Disaggregated level child comorbidity in Zambia: Application of Small Area Estimation method

Audrey Kalindi & Sumonkanti Das
School of Demography, Australian National University
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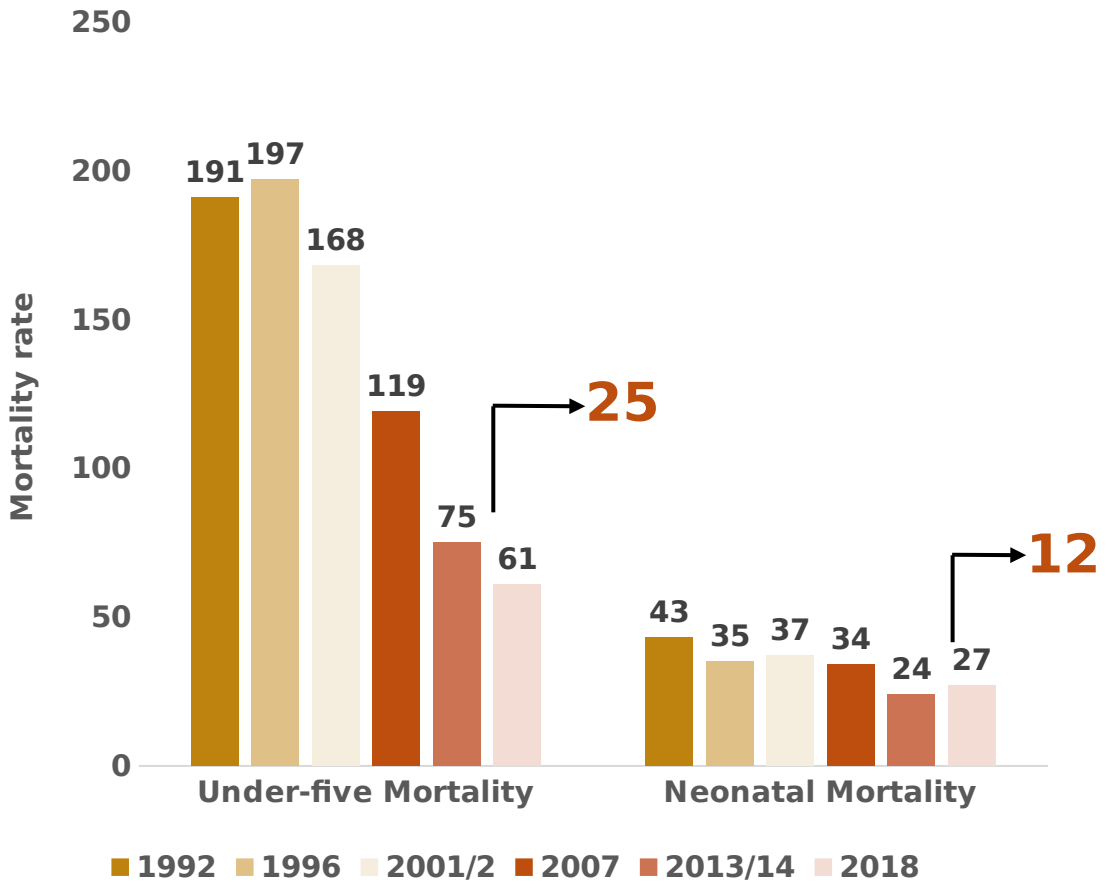
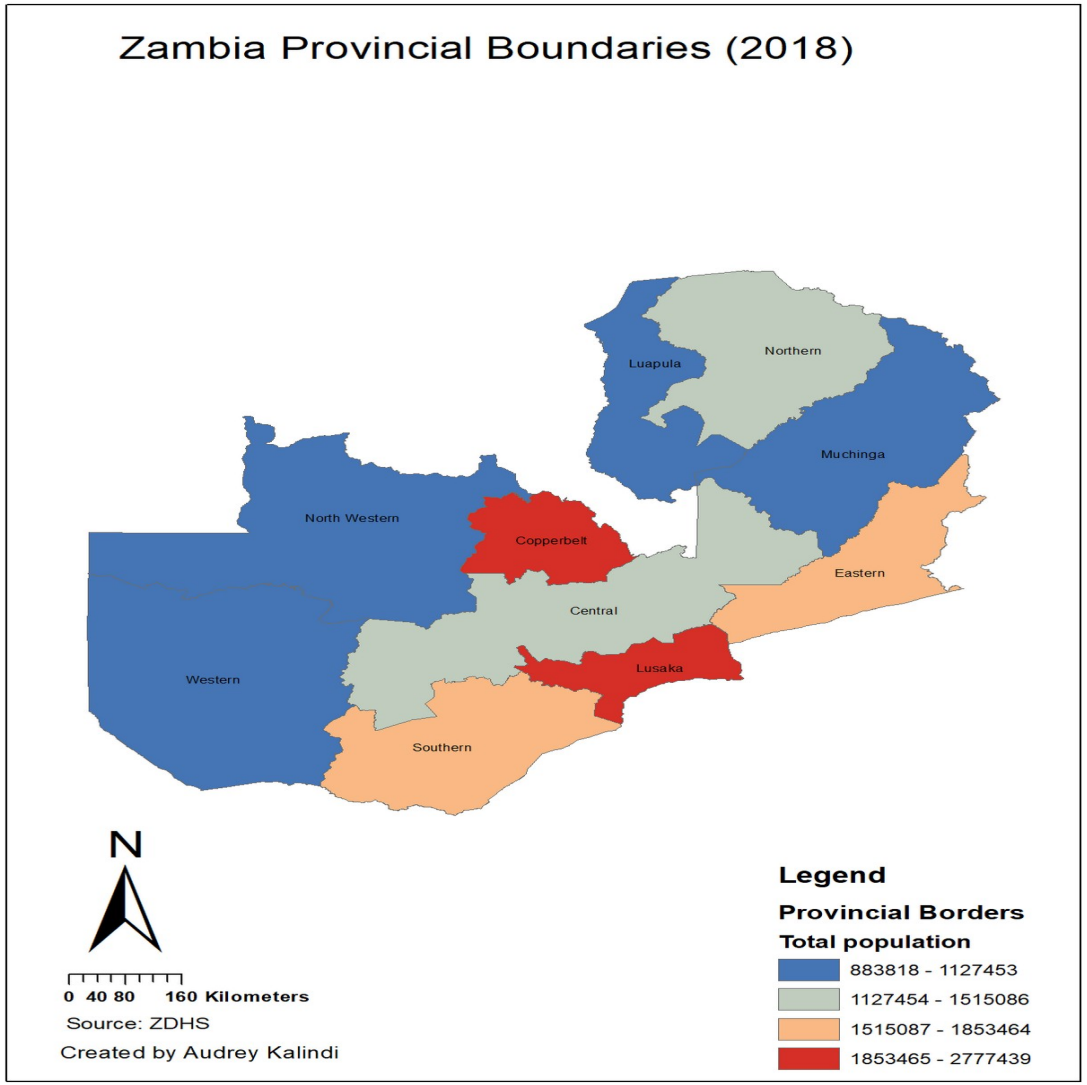
Background mortality

