Forecasting the future burden of disability through changing patterns of disease: the SIMPOP model

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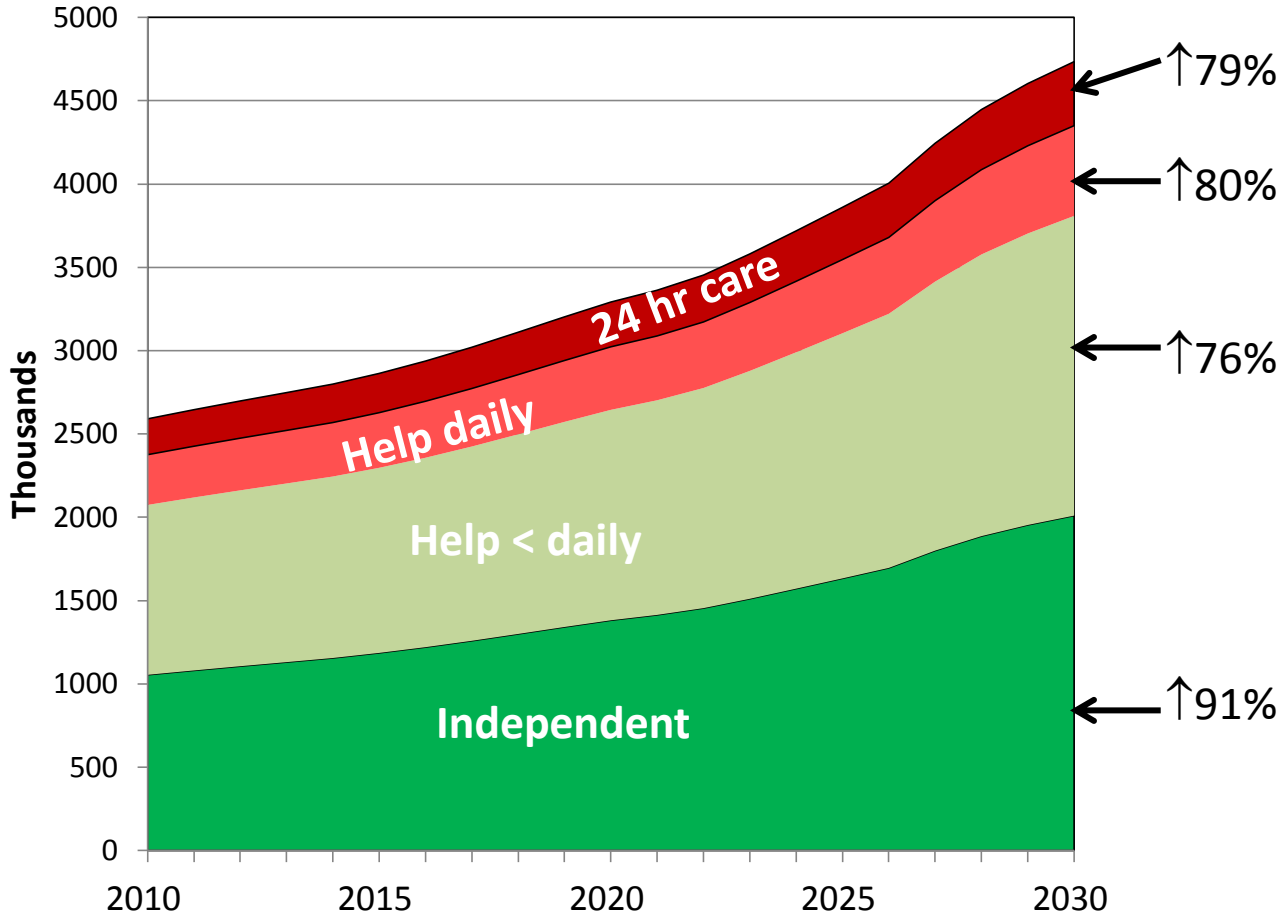
Plan

- Why link diseases and disability
- Simulation model
  - Where it fits in the MAP2030 project
  - Data
  - Model
  - Informing model parameters – literature review
- Results of scenarios
  - Disabled population aged 65+
  - Numbers with individual diseases aged 65+
  - Life expectancy and disability-free life expectancy
- Conclusions
- Future work

Drivers of need for Long Term Care (LTC)

- Major driver of need for LTC is disability
- Disability usually measured by activities of daily living:
  - Dressing, bathing, getting to and from the toilet
  - Assess ability to live independently
- Projections of future need for LTC have generally assumed:
  - constant age-specific prevalence of disability
  - improving disability rates alongside healthy ageing

Projected numbers in England and Wales aged 80+ by interval-need dependency, 2010-2030



Source: Newcastle 85+ Study

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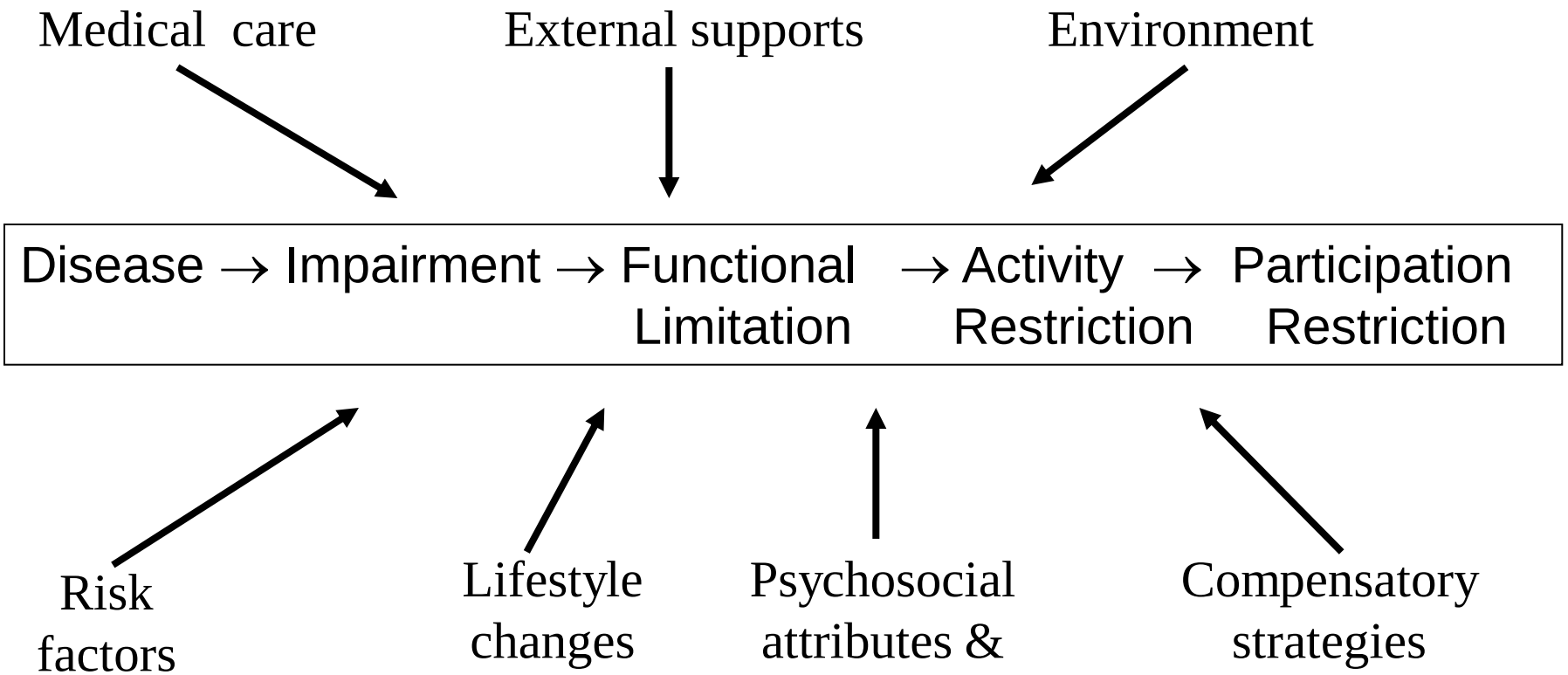
Why focus on disease?

