Knowledge Laboratory of the Early Life Course

COMPASS
RESEARCH CENTRE

FACULTY OF ARTS
THE UNIVERSITY OF AUCKLAND

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Outline

- Background: **MEL-C project** (2009-2013)
    - What, why, how
    - Insights
    - Observations

- Knowledge Lab project (2013-2016)
    - Plan
    - Progress
    - Issues
    - Next Steps

Funded by MBIE

MEL-C
- What? Why? How?

1. Goals … what are we trying to do?

- Develop a software application as a decision-support tool for policy-making

2. Rationale … why are we doing it?

- To improve policymakers' ability to respond to issues concerning children and young people

3. Means … how are we doing it?

- By building a computer simulation model with data from existing longitudinal studies to quantify the underlying determinants of progress in the early life course

MEL-C
- Conceptual framework

Structural level

Child characteristics
- *gender*
- *ethnicity*

Parental characteristics
- *age at birth of child*
- *ethnicity*
- *education level*

Socio-economic position
- *SES at birth of child*

Perinatal and early life factors
- *birth weight*
- *multiple birth*
- *gestational age*
- *birth order*
- *smoking during pregnancy*
- *drinking during pregnancy*
- *breastfeeding*

Intermediate level

Family characteristics / employment
- *single-parent status*
- *number of children*
- *number of household members*
- *employment status*
- *welfare dependent*

Psychosocial factors / housing
- *change of parents*
- *change of residence*
- *parental smoking*
- *accommodation type*
- *housing tenure (owned/rented)*
- *overcrowding*
- *maternal responsiveness*
- *maternal punitiveness*
- *early childhood education*

Outcome

Health service use
- *GP visits*
- *hospital admissions*
- *hospital outpatient attendances*

Education
- *Reading ability*

Social/Justice
- *Conduct problems*

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MEL-C
How? *Microsimulation*

- ▪ <u>We start with a sample of individuals</u>
  - ◦ Synthetic (derived from Census 2006), n=5,000
- ▪ <u>We derive statistical rules to create a 'virtual cohort'</u> through to age 13
  - ◦ Analyse combined data from 3 longitudinal studies (Christchurch HDS, Dunedin MHDS, Pacific Islands FS)
  - ◦ Produces a sample of children with typical biographies over the life-course, allowing for variation
- ▪ <u>We then simulate what might happen if policy were to change, by altering parameters</u>
  - ◦ Using software application

MEL-C
- Insights

- Able to model early life-course very well (against external benchmarks)

- Changing (single) factors in children's lives often had weak effects on child outcomes

  - Is that just the reality of policy impact?

  - Does it indicate that estimates based on observational analysis do not reflect causal effect of interventions?

- Policy relevance increased by increasing range of outcomes and factors

- Childhood factors have impacts into adulthood

MEL-C
- Observations

- There are many well-established estimates for factors that impact the lives of children, but these exist in isolation; micro-simulation offers a way to bring these together.
  - John Lynch, Professor of Public Health, University of Adelaide

- 'Best' estimates are thought to be derived from systematic reviews/meta analyses, but it is difficult to test their validity.
  - David Gough, Professor of Evidence Informed Policy and Practice, Institute of Education

New Zealand

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  - What, why, how
  - Insights
  - Observations
- **<u>Knowledge Lab project</u>**
  - What, why, how – extension
  - Plan
  - Progress:
    - 1. End-users, 2. Literature search, 3. Software selection
  - Issues
  - Next Steps:
    - 1. Model building, 2. Scenario testing & deployment, 3. Software

Knowledge Lab
- What? Why? How?

1. Goals … what are we trying to do?

- Develop a software application as a decision-support tool for policy-making

2. Rationale … why are we doing it?

- To improve policymakers' ability to respond to issues concerning children and young people

3. Means … how are we doing it?

- By building a computer simulation model with data from the **international evidence base** to quantify the underlying determinants of progress in the early life course

Knowledge Lab - Plan

- Identify key determinants of child and adolescent outcomes
- Integrate estimates from systematic reviews/meta analyses into working model of early life course
    - Developed from MEL-C; extended in breadth (more determinants and outcomes), and length (to age 21)
- Use as knowledge laboratory (microsimulation)
    - Test the validity of 'best' estimates
    - Test policy scenarios using validated model
    - Deploy in policy agencies

Outline

■ Background: MEL-C project

 ◆ What, why, how

 ◆ Insights

 ◆ Observations

■ **Knowledge Lab project**

 ◆ What, why, how – extension

 ◆ Plan

 ◆ Progress:

   1. End-users, 2. Literature search, 3. Software selection

 ◆ Issues

 ◆ Next Steps:

   1. Model building, 2. Scenario testing & deployment, 3. Software

Knowledge Lab – Progress: 1. End User Advisory Group

- ## End User Advisory Group (EUAG)
    - Model is (ultimately) for policy makers, so we want to involve them in its development
    - Precedent from MEL-C
        - 4 Government Ministries – Health, Education, Social Development, Justice
        - Regular meetings to discuss progress & next steps
        - Deployment of tool with these ministries
    - Augmented for Knowledge Lab
        - 4 additional agencies: Te Puni Kōkiri, SUPERU, Children's Commission, Pacific Islands Families Study
        - Same format

Knowledge Lab – Progress: 2. Literature search

- **Determine search strategy**
  - ARTICLE TYPE: Systematic Review <u>OR</u> Meta Analysis
  - AGES: Birth-24
- **Databases: PubMed, Cochrane Reviews, ERIC, PsycInfo, etc**
- **Search results: 10,000 papers found**
- **Determine important factors - identify estimates that can be used from the literature**
- **Input from end-users on relevance (via EUAG)**

Knowledge Lab – Progress: 2. Literature search

Search	Search terms	Result
Alcohol	"alcohol" or "alcoholism" or "drinking"	726
Ambulatory sensitive hospitalizations	"ambulatory sensitive hospitalizations" or "avoidable hospitalizations"	0
Asthma	"asthma"	552
Birth weight/ gestational age	"birth weight" or "gestational age"	848
Books in home	"books" or "literacy"	202
Breastfeeding	"breastfeeding"	285
Child health groups	"health group"	51
Drug abuse	"drug abuse" or "drug dependence" or "cannabis" or "methamphetamine" or "cocaine" or "heroin"	76
Early childhood education	"early childhood education"	39
Early parenting	"teen parents" or "teen pregnancy" or "early pregnancy"	21

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Knowledge Lab – Progress: 2. Literature search

| Search	Search terms	Result
Mental health		
ADHD	"attention deficit"	188
Anxiety	"anxiety" or "anxious" or "panic" or "phobia" or "agoraphobia" or "obsessive compulsive disorder"	505
Conduct disorder	"conduct disorder" or "conduct problem" or "antisocial"	66
Depression	"depression" or "depressive"	371
Eating	"eating disorder" or "bulimia" or "anorexia"	42
Psychosis	"manic" or "mania" or "bipolar" or "psychosis" or "schizophrenia" or "schizophreniform" or "schizotypy"	181
Nutrition	"nutrition"	393
Obesity	"obsesity"	370
Otitis media	"otitis media" or "hearing"	264
Parental involvement in schools	"parent" & "schools" & "involvement"; yielded some references but not along lines hoped for	7

Knowledge Lab – Progress: 2. Literature search

Search	Search terms	Result
Physical activity	"physical activity" or "exercise"	298
Respiratory health	"respiratory"	423
School type (single-sex/co-ed)	school & (single-sex or co-educational)	0
Smoking	"smoking" or "tobacco"	127
Socioeconomic measures	"income" or socioeconomic" or "deprivation"	351
Suicide	"self harm" or "suicide"	41
Teacher quality	(teacher or teaching) & quality	5
Transfer payments	"transfer payments"; a few different combinations	0
Transitions to employment	"employment"	60
Violence in families	"violence"	51
Welfare dependence	"welfare" or "poverty"	116
Total		**9852**