- High rates of child morbidity and lost developmental potential among <5 children remain important challenges and inequity drivers in SSA
- Despite Zambia experiencing substantive progress in <5 mortality decline, rates are still high and vary considerably by region **(110 vs 26)**
- These variations are expected to be more pronounced at lower levels of geography
- Country representative surveys are designed for national and provincial estimates only
- Small area estimations can assist in generating estimations at disaggregated

Child



Country context



- Landlocked country in sub-Saharan Africa
- 752,614 km squared
- Population = 19,610,769
- Growth rate of 3% per annum
- 40% urban, 60% rural population
- ½ population < 18 years

(ZSA 2022)

Gaps in knowledge

- Lack of district level child morbidity estimates due to lack of information in survey
- To what extent child morbidity inequities are distributed at district level

Aim

- To investigate how child morbidity prevalence is geospatially distributed at the disaggregated administrative units using small area estimation method

Research Questions

- What is the prevalence of child morbidity at district level in Zambia?
- To what extent are child morbidity levels unequally

Significance

- Contributes to the literature by introducing novel methods for measuring population indicators at the district level
- Basis for social policy formulation in addressing gaps in child morbidity at lower levels

Data and Methods

- 2018 Zambia Demographic and Health Survey (ZDHS) data and 2010 Zambian Population of Census and Housing (ZPCH)
- 10 Provinces, 115 Districts
- Target cross-classified domains: 345 = 115 district × 3 Age-groups (0-11, 12-23, 24+ months)
- Child Comorbidity: A child having either diarrhoea, fever or acute respiratory infections (ARI) during the last two-week preceding the survey
- Model Inputs: Domain-specific child comorbidity estimates obtained from survey data (ZDHS)

Data and **Methods**

- Bayesian multilevel models, assuming the outcome variable (number of children exposed to morbidity) follows a binomial distribution
- Bayesian model borrows spatial strength from neighbouring regions, and use auxiliary data and characteristics from similar neighbourhoods

and represent domain-specific random effects and district-specific spatial effects;

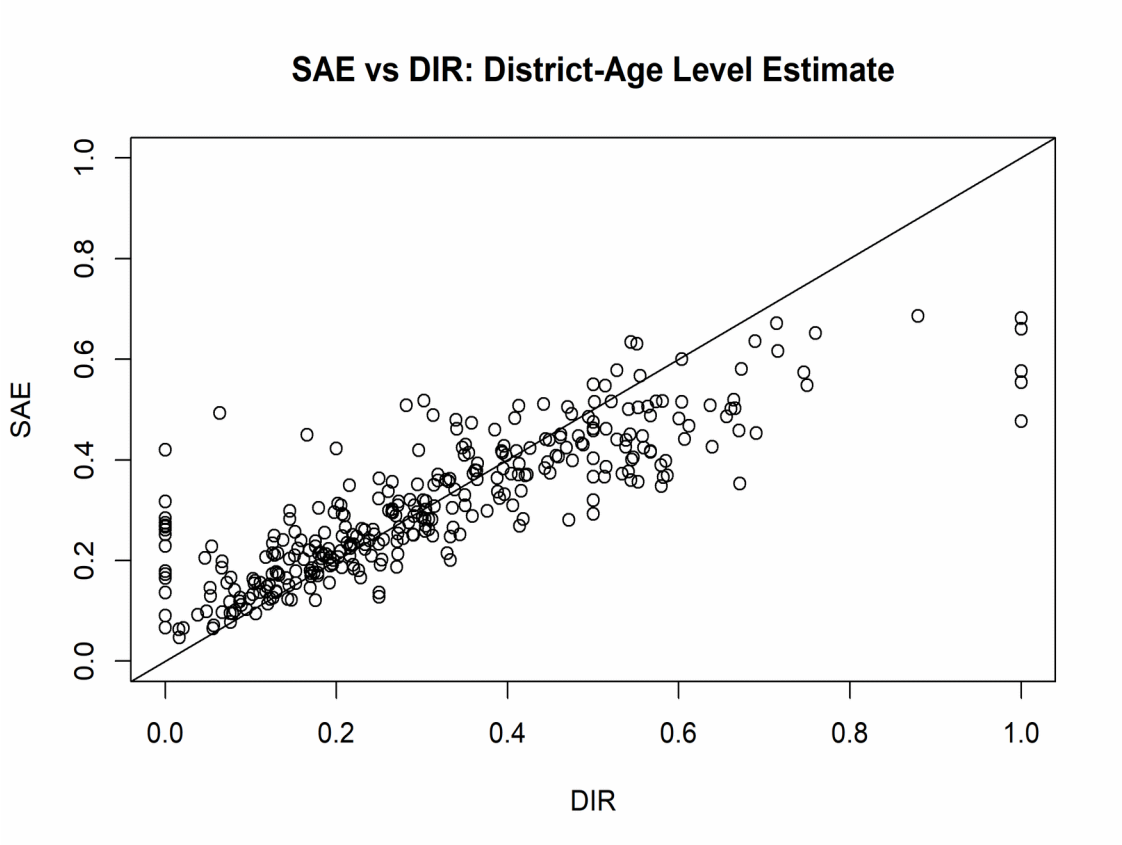
The linear predictor is the log relative risk of a child having morbidities; is the overall level of relative risk; is the −vector of regression coefficient often known as fixed effect parameters