- Disease is at the start of most conceptual models of the disablement process
- Major causes of disability in later life are: arthritis, CHD, dementia, stroke, sensory problems
- Substantial reductions in mortality from CHD and stroke have occurred
- Increases in obesity projected to continue impacting on CHD, stroke, arthritis, vascular dementia, diabetes
- Need models incorporating multiple diseases since:
  - multimorbidity increases with age
  - risk factors (and treatments) may affect more than one disease e.g. better control of vascular risk factors

The disablement process

(adapted from Verbrugge & Jette, 1994)



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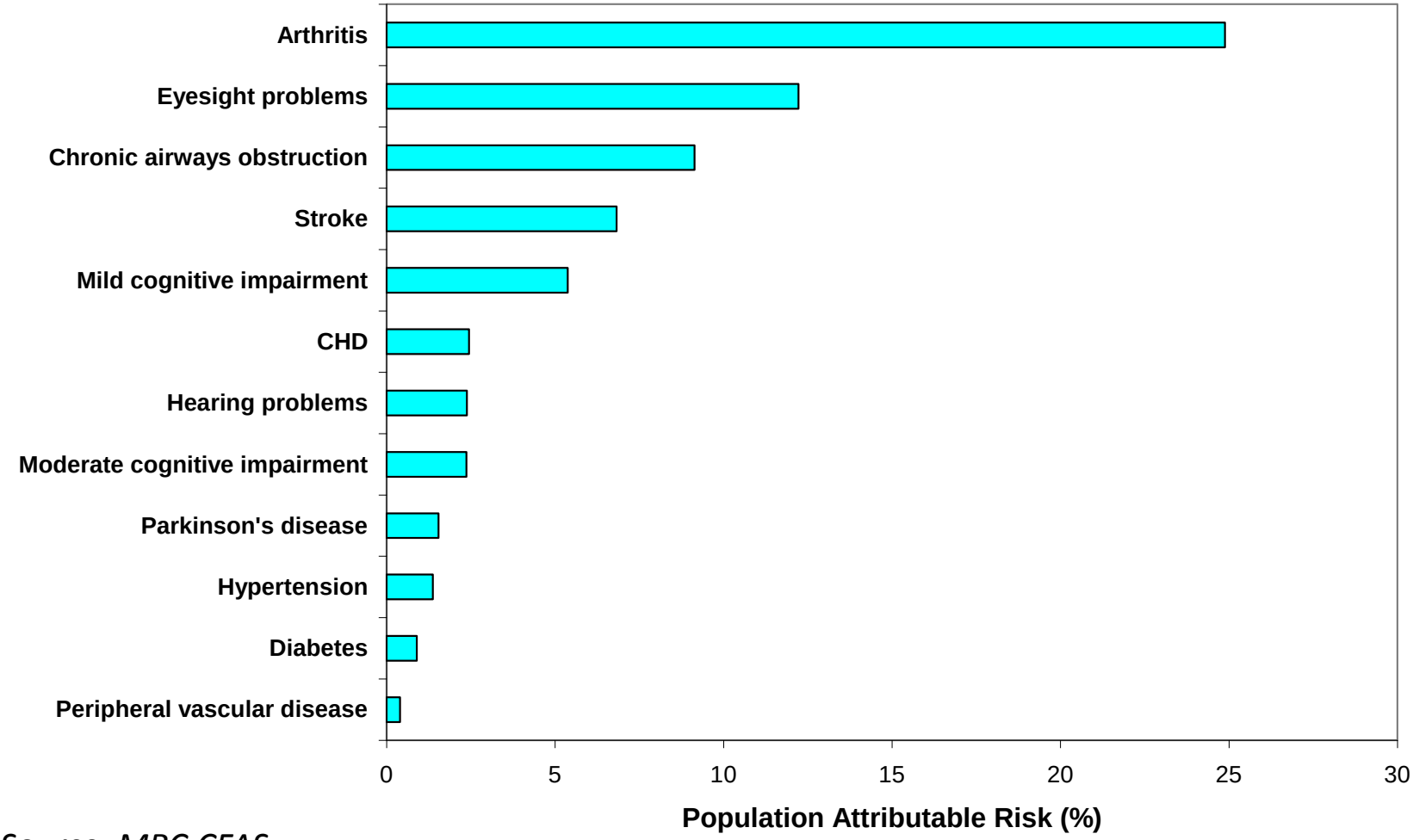
Impact of diseases on disability



Source: MRC CFAS

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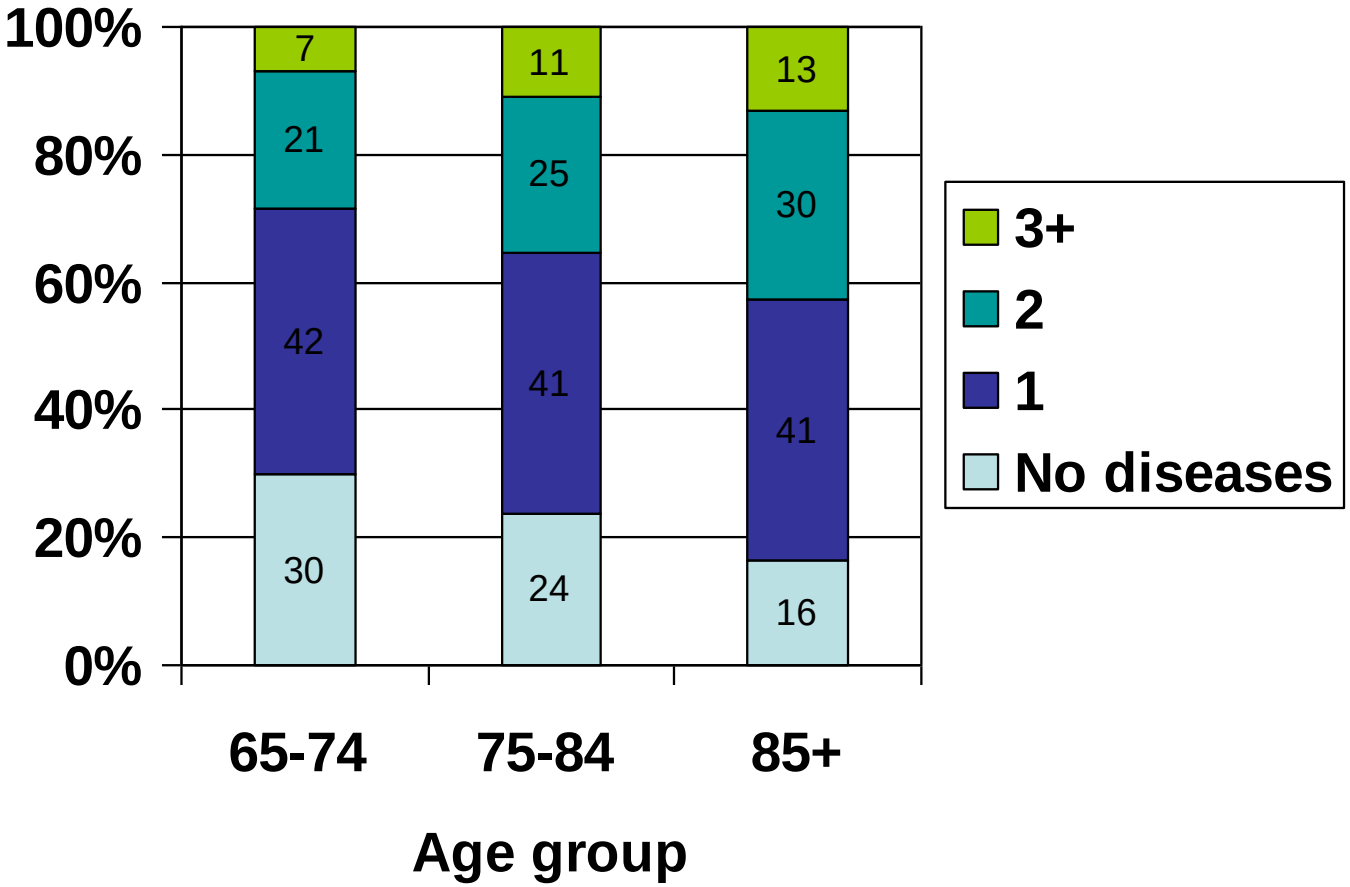
Comorbidity increases with age



7 diseases: arthritis, stroke, CHD, CAO, PVD, cognitive impairment, diabetes

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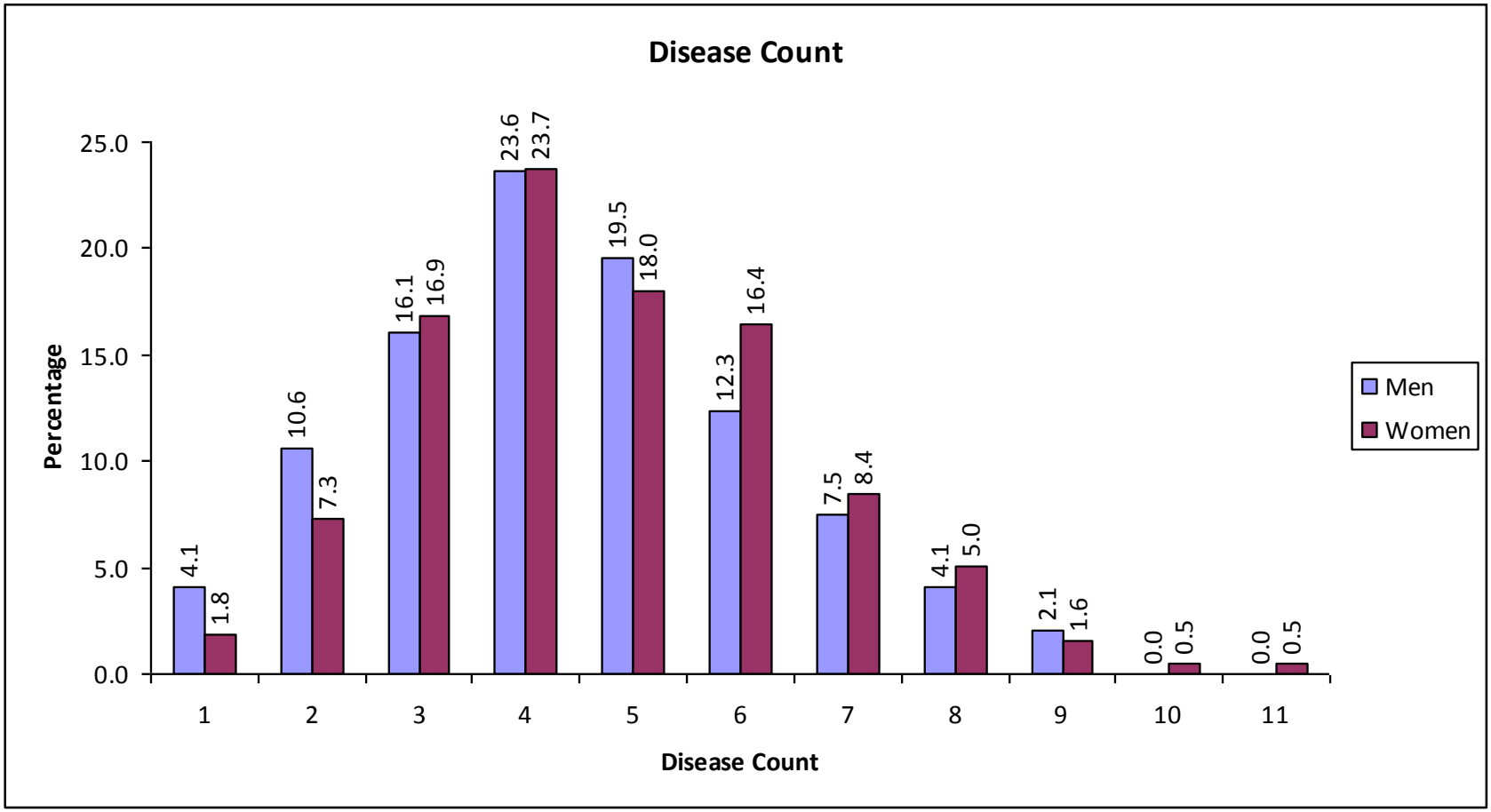
Multimorbidity in 85 year olds



