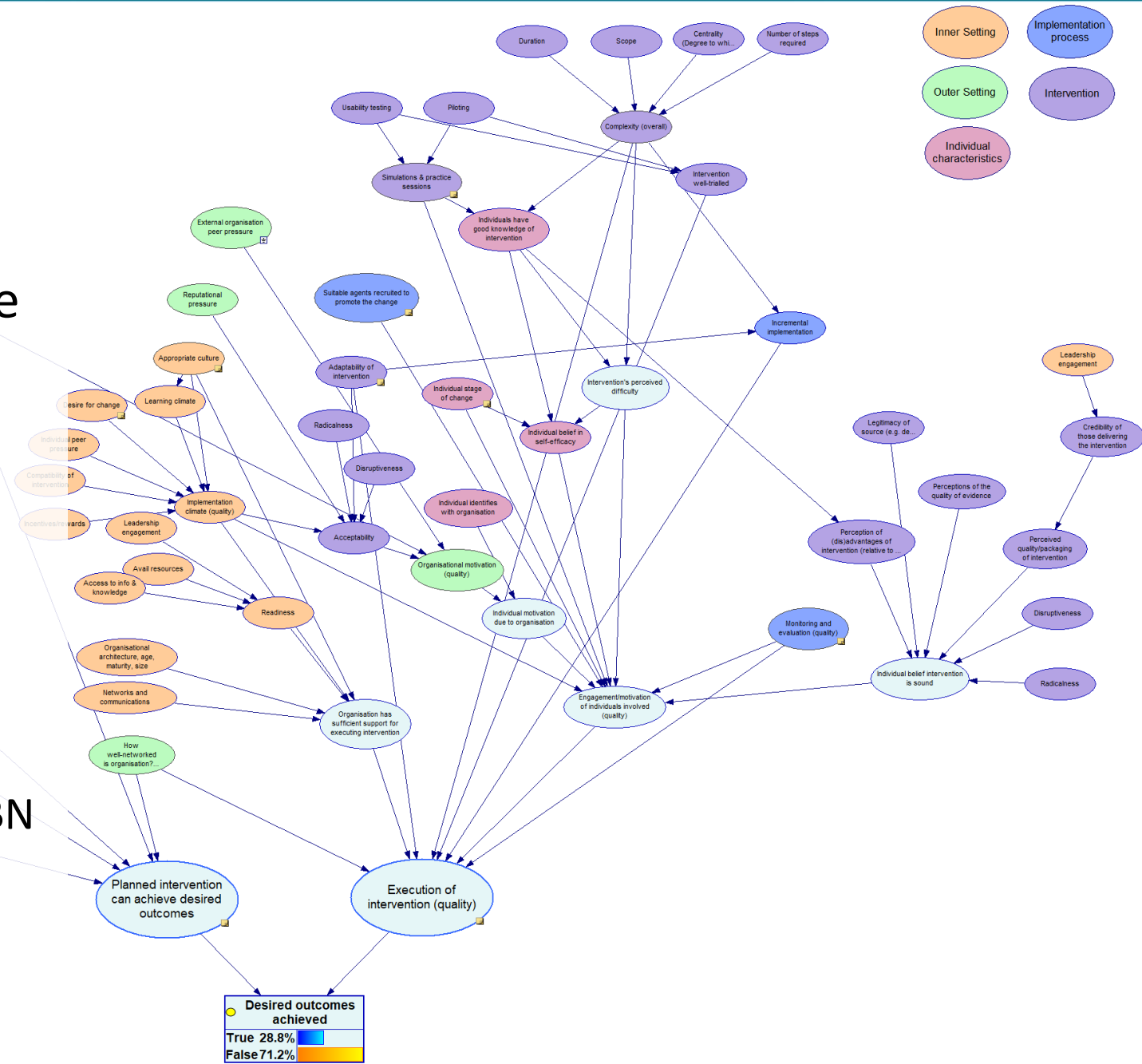
To make better use of resources we need to ask some questions

1. How do these barriers and enablers affect outcomes?
 - This will tell us where intervention can be useful
2. How much do these barriers and enablers affect outcomes?
 - Need to estimate size of causal effect not size of correlation
3. How likely is a barrier or enabler to affect an outcome in specific settings?
 - Some locations may benefit more from a different allocation of implementation resources over barriers and enablers

Causal Bayesian networks can help answer these questions

Initial approach

- Developed a BN encapsulating the CFIR
- General model for assessing any organisational implementation
 - High level/abstract implementation concepts
- Shifted focus to a bespoke model for this implementation
 - Future work will look at a robust method for moving from the CFIR-BN to (when needed) a bespoke BN



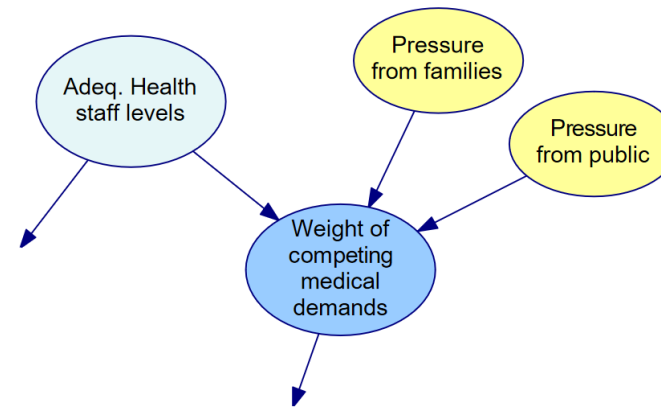
APPLE-BN: Practitioner model

Builds naturally upon earlier implementation studies for the clinic

Adds:

- Causal structure (the links)
- Strength of influence

(both elicited from experts)



Validating in multiple ways (experts, stakeholder surveys, outcomes)