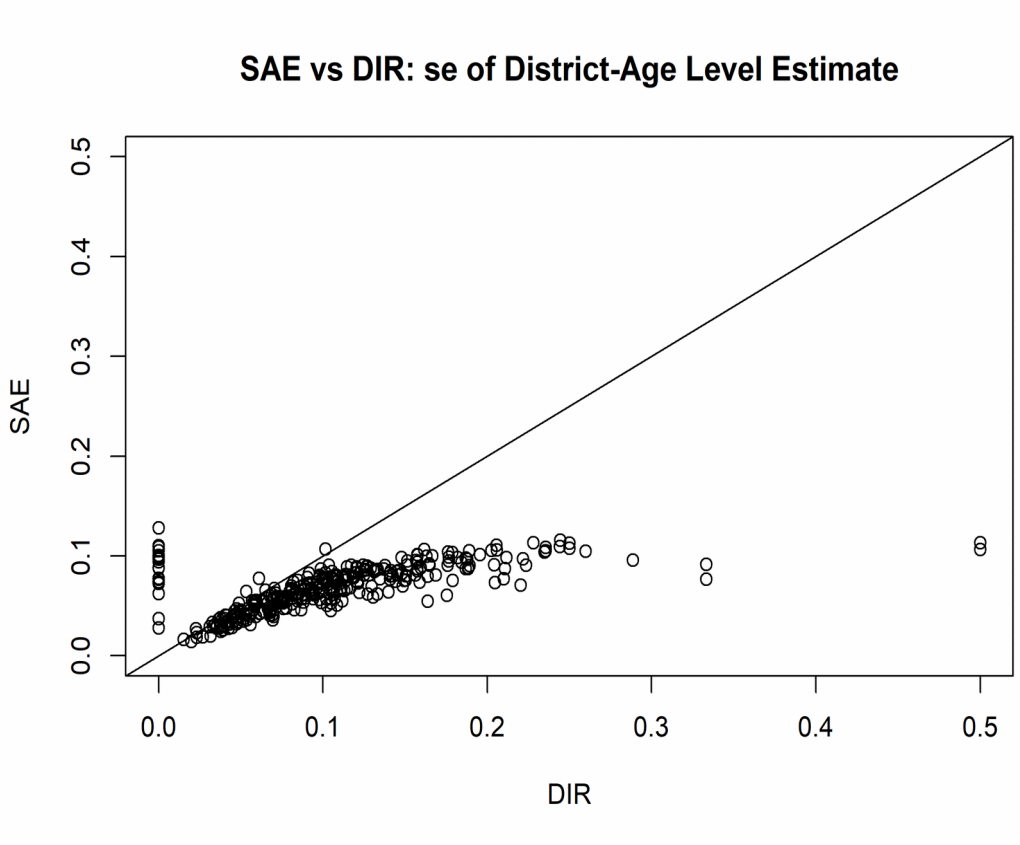
- Higher geography level estimates are obtained by aggregating detailed level domain predictions, allowing for the examination of numerical consistency in morbidity prevalence from micro to macro levels.
- This method allows the random effects to be either structured or unstructured for improved region-specific prevalence estimates
- Models are developed using Markov Chain Monte Carlo (MCMC) simulations utilising mcmcsae R package