Median (IQR) disease count: men= 4 (3-6) women = 5 (3-6)

Source: Newcastle 85+ Study

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SIMULATION MODEL

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SIMPOP Projection model

- SIMPOP developed as part of the Modelling Ageing Population to 2030 (MAP2030) project.
- Produces projections of numbers of older people with disability and disability-free life expectancy (DFLE) **under different health/disease scenarios**
- Based on **two year transitions** to disability and death in MRC CFAS
- Use of multiple diseases more realistic than single disease models

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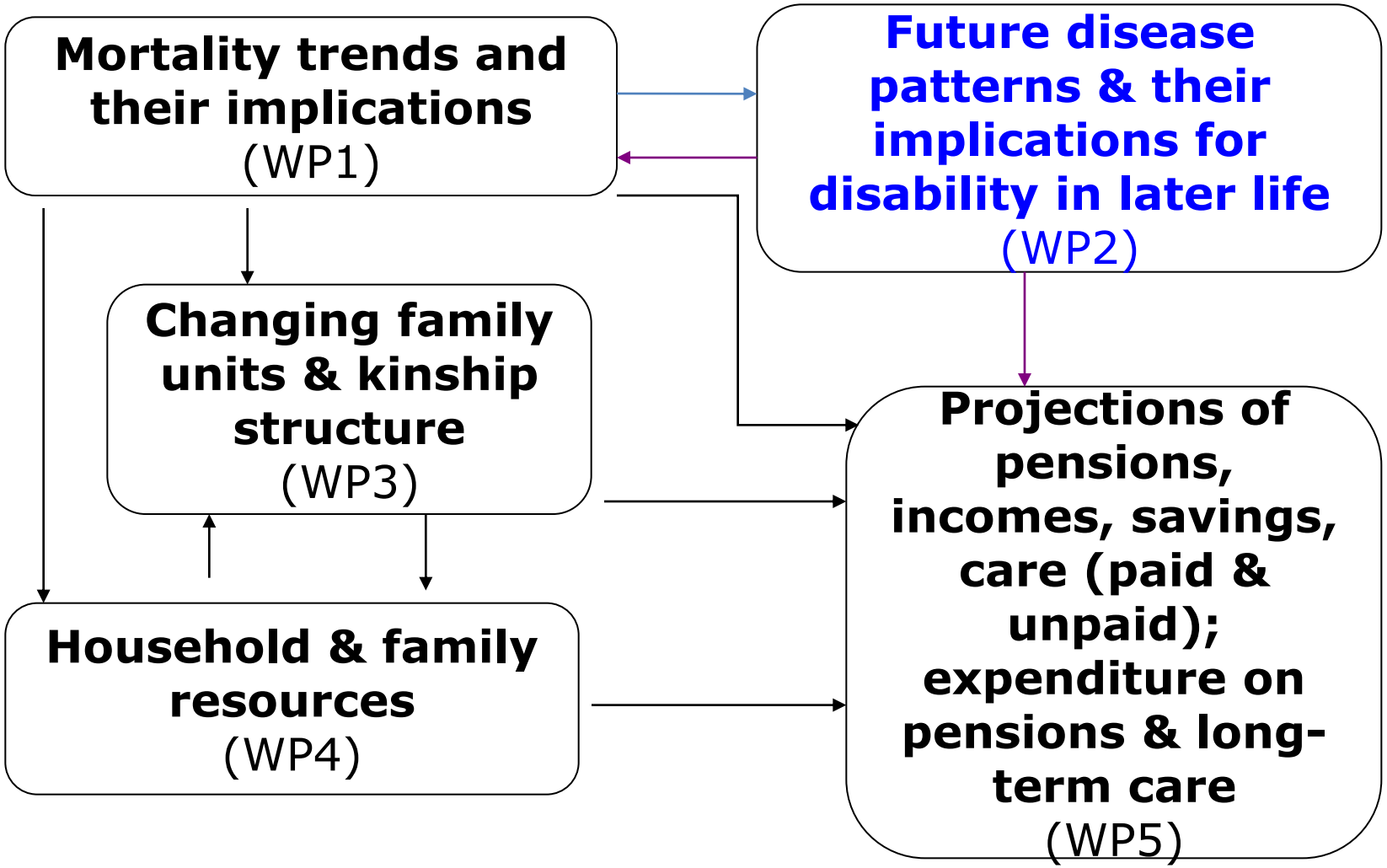

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Data source: MRC CFAS

- Five centres used
- stratified random sample aged 65+
- includes those in institutions
- N=13004 at baseline (1991)
- 2 year follow-up
- death information from National Death Registry

See www.cfas.ac.uk

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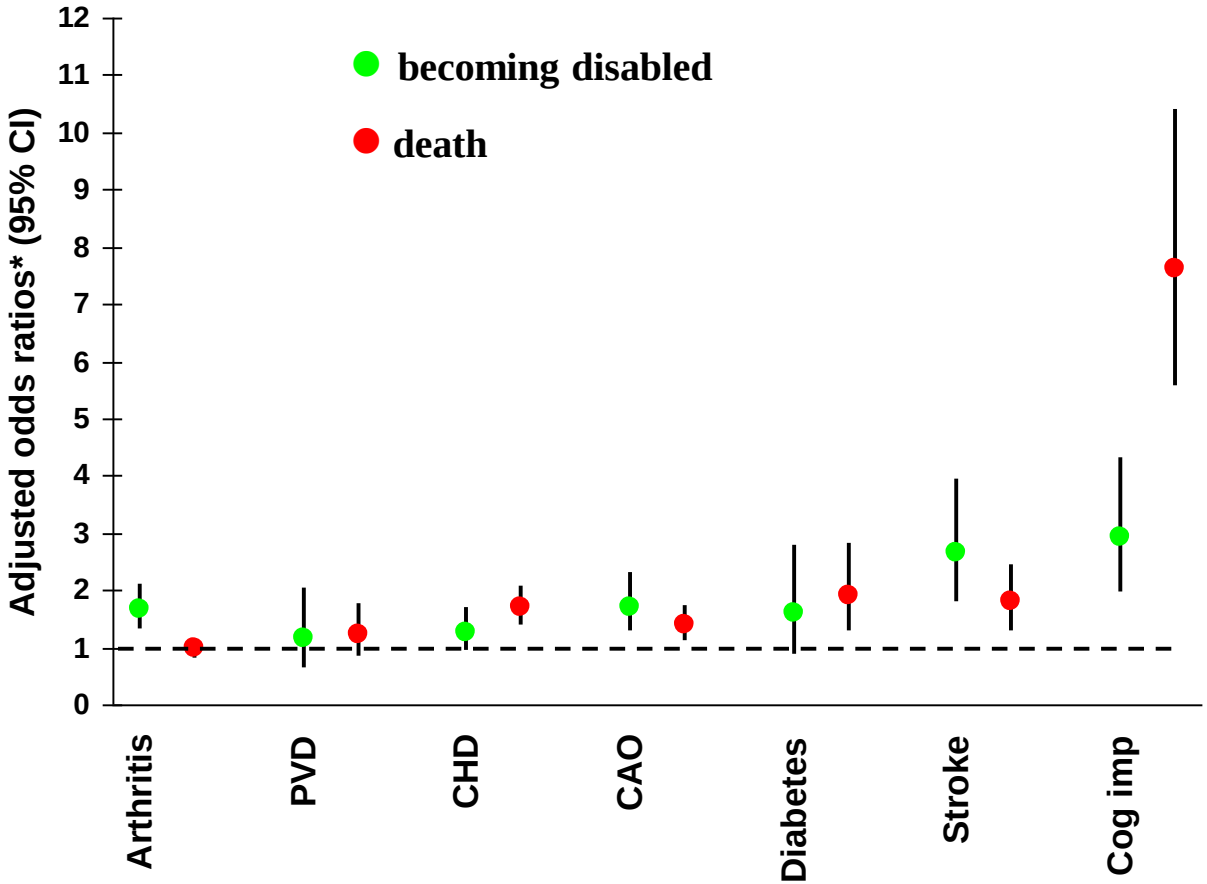
Defining disability and disease