Initial organisation of concepts

= Already in MELC   = Outcome variable   = Predictor variable
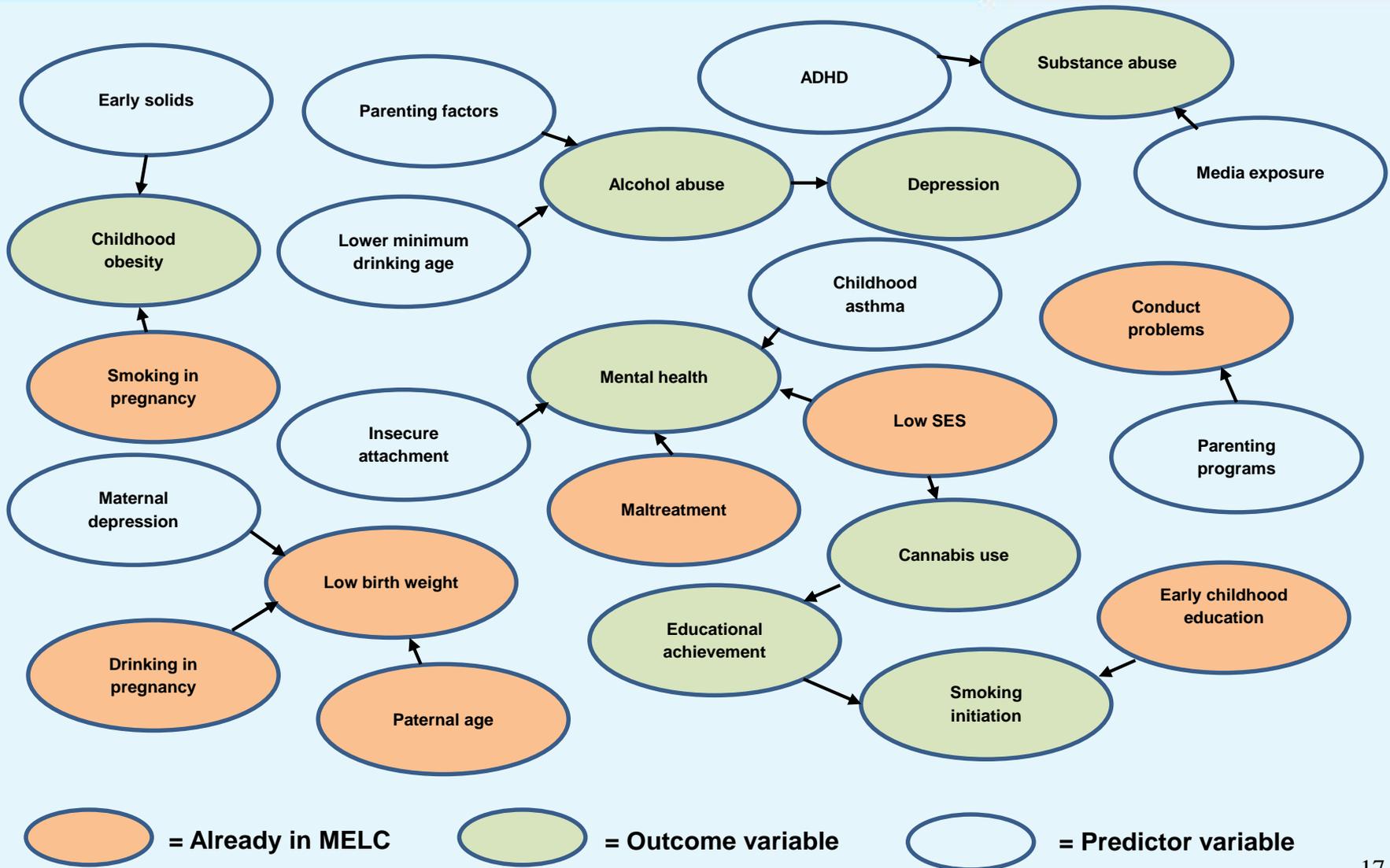
Important factors
(in consultation with EUAG)

Focus on 6 factors

Alcohol and drug use	**Ethnicity**	Justice contacts	Physical activity
Ambulatory Sensitive Hospitalisations	Family transitions – formation/disintegration	Lead Maternity Carer enrolment	School type (single sex/co-ed)
Asthma/respiratory health	Food in schools	Maltreatment	Smoking
Birth weight/gestational age	Health visits	**Mental Health**	**Poverty**
Books in home	Home visiting	Nutrition	Suicide
Breastfeeding	Housing quality	**Obesity**	Teaching quality
Conduct disorder	Immunisation	Otitis Media	Transfer payments
Early Childcare education (amount, quality, type)	Injuries	Parental and intergenerational welfare dependence	Transition to employment
Early parenting	Involvement in Child Health groups (e.g., plunket)	Parental involvement in schools	**Violence in families**
Education		Parental mental health	

Finding literature for Māori

❑ Check international estimates against those found for Māori (work by Lucy Cowie):

- Catalogue all publications on health (80%), social, behavioural, and educational outcomes for Māori children & youth

- Health (539 papers identified)

  - most papers relate to prevalence
  - Very few papers (10%) found which give estimates of the effect of risk factors on outcomes for Māori
  - Suggests a large gap in the literature

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Catalogue of Māori research: Health – top 10 ICD chapters