Model development

- Children age-group and province are used as fixed effects components
- Age-by-district specific (unstructured) random effects are assumed to follow normal distribution with unequal variance for each age-group
- District specific **unstructured** random effects are assumed to follow normal distribution with equal variance
- District specific **structured** random effects are assumed to follow intrinsic conditional auto-regressive (ICAR) model
- The domain-specific random effects can be interpreted as random intercepts
- District specific census variables (i.e., mother education, employment, etc.) were examined but found non-significant (may be due to 74 districts in the last census)

Unbiasedness and consistency of model-based estimates

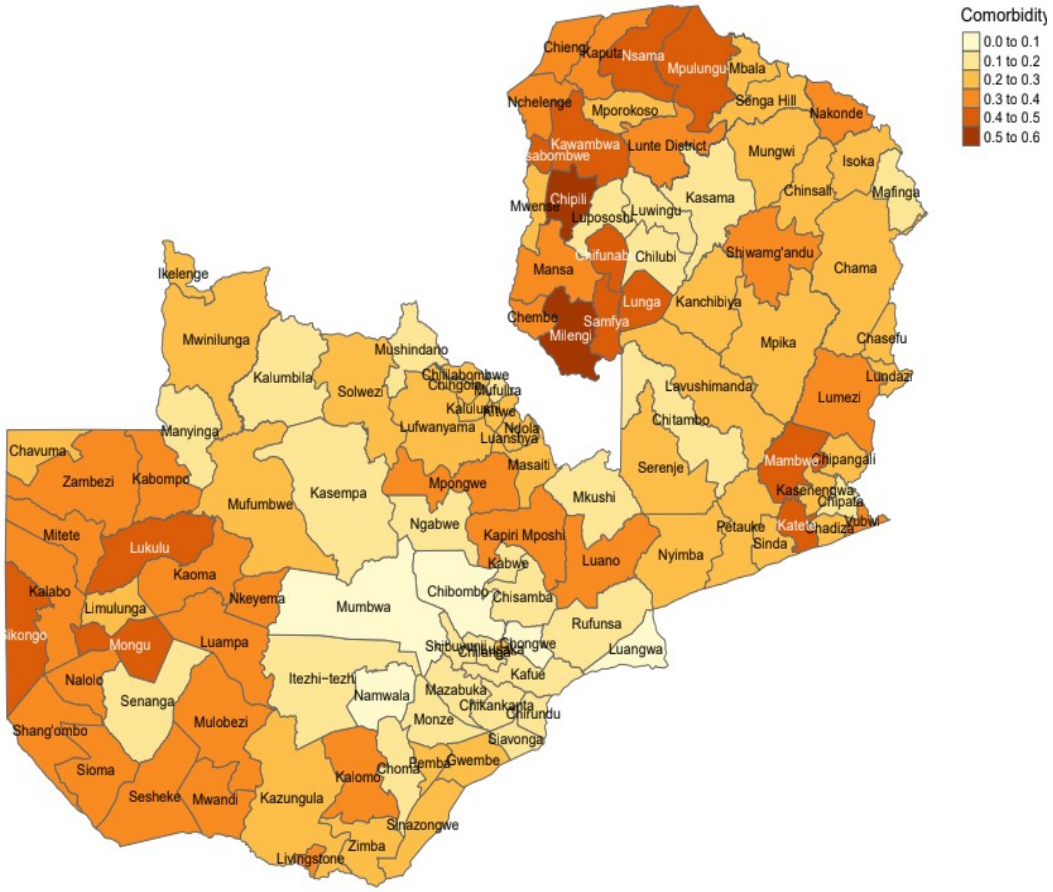


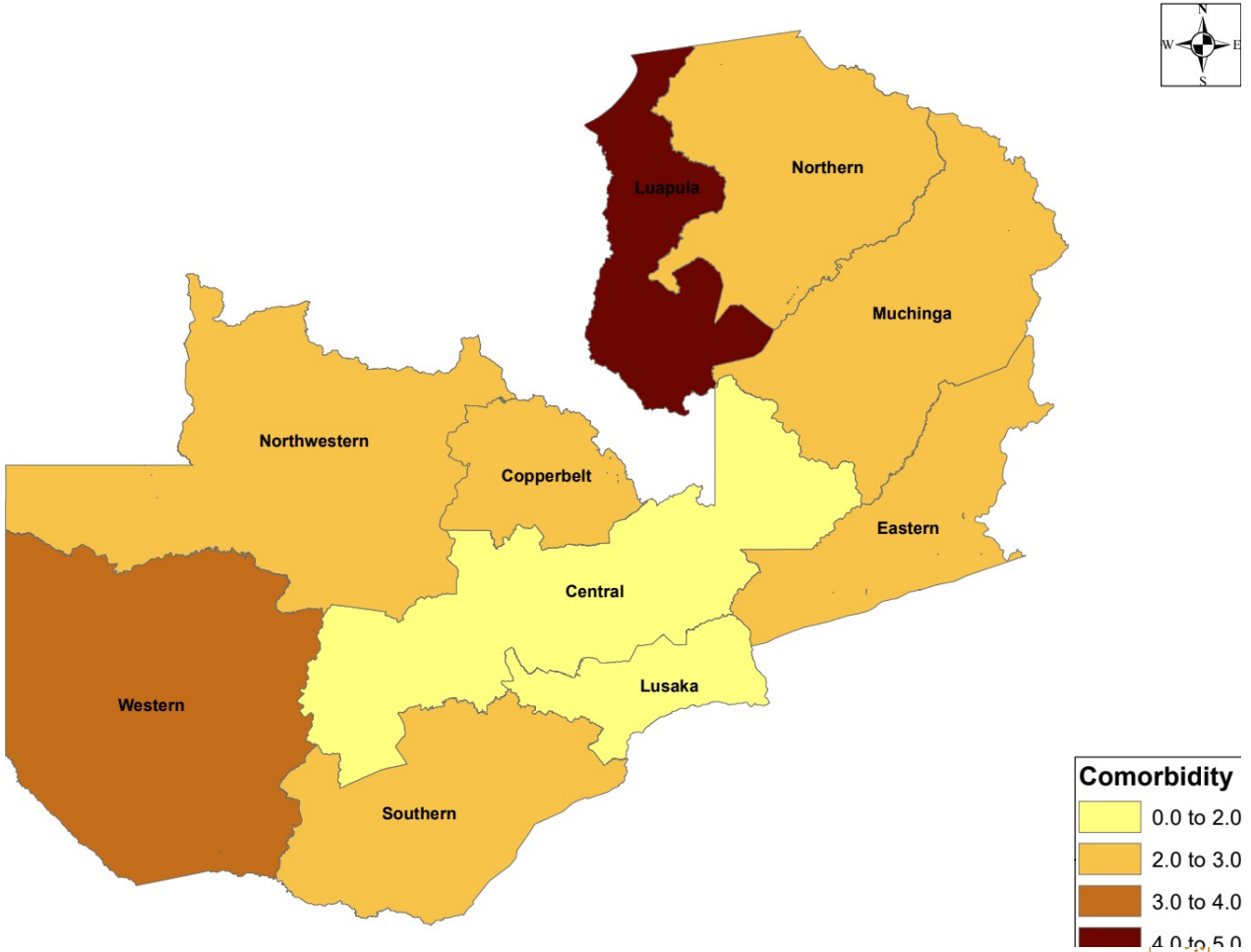


Provincial level child comorbidity

	Direct estimates	SAE
Province	Comorbidity	Comorbidity
Western	35.6(32.4-38.8)	34.1(30.1-38.2)
Southern	22.1(19.4-24.9)	21.3(18.6-24.2)