- **Disability**: Unable to perform at least one of three ADLS/IADLs independently - put on shoes and socks, have a bath or all over wash, or transfer to and from bed.
- **Diseases and conditions**: CHD (angina or heart attack), peripheral vascular disease (PVD), cognitive impairment, arthritis, CAO (asthma or bronchitis), hypertension, stroke, diabetes, Parkinson's disease, hearing problems, eyesight problems
- **Statistical analysis**: Polytomous regression model (non-disabled, disabled, dead) adjusting for socio-demographic and lifestyle factors in those not disabled at baseline (N=8,693)

Diseases have different impacts



*adjusted for age, gender, living alone, social class and smoking

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Main elements of SIMPOP

- Transition stage uses MRC CFAS to estimate **2 yr** transitions to disability and death conditional on a range of diseases
- Projection stage applies transition rates to 'age' the population in two year age bands*
- Adjustments added to calibrate to Government Actuary's Department (GAD) 2006-based population projections based on q_x from GAD.
- Adjustments to prevalence of diabetes to calibrate with Health Survey for England 2005
- Life expectancy calculated from deaths and population using abridged life tables
- DFLE calculated using Sullivan's method

**more detail in Jagger et al. Age and Ageing 2009;38:319–25*

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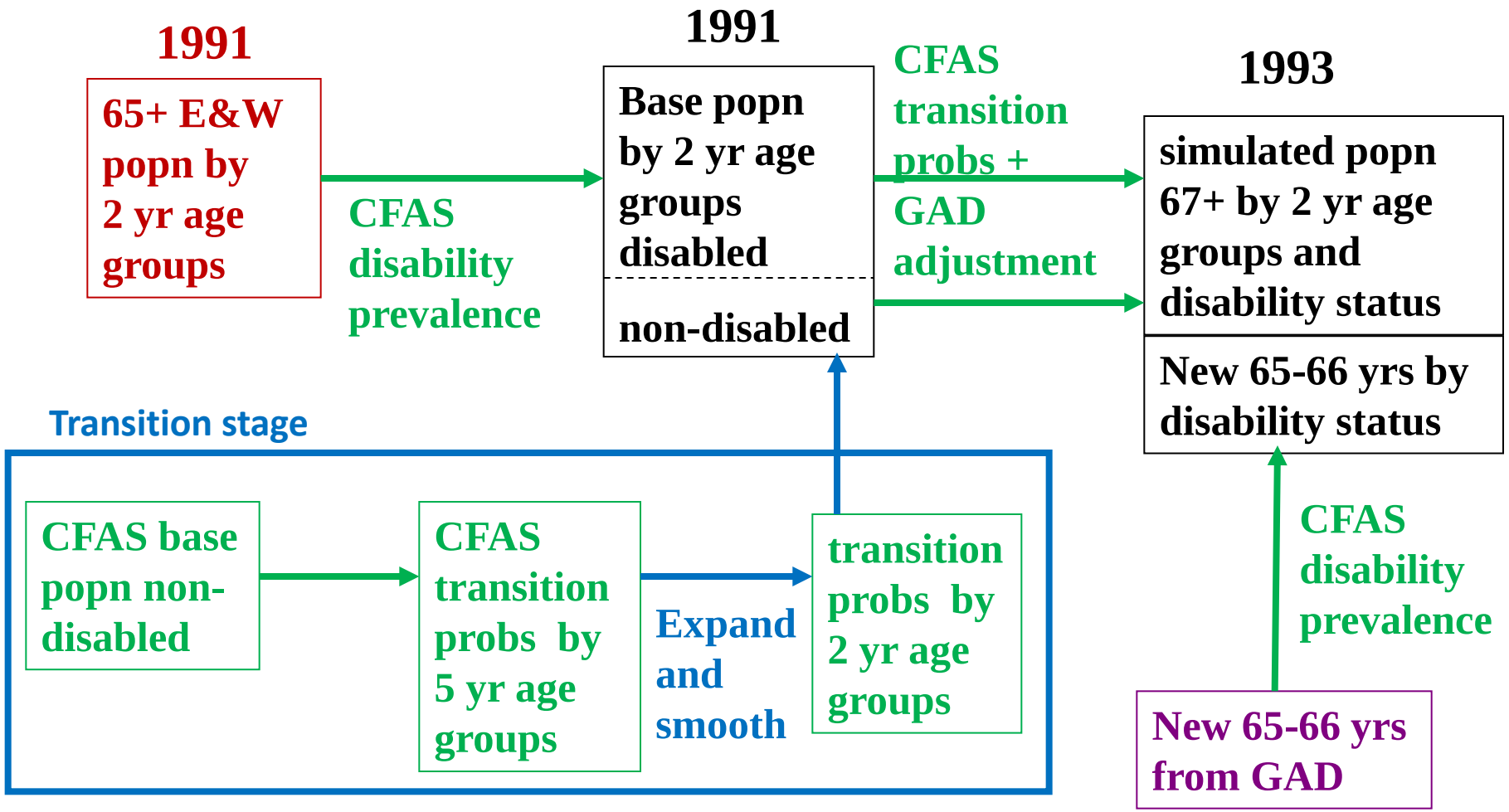
Projection stage



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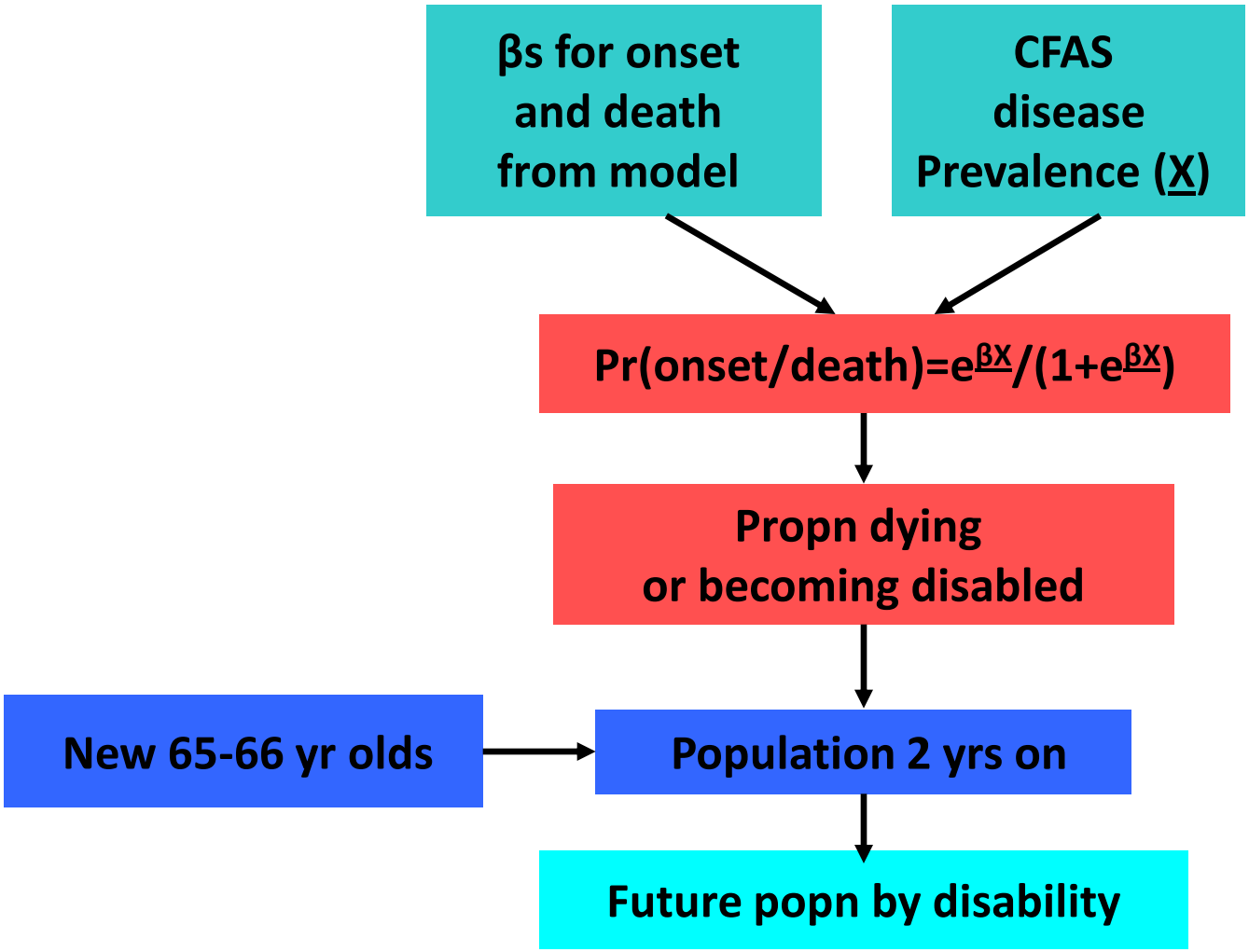
SIMPOP design