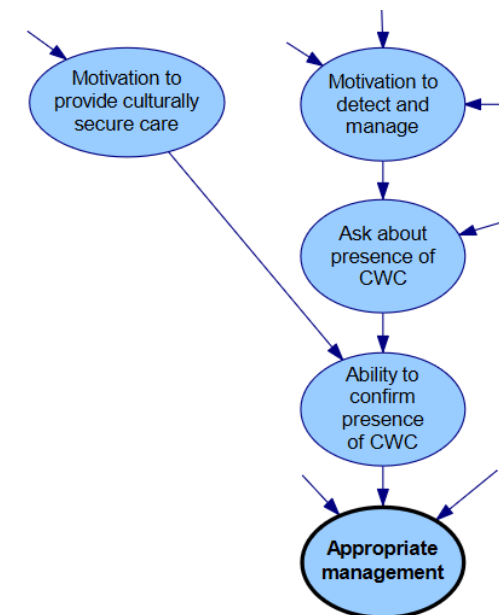
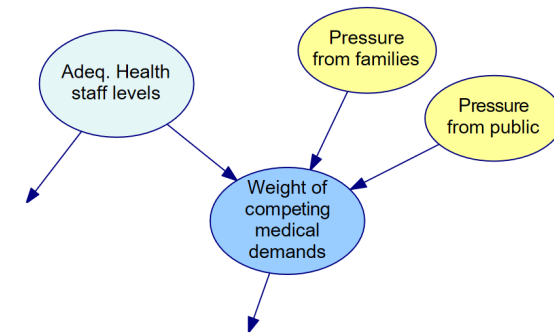
Selecting factors for the BN

Start with barriers and enablers

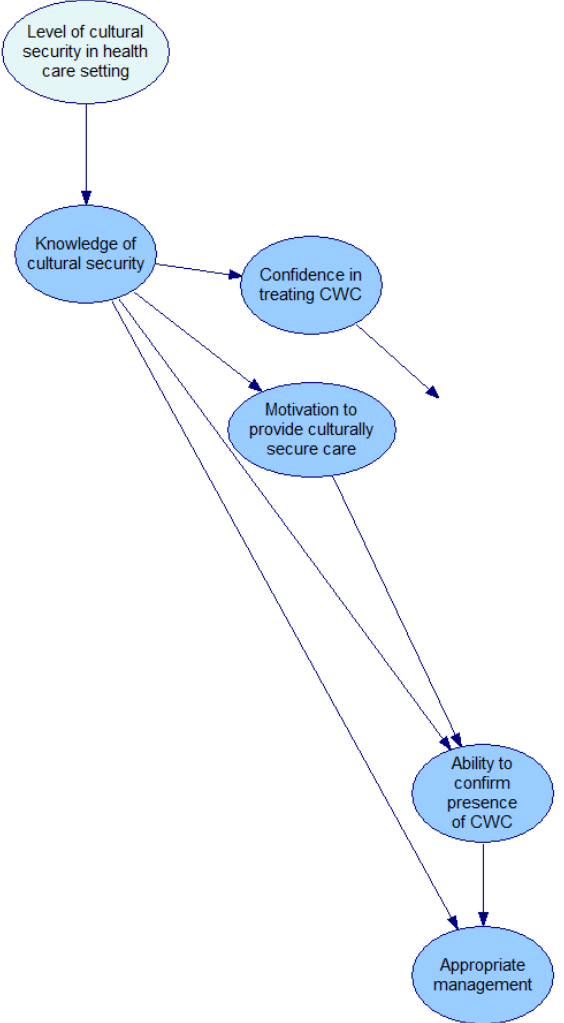
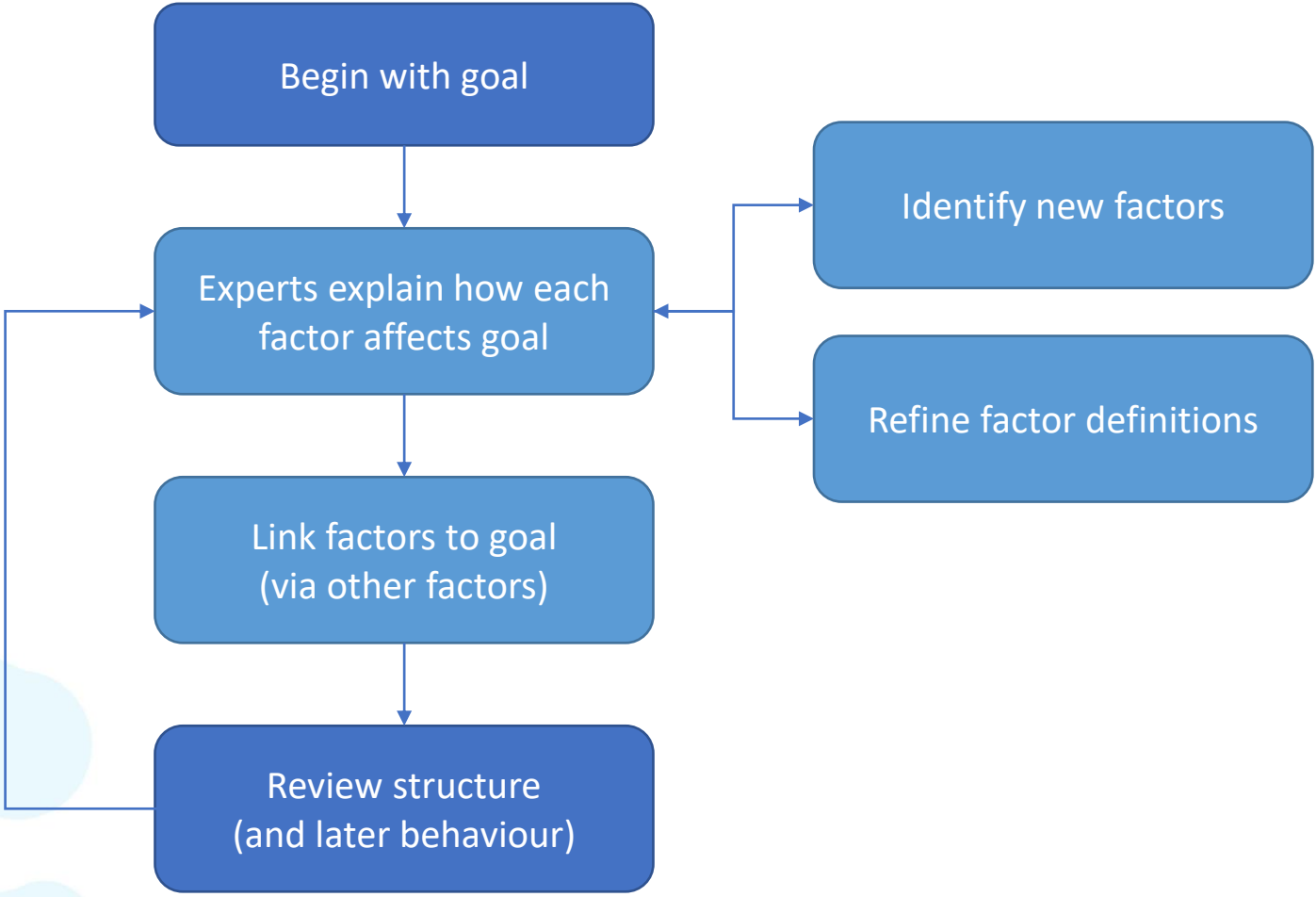
- Primarily those within the clinic
- Some external, where they directly affect clinical factors