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ICD-10 Chapter	Subject	Overall	Prevalence	Risk Factors
21. Factors influencing health status and contact with health services	Alcohol and drugs	18	12	3
	Immunisation	9	9	1
	Primary Healthcare Use and Access	20	17	1
	Smoking	41	30	14
	Other	11	9	2
		(99)	(77)	(21)
4. Endocrine, nutritional and metabolic diseases	Diabetes	19	17	1
	Diet, Nutrition, Weight and Physical Activity, Vitamin D, Cystic Fibrosis	49	40	5
		(68)	(57)	(6)
10. Diseases of the respiratory system	Asthma	24	22	3
	Other including pneumococcal, pneumonia, bronchiectasis and influenza	22	20	1
		(46)	(42)	(4)
1.Certain Infectious and Parasitic Diseases	Whooping cough, TB, Staphylococcus, Streptococcal, Hepatitis, H pylori, Measles	32	30	3
19. Injury, poisoning and certain other consequences of external causes	Other including injury	32	29	2
5. Mental and behavioural disorders	Mental Health	19	19	
	Antisocial	8	7	1
	Others including snoring, ADHD, amnesia	4	4	
		(31)	(30)	(1)
20. External causes of morbidity and mortality	Mortality	10	10	
	Suicide and Self Harm	14	12	
	Other including violence	6	3	
		(30)	(25)	
11. Diseases of the digestive system	Oral health	23	20	2
	Other	6	6	
		(29)	(26)	(2)
9. Diseases of the circulatory system	Rheumatic Fever and Heart Disease	16	15	
	Other including cardiovascular disease and blood pressure	12	11	
		(28)	(26)	
22. Codes for special purposes	Health Status	8	7	
	Health Status Overview Paper	11	11	2
	Other	6	5	
		(25)	(23)	(2)

Catalogue of Māori research: Health – bottom 12 ICD chapters

ICD-10 Chapter	Subject	Overall	Prevalence	Risk Factors
18. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	Sudden Infant Death Syndrome	13	11	2
	Other including psychological testing	7 (20)	4 (15)	1 (3)
15. Pregnancy, childbirth and the puerperium	Contraception	5	4	2
	Pregnancy	7	5	
	Other	7 (17)	6 (15)	(2)
2. Neoplasms	Leukaemia, HPV, others	15	12	3
13. Diseases of the musculoskeletal system and connective tissue	Other including Gout and Bones	12	11	1
6. Diseases of the nervous system	Meningococcal and others including orbital infection, meningitis and growth hormone treatments	11	10	1
12. Diseases of the skin and subcutaneous tissue	Skin Infection and Acne	9	9	1
8. Diseases of the ear and mastoid process	Hearing	9	8	2
14. Diseases of the genitourinary system	Other including kidney disease	8	7	
3. Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Anaemia and Iron Deficiency	7	5	3
16. Certain conditions originating in the perinatal period	Birthweight and Others	5	5	
17. Congenital malformations, deformations and chromosomal abnormalities	Club Foot and Spina Bifida	3	3	1
7. Diseases of the eye and adnexa	Sight	3	3	

New Zealand

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Knowledge Lab - Progress: 3. Software selection

We need software that is:

- **Flexible**
  - To develop existing models further
  - To handle whatever microsimulation models we undertake in the future
- **Web deployable?**
  - To allow for a greater number of end-users
  - To allow for the model to be updated seamlessly
- **Open source?**

Two candidates ... more later

Knowledge Lab
- Issues

- Estimates from international studies so relevance to NZ unclear …but can be tested

- Very few have looked specifically at Māori and Pacific groups (important to NZ)

- Still need NZ prevalence rates for risk factors to plug into model … and may need models for these

- Extending model to age 21 … uncharted territory

- Closed or open cohort or population - birth, death and migration? Utility for policy?

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Knowledge Lab - Next Steps: 1. Model building

- Complete literature search
    - More databases
- Update conceptual model
- Apply estimates derived from literature to the microsimulation model
    - Program estimates into the decision-support tool, in the order specified by the conceptual model
- Validate model, as per MEL-C
    - Check it is reproducing NZ rates
    - This is a test of the 'best' estimates

Knowledge Lab – Next steps:
2. Scenario testing & deployment

- ## Test scenarios using model
  - Guided by EUAG
  - Wider range of outcomes should make model more policy relevant

- ## Deploy model in policy agencies
  - How to deploy? Previously loaded on dedicated computers – or – maybe web-accessible platform?

Knowledge Lab – Next steps: 3 What software?

Characteristic	*JAMSIM-SIMARIO*	*MODGEN (& re-implementations)*
Software	JAVA, R	C++
Developer	COMPASS (in-house)	Statistics Canada University of Ottawa (OpenM++)
Tested and used	MEL-C project	Statistics Canada, international user base (limited)
Support & further development	COMPASS (in-house)	External parties
Expertise	COMPASS (in-house)	External parties
Control	In-house autonomy & direction	External parties
Learning (development)	Already in place	Effort to learn & to transfer model – easier for new projects
End-user friendly	Customised GUI	More generic
Web deployable	Not yet, but Rstudio's SHINY web application framework	Modgen Web – under construction
Open source	GoogleCode, GitHub, R.org	OpenM++ - under construction

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Knowledge Lab – Plan: Recap

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Questions

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QUESTIONS?