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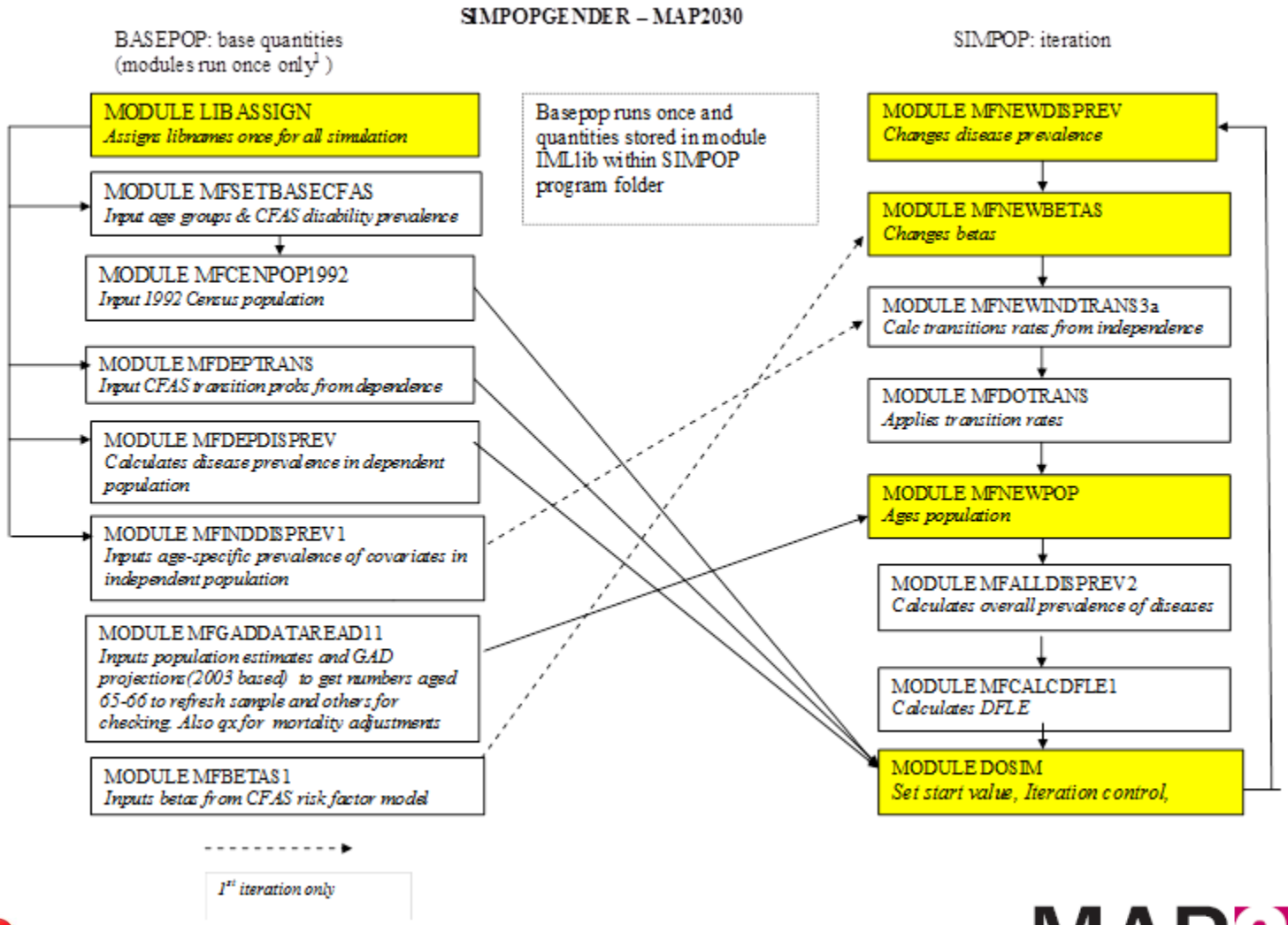

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OUTPUTS

1. Projections of number of older people with disability (of a level to require social care) – results feed into PSSRU model
2. Projections of number of older people with: arthritis, CHD, stroke, diabetes, dementia (moderate or severe cognitive impairment)
3. Projections of life expectancy (LE), disability-free life expectancy (DFLE) and years with disability (DLE) – important for assessing compression/expansion of disability

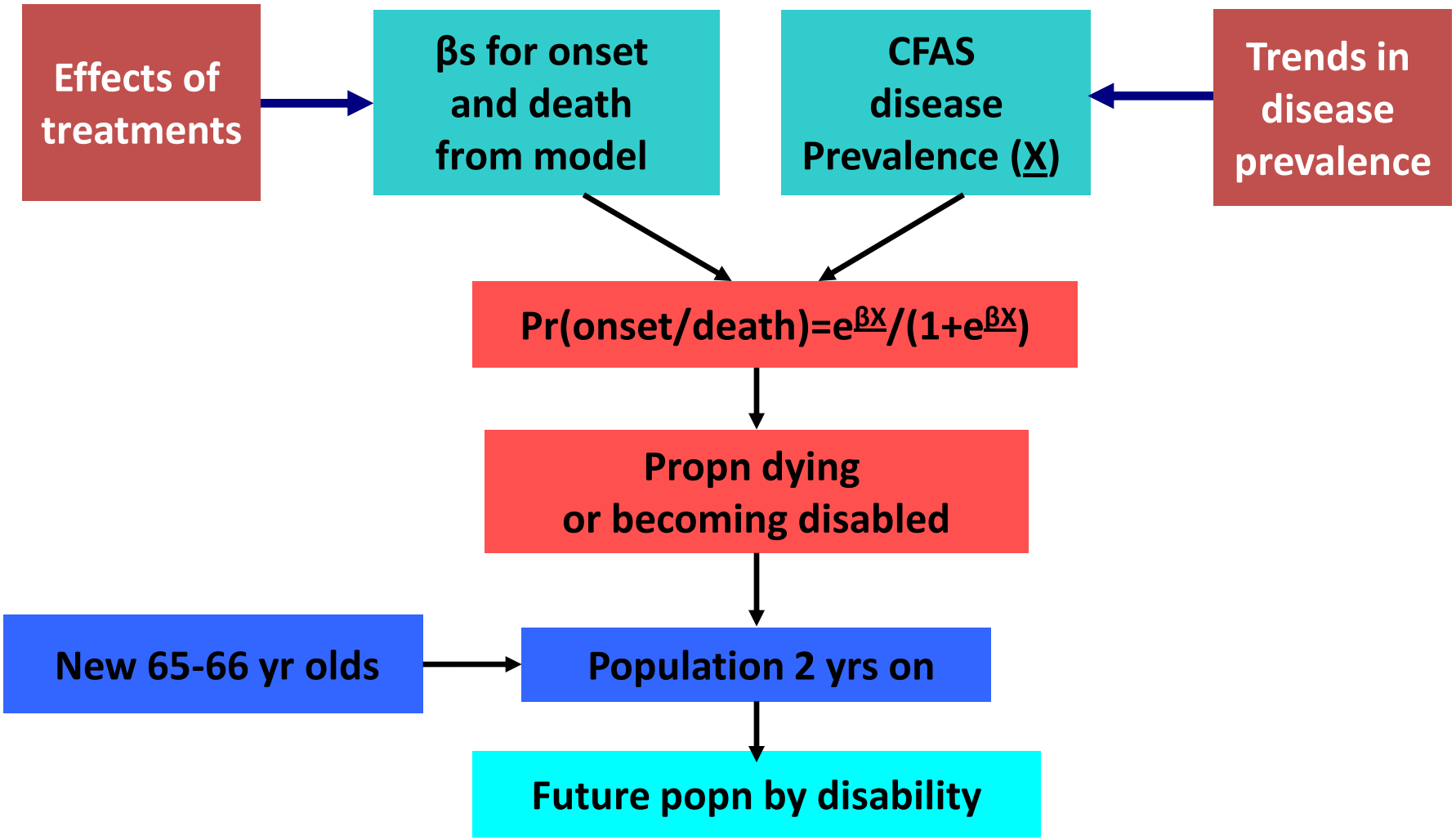
- all projections available for men and women separately and by age group

Operationalising the disease scenarios

In SIMPOP three parameters can be altered to simulate time trends in each disease or their treatments and risk factors

- *Prevalence of disease*
  - reflects changes in cohorts or risk factors
- *Disabling effect of disease*
  - reflects changes in treatments or severity of disease
- *Mortality from disease*
  - reflects changes in treatments or severity of disease