Also include:

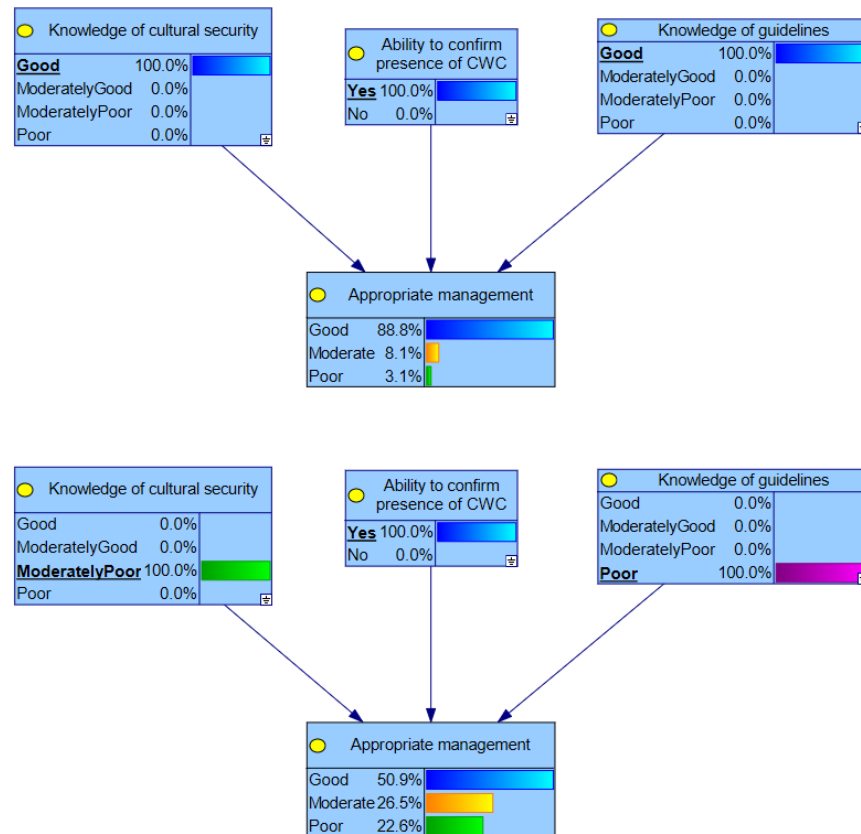
- Goal(s)
- Mediating factors not yet identified
- Additional factors from the CFIR



Determining the causal structure



Determining strength of influence (parameterisation)



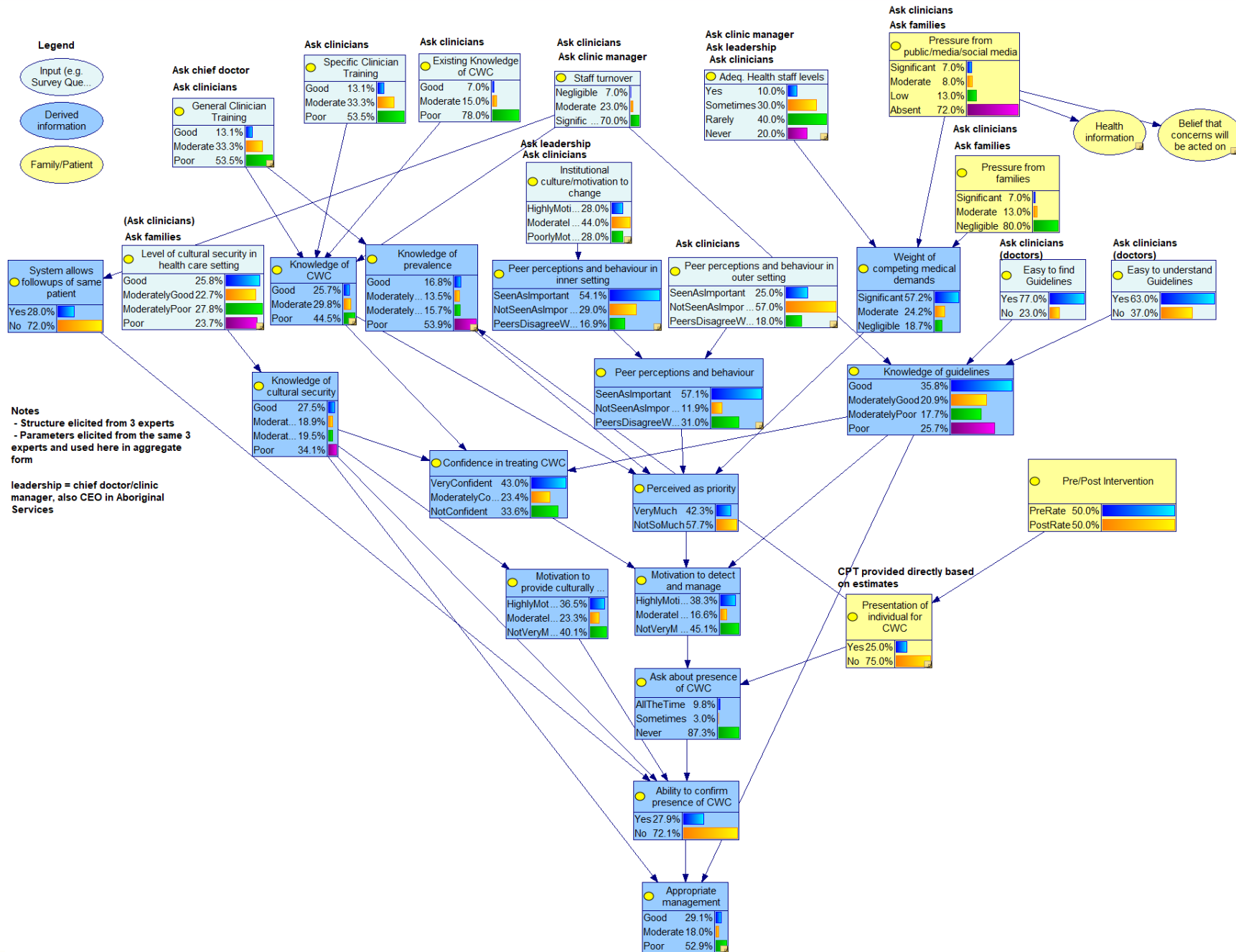
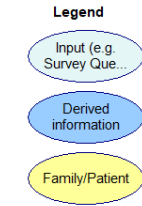
Used InterBeta tool (Bayesian Intelligence)