Northern	26.5(23.7-29.2)	26.7(23.7-29.9)
North-Western	23.2(20.2-26.1)	20.4(16.7-25.0)
Muchinga	26.9(23.9-29.8)	28.0(24.2-32.2)
Lusaka	19.7(17.2-22.3)	19.4(17.0-22.2)
Luapula	39.3(36.4-42.2)	40.6(37.1-44.3)
Eastern	27.8(25.2_30.5)	26.8(24.3-29.4)
Copperbelt	24.7(21.6-27.7)	25.6(23.0-28.3)
Central	18.7(16.4-20.9)	18.0(15.3-21.1)
Total	**26.0(24.6-26.7)**	**26.0(24.8-26.8)**

District and provincial level comorbidity





Discussion

- Child morbidity remains high in specific regions (Luapula 39.3% and Western (35.6%)
- Surprisingly, even districts within provinces that demonstrate better overall health outcomes have elevated child morbidity rates
- There are districts in other provinces where comorbidity rates are also substantial such as Katete and Mambwe in Eastern province and Nsama and Mpulungu in Northern province with lower provincial morbidities
- Children aged 11-23 months have the highest prevalence compared with lowest (24+ months)
- The small area morbidity estimates closely align with the direct estimates, highlighting the accuracy and reliability of the small area estimation method employed

Conclusion

- Child comorbidity is still high at all levels from national, provincial and the district estimates are even higher
- The findings of this study provide data-driven evidence for monitoring progress towards child health goals within detailed districts in Zambia

Way forward

- Explore how other socioeconomic factors can be incorporated to assess the effect of inequalities on child mortality at district levels
- Update the model with the 2022 census and DHS results and assess if the results differ

THANK YOU

audrey.kalindi@anu.edu.au

School of Demography
College of Arts and Social Sciences
Level 5, Room 5.07
RSSS Building,146 Ellery Crescent
The Australian National University
Acton ACT 2601

Australian
National
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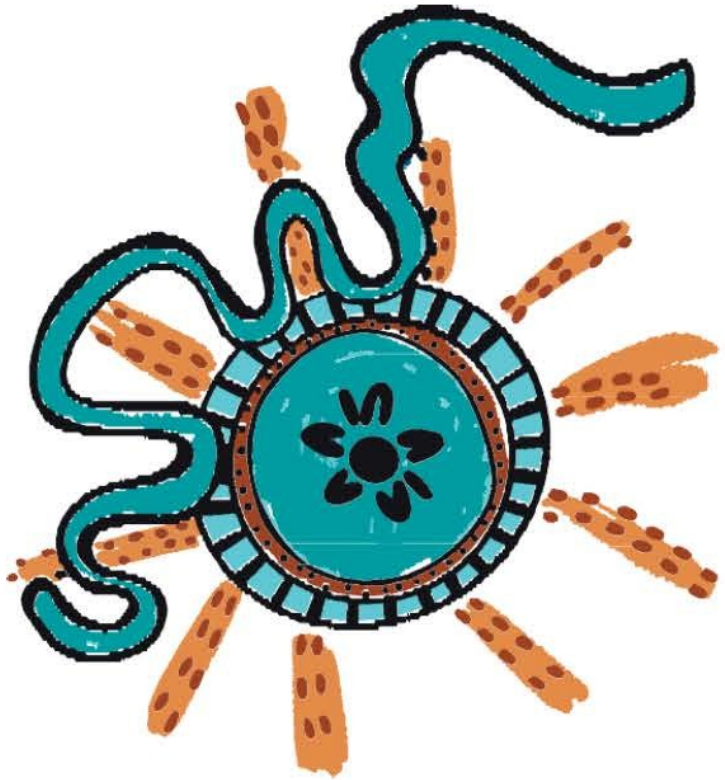

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