Simulation model



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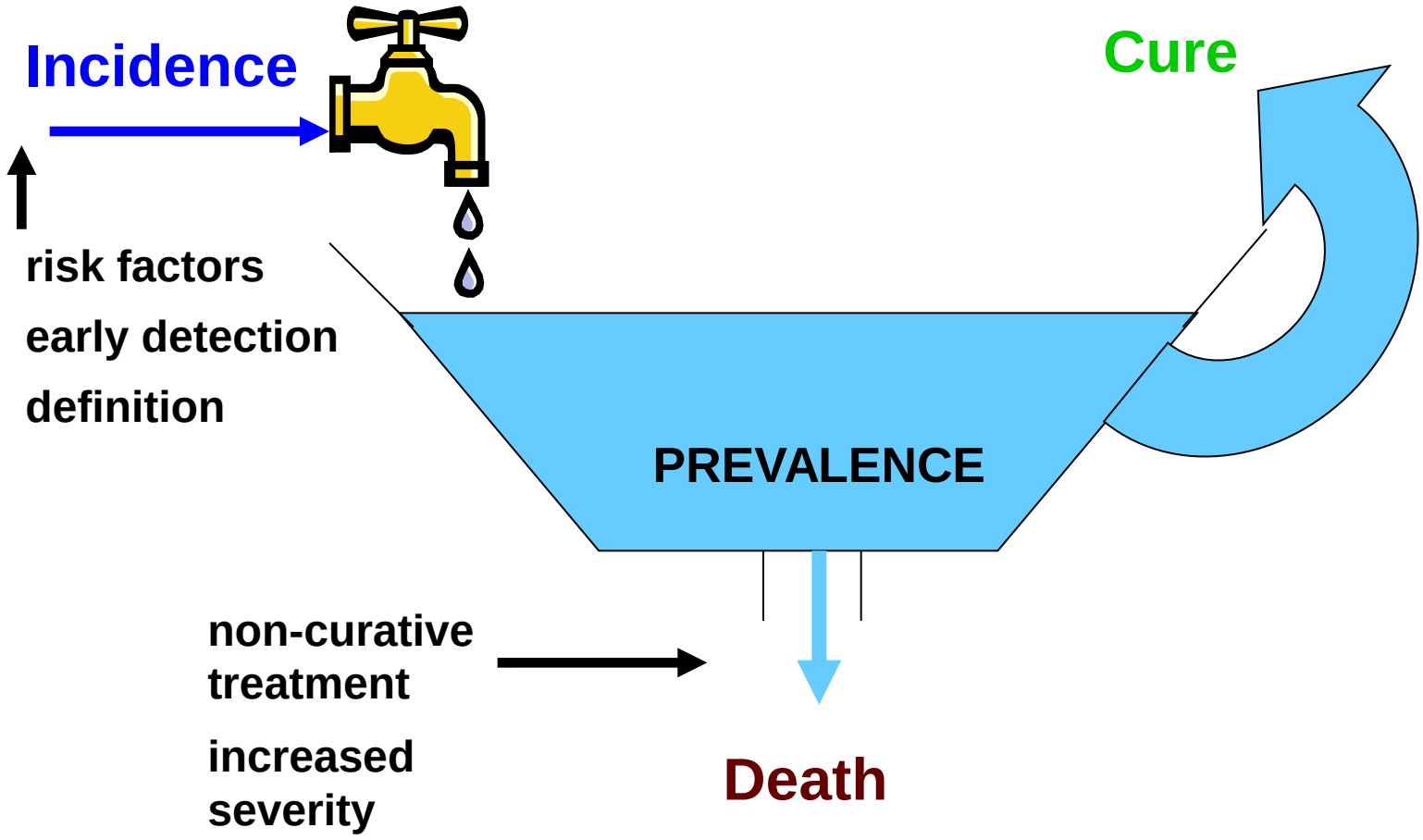
What affects prevalence?



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Estimating parameters

We undertook systematic reviews in each disease for good evidence of:

- Important risk factors
  - association with disease, disability or survival with disease
  - risk factor trends
  - applicability to a sufficiently large section of the population to estimate a significant impact
- Potentially effective preventative strategies and treatments
  - beneficial effect upon disease incidence, disease-specific disability or survival with disease
  - applicability to a sufficiently large section of the population

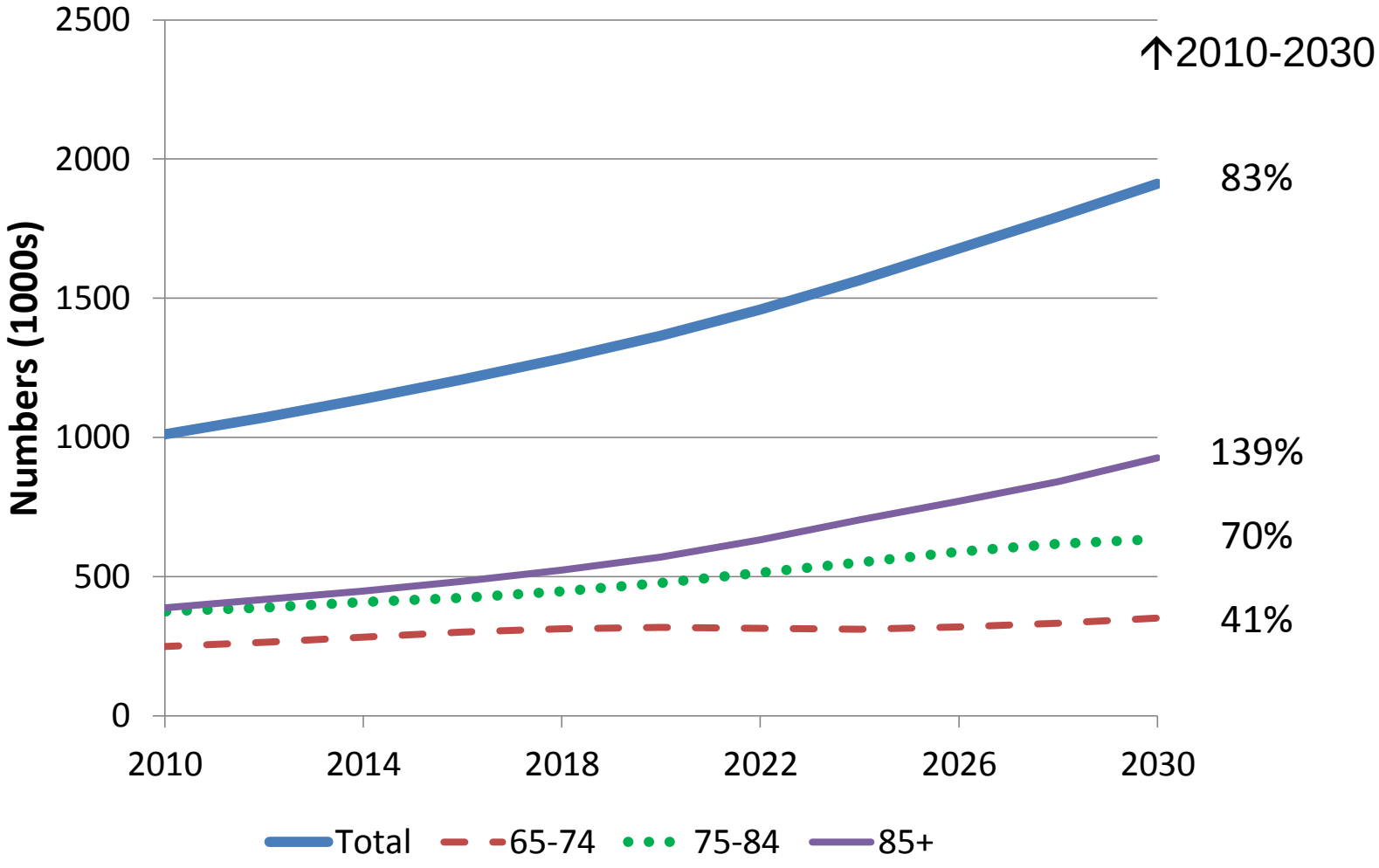
Central health scenario (Ageing of the population alone)

- No change in:
  - Age-specific prevalence of diseases
  - Incidence of and recovery rates to disability
  - Mortality rates from GAD principal projections
  - Prevalence of disability for new cohort aged 65-66 (sensitivity analyses performed)

- Prevention strategies and effective treatments simply offset the negative influences of obesity and other cohort trends (emergence of ethnic minorities into older cohorts with increased CHD, stroke, diabetes)