Elicited from experts:

- Best/worst case for each factor
- Strength of link

(Other combinations interpolated)

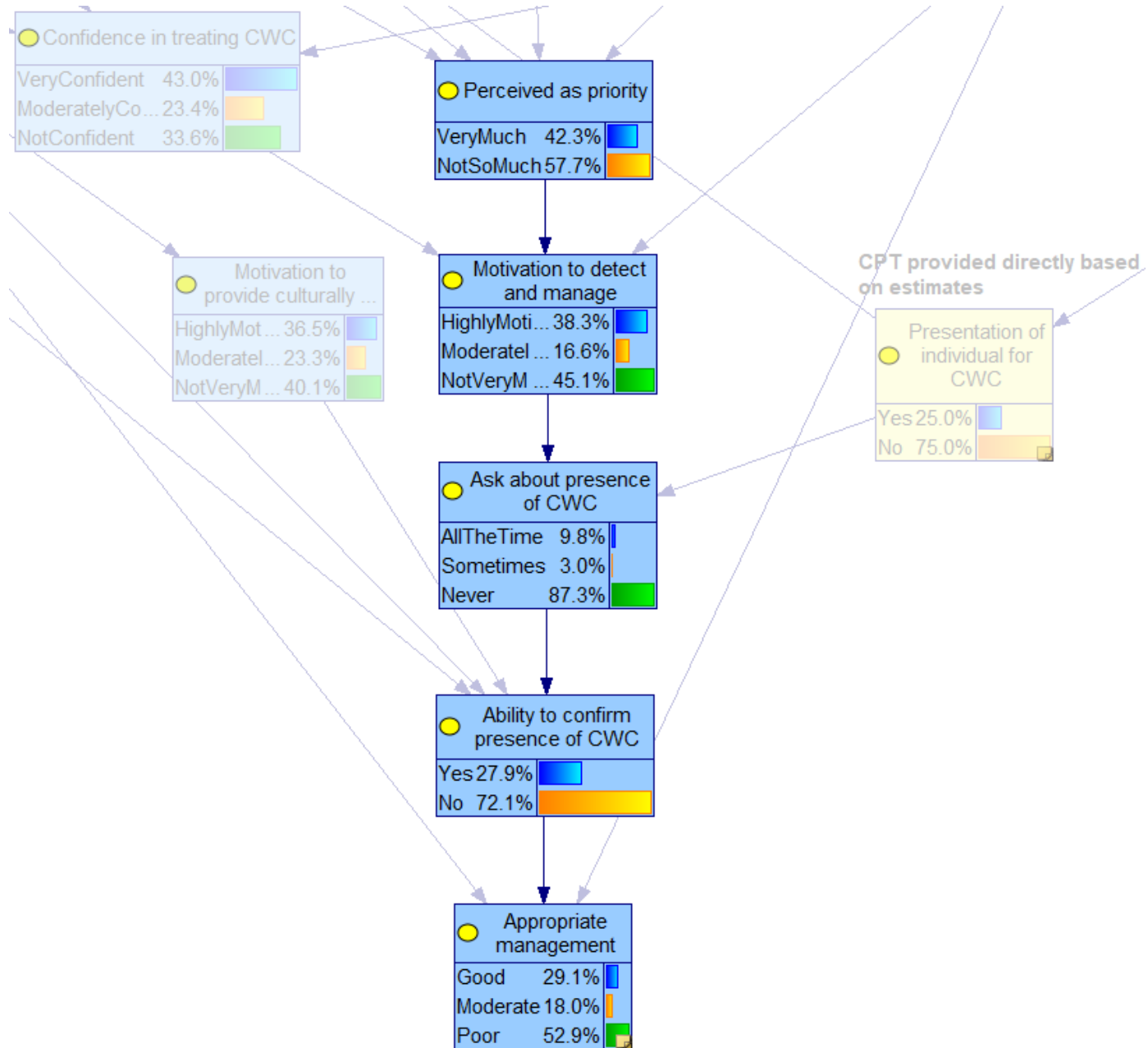
Elicitation followed Delphi process

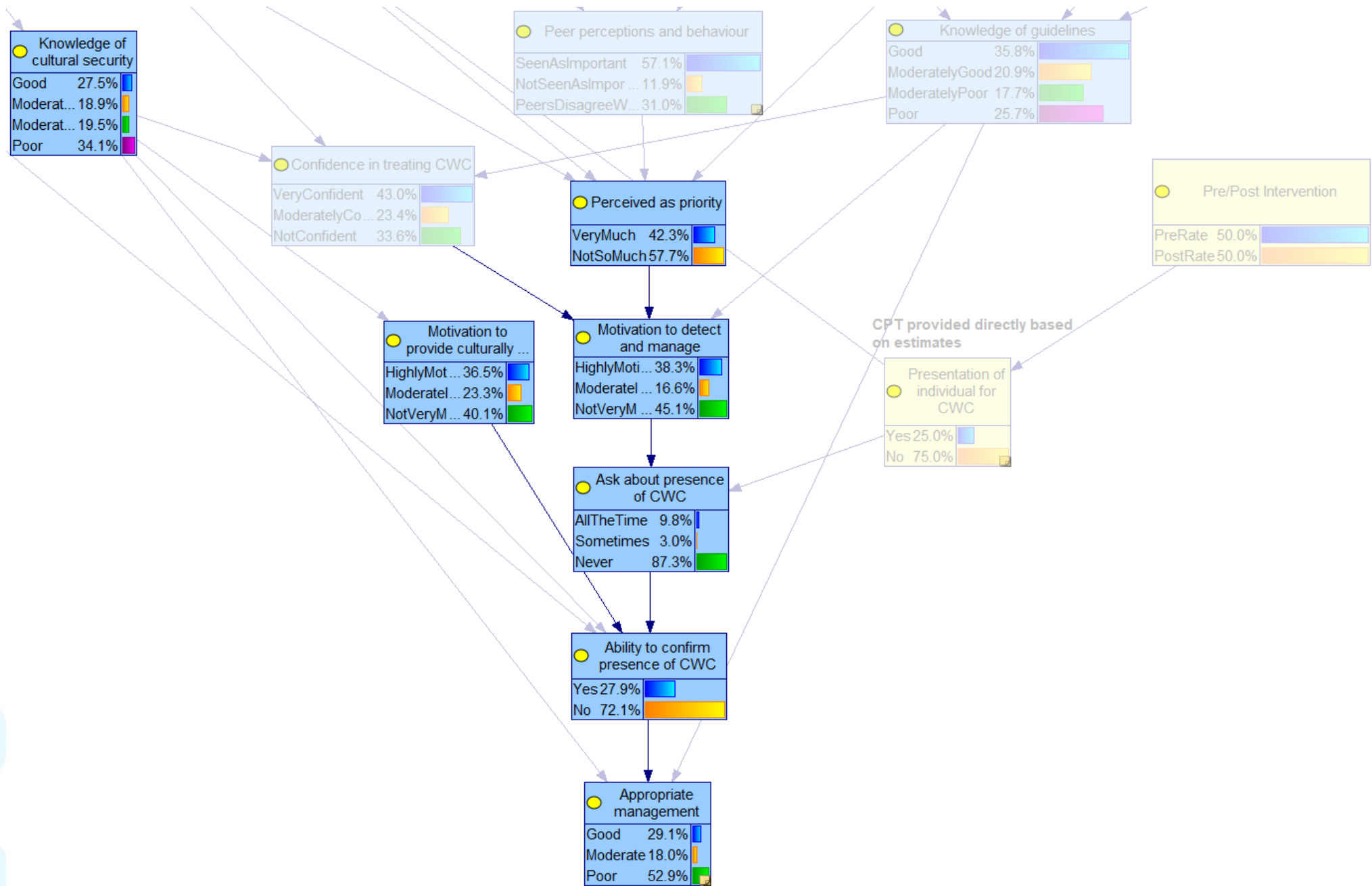


Notes

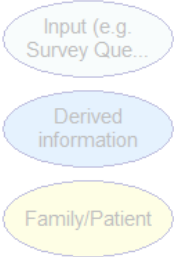
- Structure elicited from 3 experts
- Parameters elicited from the same 3 experts and used here in aggregate form

leadership = chief doctor/clinic manager, also CEO in Aboriginal Services



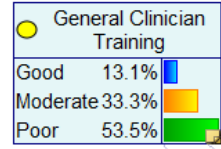


Legend

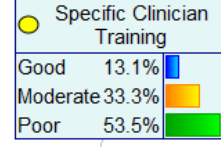


Ask chief doctor

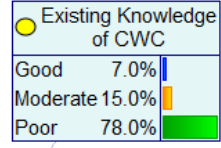
Ask clinicians



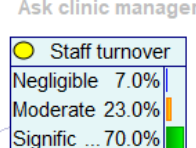
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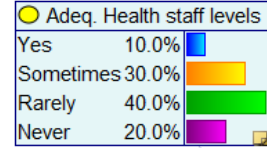
Ask clinicians



Ask clinicians

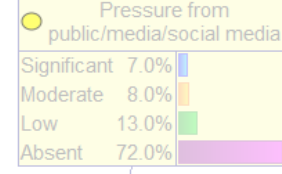


Ask clinic manager
Ask leadership
Ask clinicians



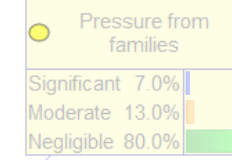
Ask clinicians

Ask families



Ask clinicians

Ask families

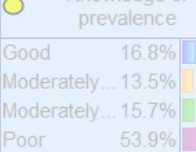
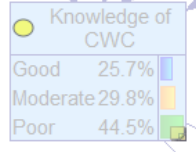
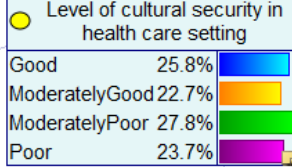


Health information

Belief that concerns will be acted on

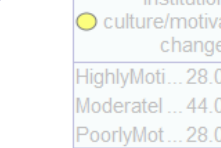
(Ask clinicians)

Ask families

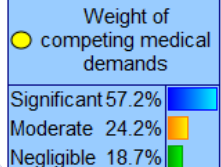
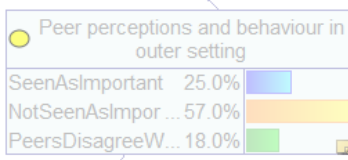


Ask leadership

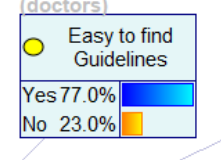
Ask clinicians



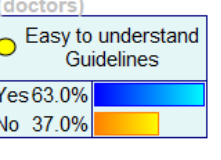
Ask clinicians



Ask clinicians (doctors)

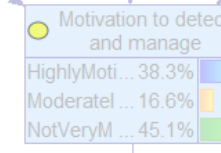
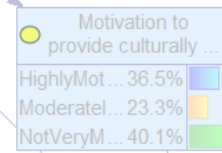
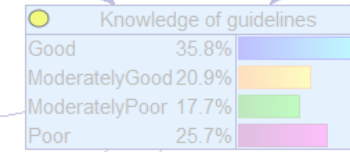
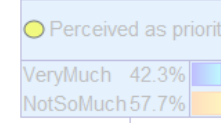
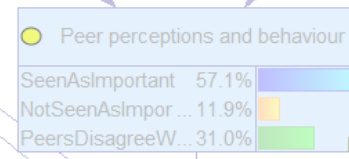
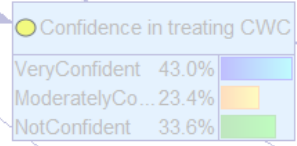
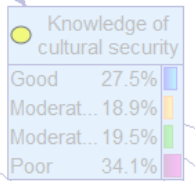


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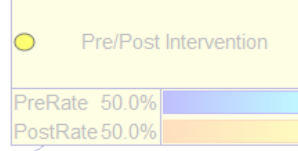
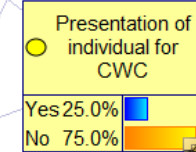