RESULTS OF SCENARIOS

Numbers with disability by age 2010-2030



Central Health Scenario

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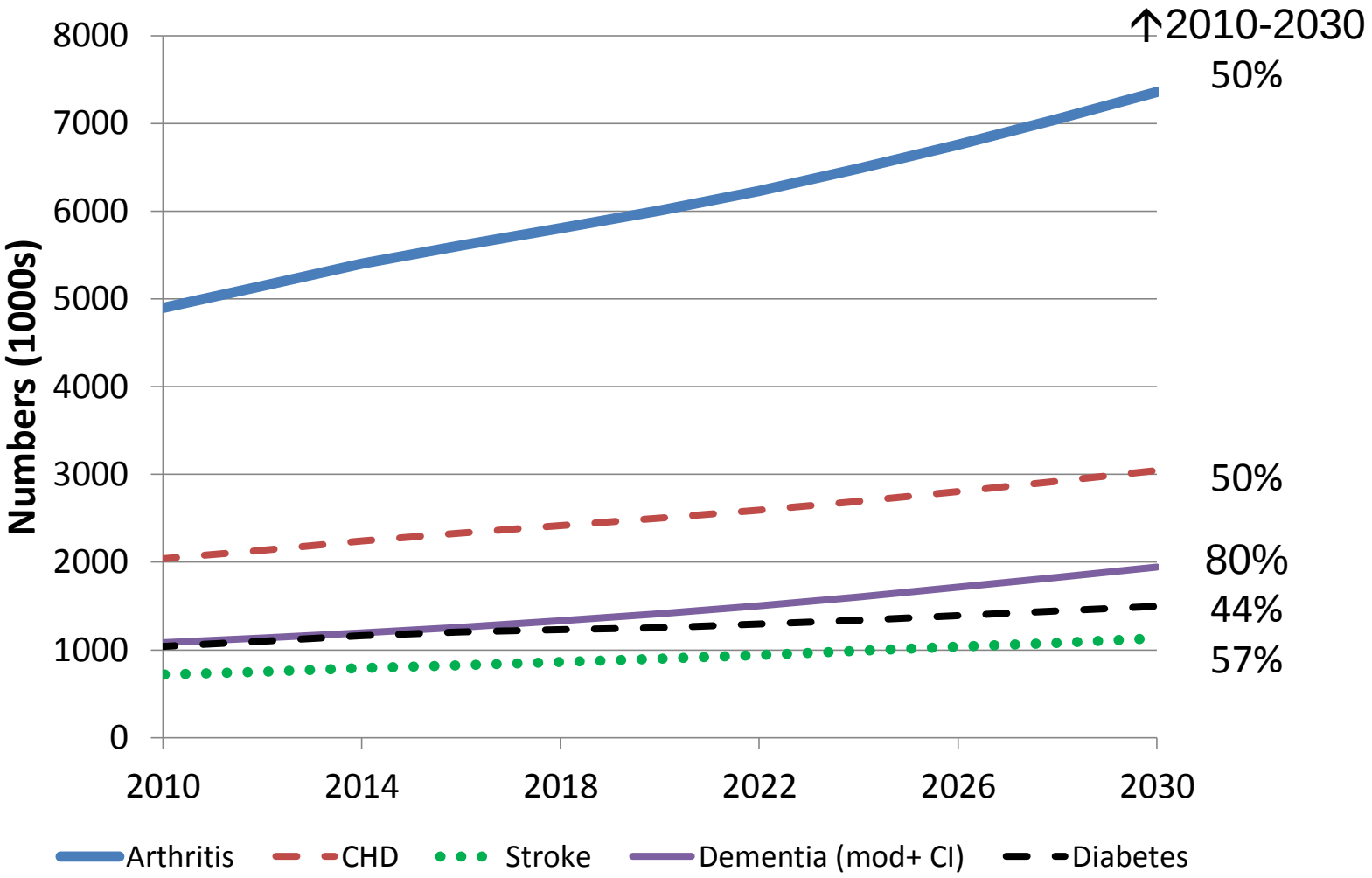
Numbers with key disease 2010-2030



Central Health Scenario

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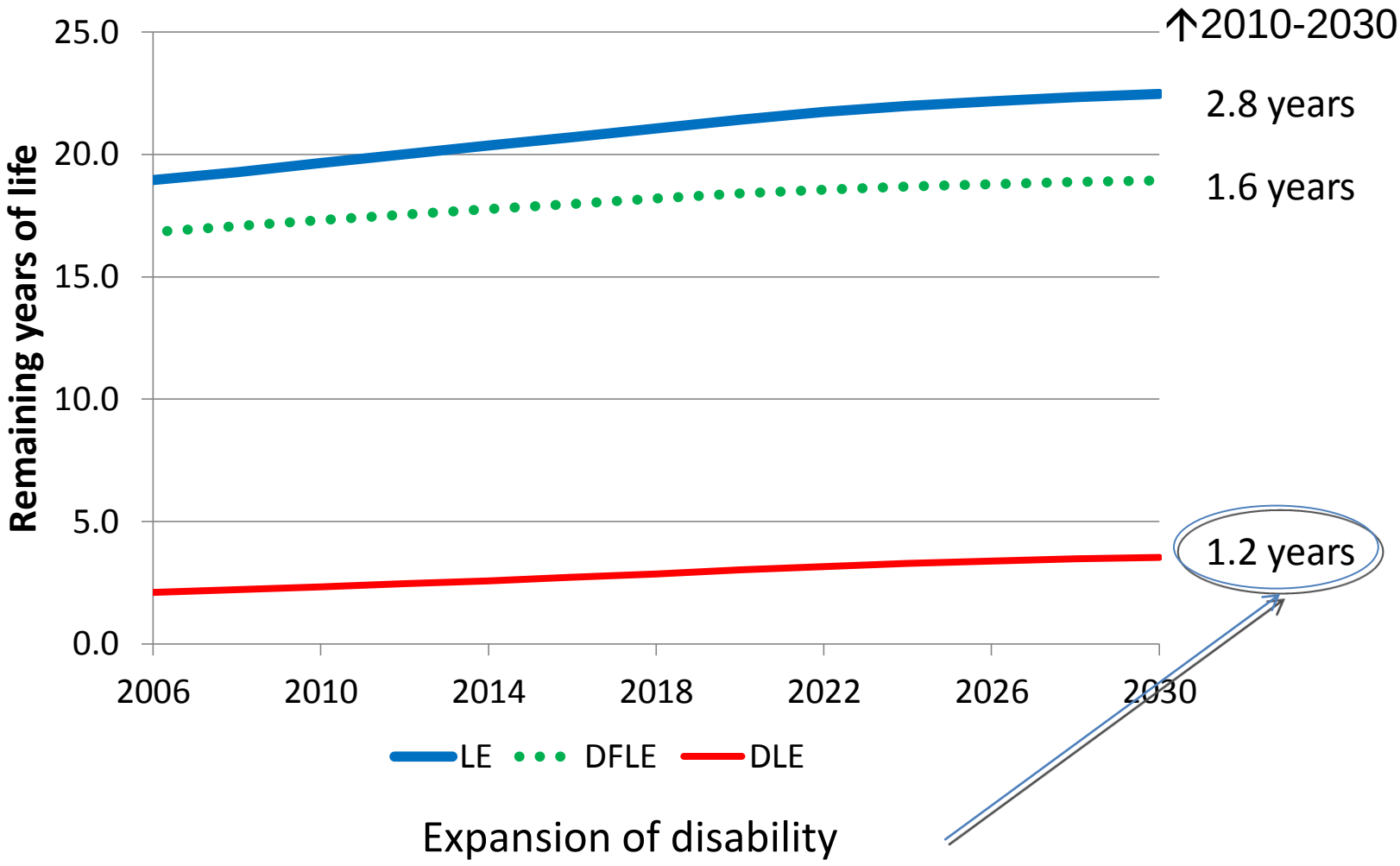
Women's LE, DFLE and DLE at age 65



Central Health Scenario

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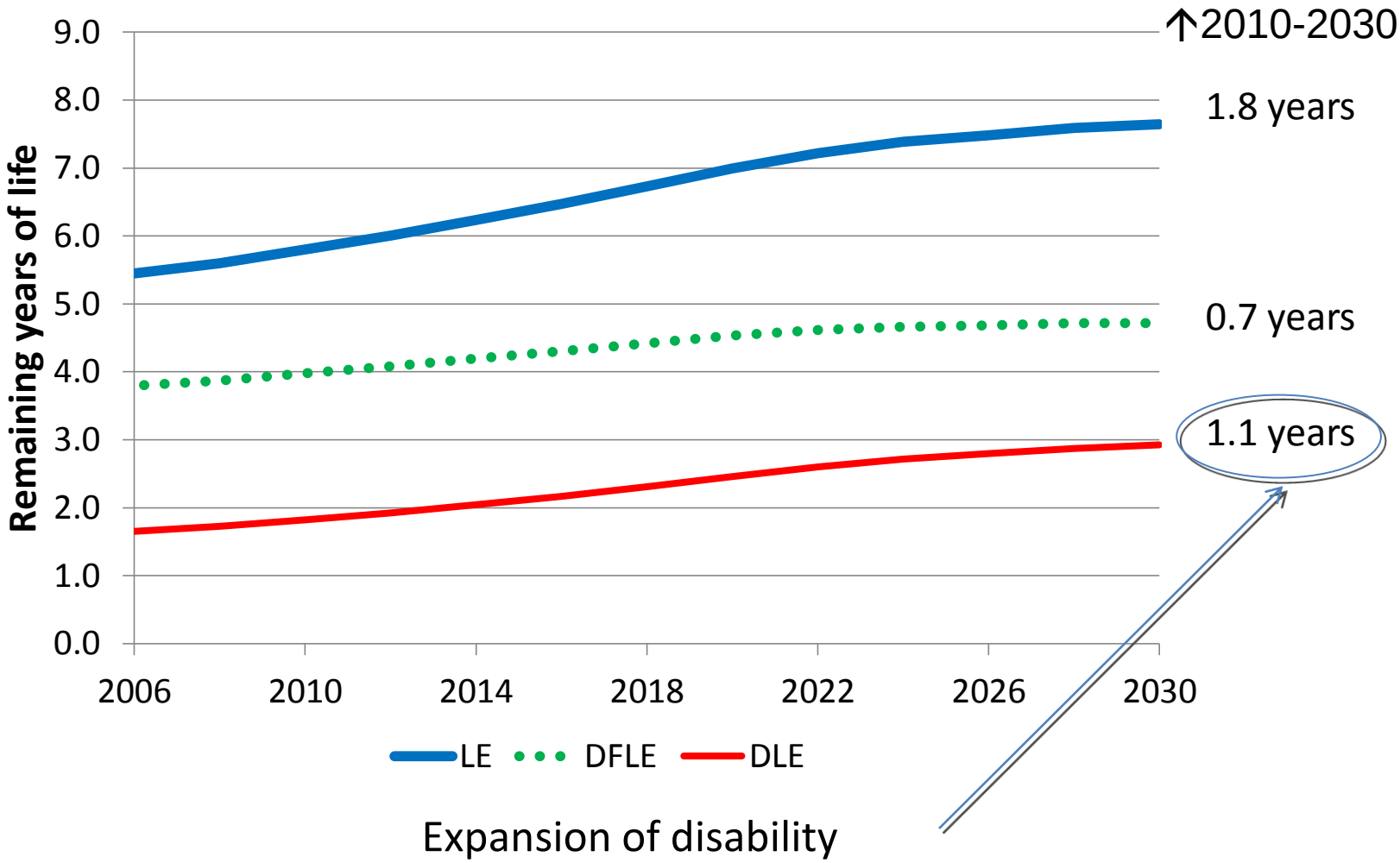
Women's LE, DFLE and DLE at age 85