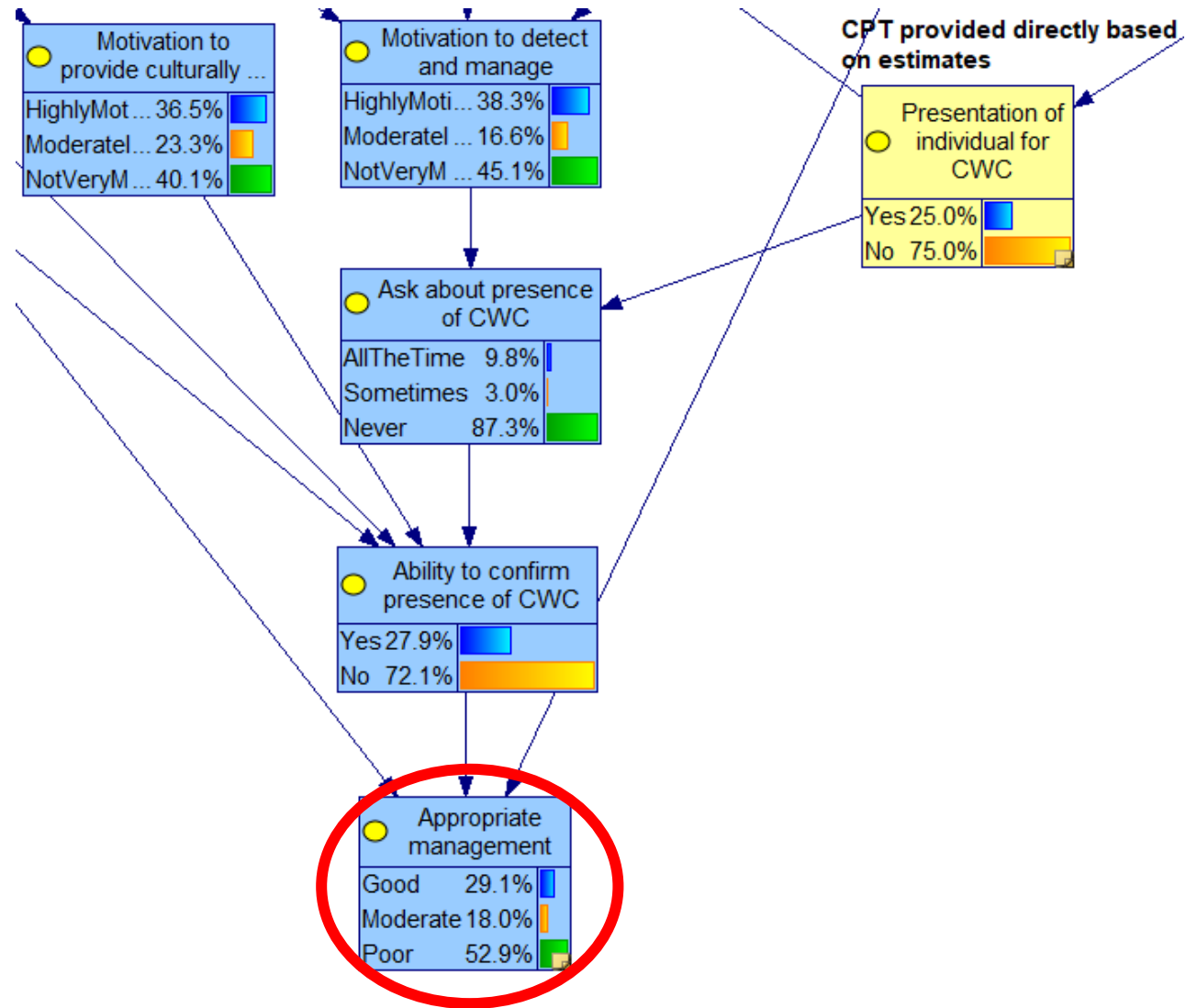
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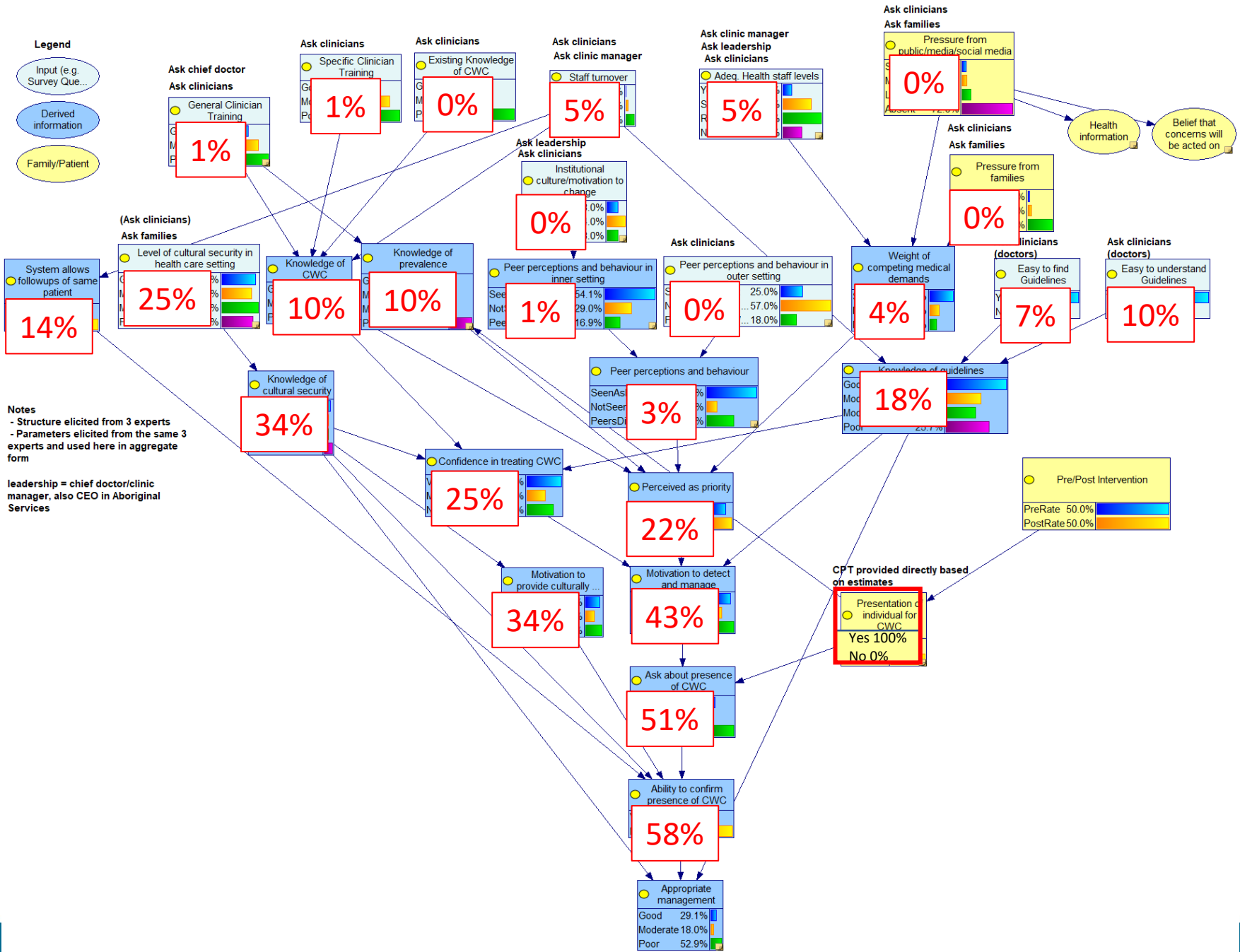
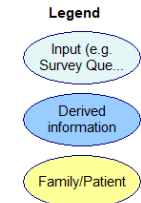
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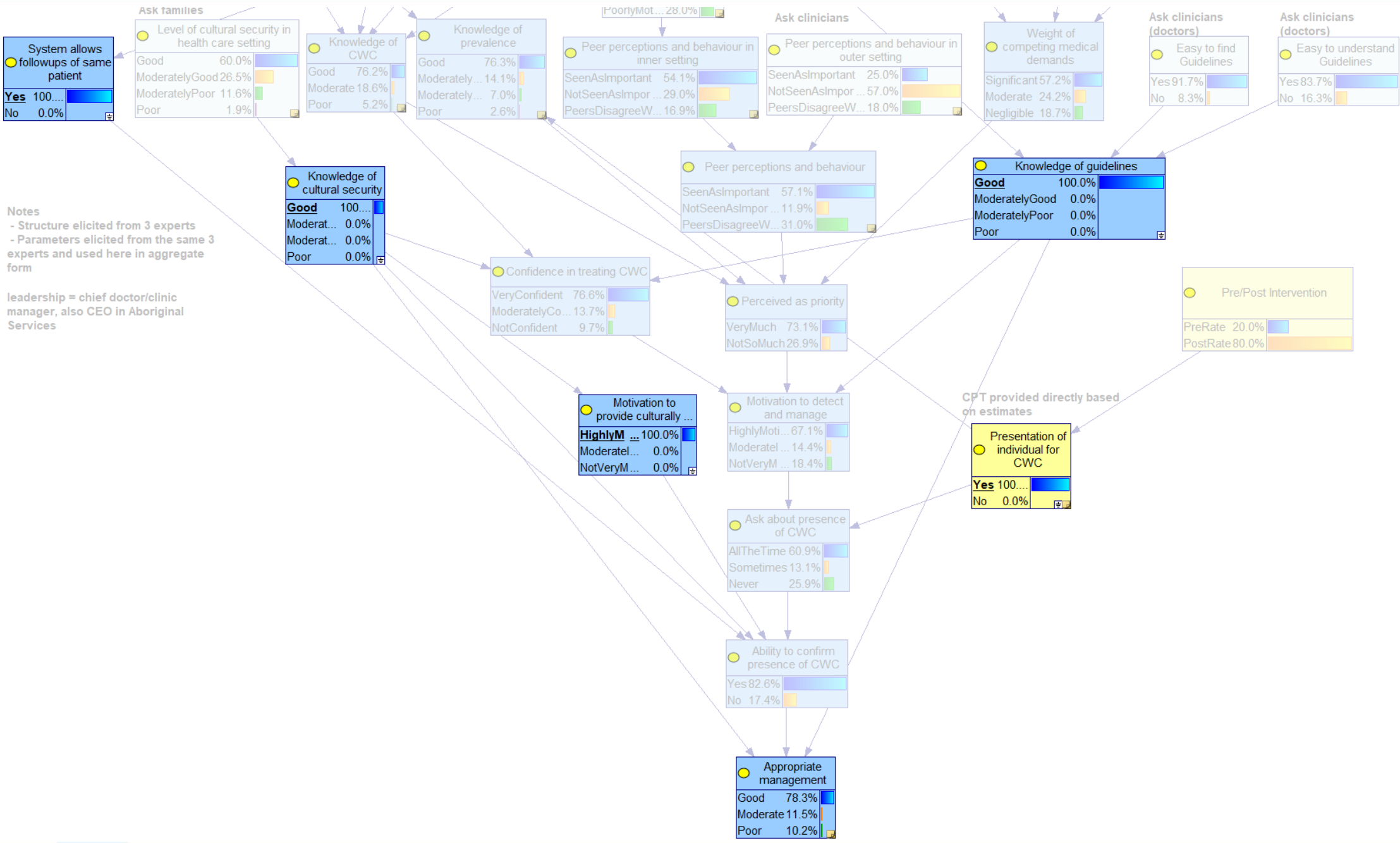