Central Health Scenario

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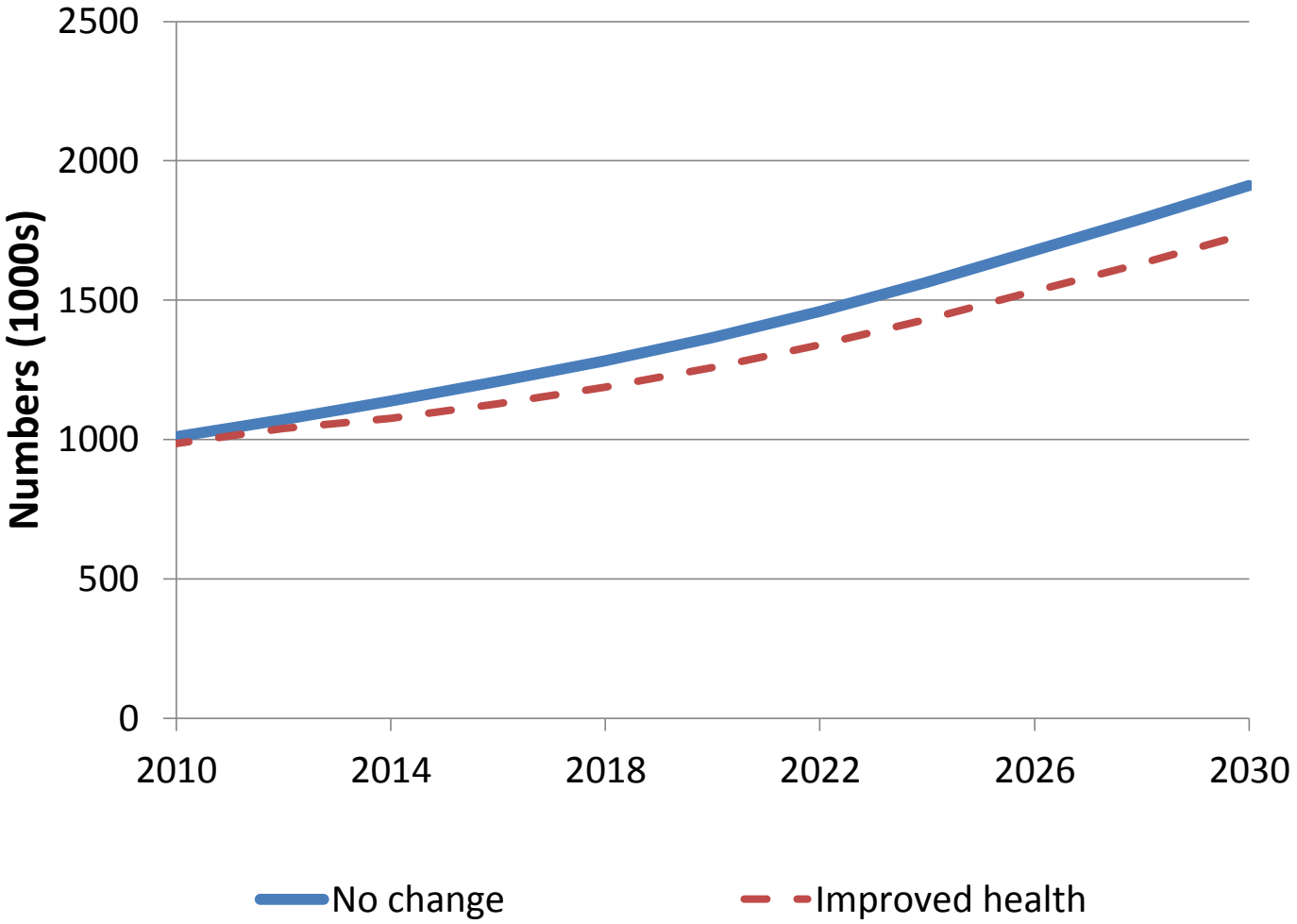
Impact of reduced disability in new cohorts

- If prevalence of disability for new cohort (65-66 yr olds) changes by:
  - 5% then 64,000 fewer with disability by 2030
  - 10% then 90,000 fewer with disability by 2030
- Little change in LE or %change from 2010-2030 in numbers with disability

Scenarios - Improving population health

- Individuals take health seriously
  - decline in risk factors, particularly smoking and obesity
- New treatments or technologies emerge that
  - reduce the disabling effects of arthritis, dementia, stroke and CHD
  - make further gains in survival with these diseases
- Health service is responsive with
  - high rates of technology uptake for disease prevention
  - excellent diffusion of new treatments to all who can benefit
- People are healthier than previously
  - new cohorts have less disability

Numbers with disability by health scenario



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Prevalence of disability 2010-2030

Improved health scenario

Age group	Disability prevalence 2010	Disability prevalence 2030	Change in disability prevalence
65-69	3.3	2.6	-0.7
70-74	6.2	5.7	-0.5
75-79	9.1	8.9	-0.2
80-84	15.6	15.5	-0.1
85+	31.1	33.6	2.4

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Relationship between LE, DFLE and DLE

- Whether DFLE is increasing faster or slower than LE is a key concern for the future
- If the number of years spent with disability (DLE) is reducing (as DFLE is increasing faster than LE) this is an *absolute compression* of disability
- If the number of years spent with disability (DLE) is increasing (as DFLE is not increasing as fast as LE) this is an *absolute expansion* of disability
- If the proportion of remaining years free of disability (%DFLE/LE) is increasing this is an *relative compression* of disability

Increases in DFLE relative to LE: men

	Increase from 2010 to 2030 in years of			
	LE	**DFLE**	**DLE**	**%DFLE/LE**
At age 65				
Central Health scenario	3.0	1.9	1.0	-3.5
Improved health	4.2	3.2	1.0	-2.6
At age 85				
Central Health scenario	2.0	0.9	1.0	-5.9
Improved health	2.7	1.7	0.9	-1.5

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Further health improvements

MALES		Age 65			Age 85		
Reduction in prevalence of diseases		Reduction in disabling effect of diseases			Reduction in disabling effect of diseases		
		0%	10%	20%	0%	10%	20%
2% reduction							
	LE (years)	4.2	4.2	4.3	2.6	2.7	2.7
	DFLE (years)	3	3.2	3.3	1.5	1.7	1.8
	DLE (years)	1	1	0.9	1	0.9	0.9
	DFLE/LE (%)	-3	-2.6	-2.2	-2.6	-1.5	-0.4
10% reduction							
	LE (years)	7.1	7.4	7.5	4.7	4.7	4.7
	DFLE (years)	6.2	6.3	6.4	4	3.8	4.1
	DLE (years)	0.9	1	1	0.7	0.8	0.6
	DFLE/LE (%)	-0.7	-1.2	-1	8.1	6.5	7.7

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CONCLUSIONS

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Limitations

- Evidence of effect of treatments on disability is lacking therefore ‘guestimates’
- Transitions based on 1991/2 older people – need new cohort but must include institutional population
- Model underestimates GAD LE by 1.2 years at age 65 and 0.8 years at age 85 – mortality for 65-69 yr age group in CFAS is higher than equivalent cohort LE
- Self-report data on disease

Strengths

- Very large cohort so can estimate low prevalence diseases
- Includes multiple diseases rather than single disease model
- Can simulate effect of joint risk factors eg obesity
- Can simulate effect of interventions that affect multiple diseases eg better vascular control
- First projections of DFLE that link back explicitly to diseases

Conclusions

- Under **Central Health Scenario** between 2010 and 2030
  - numbers of older people with disability will rise by 900,000 (83%) but numbers aged 85+ with disability will more than double
  - numbers with dementia will increase by 80%
  - prevalence of disability will increase
  - DFLE at age 65 will rise by 1.6 years but LE will rise by more (2.8 years) producing an **expansion of disability**
- Under **Improved Health Scenario**
  - prevalence of disability will be almost constant
  - 170,000 fewer with disability than Central Health Scenario
  - still expansion of disability

FUTURE WORK

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Ageing Population Projections for Policy

- Extensions to current SIMPOP
  - More accessible for others to use
  - Updating with current (2010) population projections
- Different disability measure that incorporates lesser severity levels
- New stochastic version to incorporate uncertainty around estimates
- Microsimulation to incorporate effect of multimorbidity

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Interval-need dependency*

- **Critical-interval dependent (requires 24-hour care)**
  - SMMSE < 10/ severe or profound urinary incontinence with inability to dress or undress without help/ unable without help to perform: toilet/chair/feeding
- **Short-interval dependent (requires help at regular times daily)**
  - Unable without help to perform : bed/dressing and undressing/ hot meal/medication/washing face and hands
- **Long-interval dependent (requires help less than daily)**
  - Unable without help to perform: washing all over/shopping/light housework/heavy housework/managing money/toenails
- **Independent**

*Isaacs and Neville, 1975

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- New Dynamics of Ageing Programme

MAP2030
(www.lse.ac.uk/collections/MAP2030/)

nda PROGRAMME
new dynamics of ageing
a cross-council research programme

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