CPT provided directly based on estimates



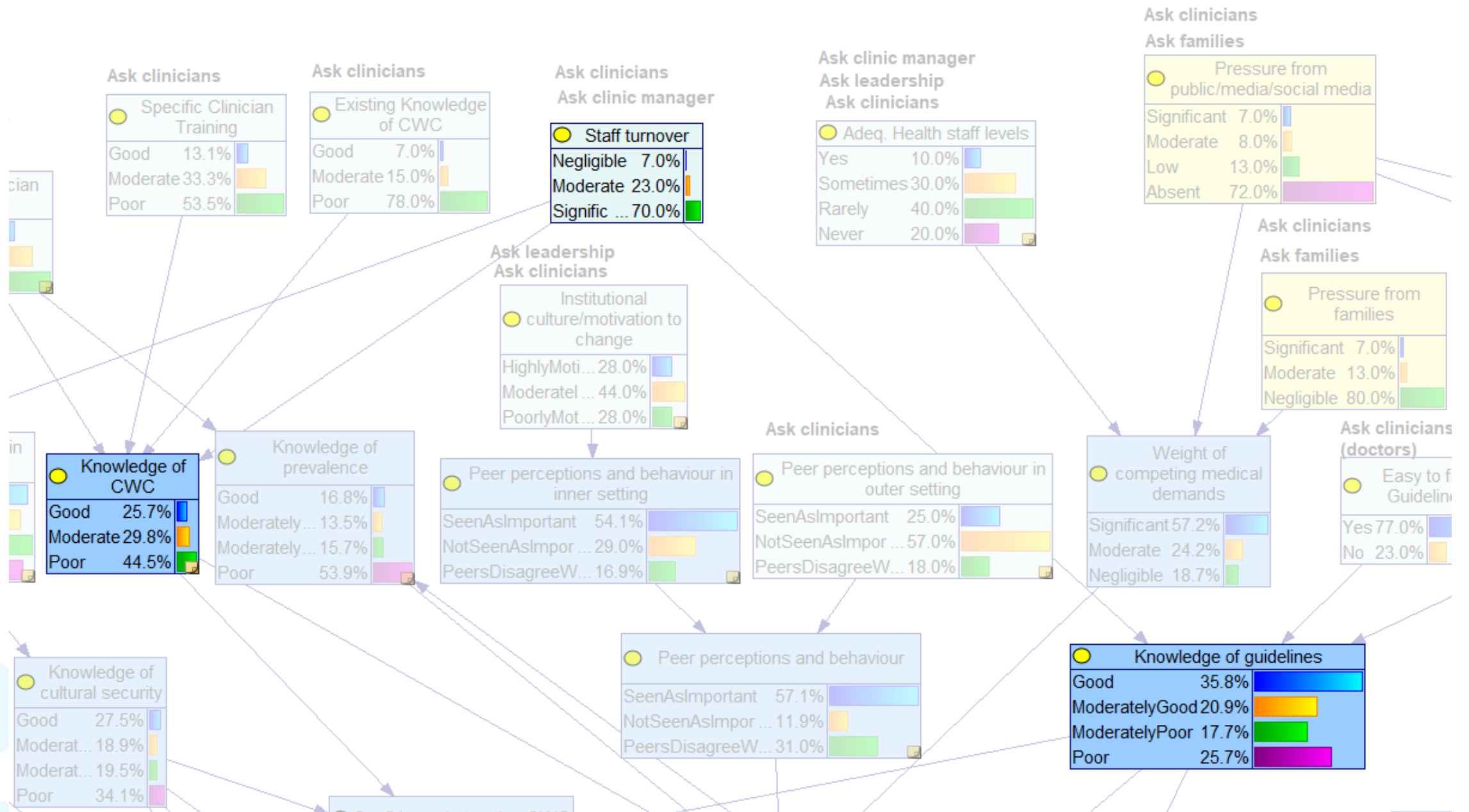






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Validation

Expert validation

(First round completed)

- Model structure reviews
- Model behaviour reviews
- Initial calibration

Stakeholder validation

(In progress)

- Survey-based
- Questions derived from model factors
- Tests model against patterns in the responses
- Survey can also be used to *assess implementation*

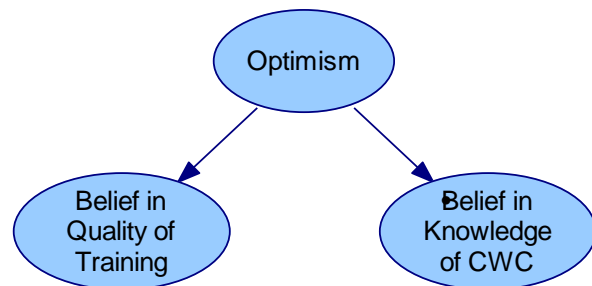
Outcome validation

(Planned)

- Real implementations
- Check model predictions
- Compare to outcomes
 - Quantitative
 - Qualitative

Survey validation

- Surveys issued to practitioners, nurses, aboriginal health workers, managers, and others
- Each BN node has its own question
 - Check correlations in responses support dependencies in expert model
 - A few questions explicitly ask about link strength
- Parameterised structure with responses, for comparison
- Issues:
 - Very small sample sizes (used “reversed” NB to parameterise CPTs in comparison BN)
 - May find correlations due to differences in people’s dispositions, not in the questions being asked



Q33) In general, how much do you expect the weight of other competing medical demands in your clinic will prevent addressing chronic wet cough in children after implementation of the strategy (please see link to description of implementation strategy below)?

Imple Part 2. Your Expectations Following Implementation

[link] The implementation aims to optimise the management of children with chronic wet cough at the institution you work in. The **implementation strategy** might include aspects such as:

- a) N - Training for staff
- b) A - Feedback to staff about their management of chronic wet cough
- c) N - Ensuring that relevant clinical practice guidelines are easily accessible
- d) V - Facilitating processes (if required) to allow follow-up of a patient by the same clinician

For the following questions, please provide an assessment of where you expect things to stand after the implementation process (please see link to description of implementation strategy below).

Q34) V your below Implementation strategy:
[link to PDF for participant download]

[link] Q30) On the whole, how good do you estimate knowledge of chronic wet cough will be within the clinic after implementation of the strategy (please see link to description of implementation strategy below), particularly amongst clinicians?

- a) P
- b) N
- c) S Implementation strategy:
- d) S [link to PDF for participant download]

Q35) V strat a) Very limited knowledge
b) Limited knowledge
Imple c) Average knowledge
[link] d) Good knowledge

a) V Q31) To what extent do you believe your clinic’s general training will improve knowledge of chronic wet cough and its prevalence? General training here refers to any regular training sessions provided by the clinic.

- b) S
- c) N
- d) G

a) Negligible
b) A little

Q36) V the c below c) Moderately
d) Very much

Imple Q32) Do you believe that staffing levels at your clinic will affect the weight of competing medical demands after implementation of the strategy (please see link to description of implementation strategy below)?

[link] Implementation strategy:
[link to PDF for participant download]

- a) V
- b) S
- c) N
- d) G

- a) Rarely
- b) Some of the time
- c) Much of the time
- d) Always

Early analysis

Very early analysis – still much more to do

MI of expert model
vs
MI in data

Node	Expert Model MI	Survey Based MI Using Model Structure	Raw Survey MI
Appropriate management	1.449	1.478	1.986
Ability to confirm presence of CWC	0.273	0.286	1.411
Knowledge of cultural security	0.089	0.194	1.007
Motivation to provide culturally secure care	0.062	0.022	1.082
Level of cultural security in health care setting	0.036	0.025	0.994
Ask about presence of CWC	0.026	0.084	1.169
Knowledge of guidelines	0.018	0.168	0.961
Presentation of individual for CWC	0.010	0.004	0.710
System allows followups of same patient	0.004	0.032	1.007
Confidence in treating CWC	0.003	0.033	0.964
Easy to understand Guidelines	0.003	0.012	1.023
Easy to find Guidelines	0.002	0.013	0.897
Staff turnover	0.001	0.007	0.746
Perceived as priority	0.001	0.002	0.914
General Clinician Training	0.000	0.000	0.808
Specific Clinician Training	0.000	0.000	0.704
Adeq. Health staff levels	0.000	0.000	0.647
Institutional culture/motivation to change	0.000	0.000	1.131

Linear correlation on MIs of 0.69
Rank correlation on MIs of 0.57 (expert model vs raw data)

Acknowledgements

- Steven Mascaro –Bayesian Intelligence
- BREATH Team
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