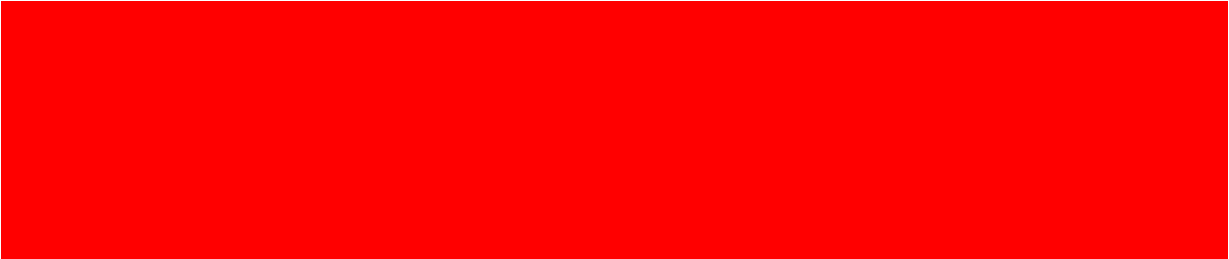# Using models to make the economic case

David McDaid

Associate Professorial Research Fellow

London School of Economics and Political Science

What Works Centre for Wellbeing Workshop

London, January 29, 2018.
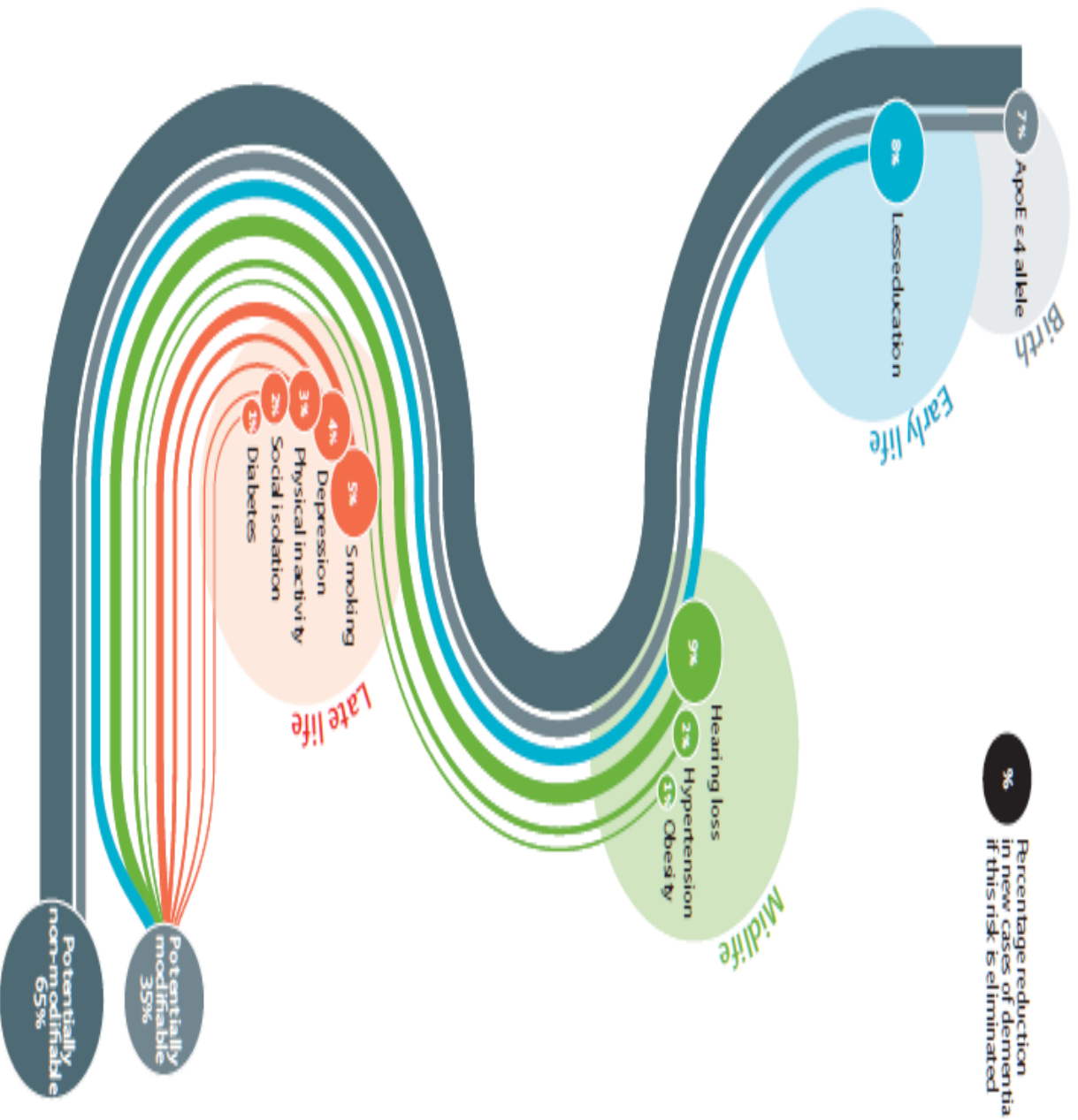
E-mail: d.mcdaid@lse.ac.uk

Why make use of modelling?

Why make use of modelling?

o Addressing uncertainty in results of any one study

o Synthesising data on costs and effects from multiple studies - often with different comparator interventions

o Assessing costs and effectiveness of ... interventions over longer time periods th... ... pirical studies

o Creating pot... ... nt interventions where loca... ...ctiveness and costs

o Looking at ... ... of coverage, uptake and continued e... ...rent interventions.

o Estimating b... ... ...ary impacts of investing in changes to infrastructure to implement wellbeing interventions.

o In the absence of definitive empirical studies, helping to prioritise where scare research funds may be invested in empirical trials.

Potential long time to impact perhaps key reason for modelling in promotion of health and wellbeing

Risk factors for dementia

The Lancet Commission presents a new life-course model showing potentially modifiable, and non-modifiable, risk factors for dementia.

THE LANCET

The best science for better lives

Birth

ApoE ε4 allele 7%

Early life

Less education 8%

Midlife

Hearing loss 9%

Hypertension 2%

Obesity 1%

Late life

Smoking 5%

Depression 4%

Physical inactivity 3%

Social isolation 2%

Diabetes 1%

Potentially non-modifiable 65%

Potentially modifiable 35%

% Percentage reduction in new cases of dementia if this risk is eliminated

35% risk factor
dementia
potentially
modifiable

Smoking
Depression
Physical
Inactivity
Social Isolation
Diabetes

Making use of modelling

Approaches to modelling

- Decision tree modelling
- Simple linear pathways from intervention to outcome
- Markov modelling – used for long time periods, probabilities of moving between different health, wellbeing or other states at end of Markov cycle

- Micro-simulation models
- Individuals move along model pathway, experiencing changes in outcomes, at varying points in time. Model considers likelihood of a further event and when this is likely to occur. This approach can be used to handle very complex models, e.g. weather forecasting.

Modelling Software

- Commercial Packages
  - – Treeage Pro – Used extensively in health economics
- Excel for decision modelling and simulation modelling
- R – for simulation modelling
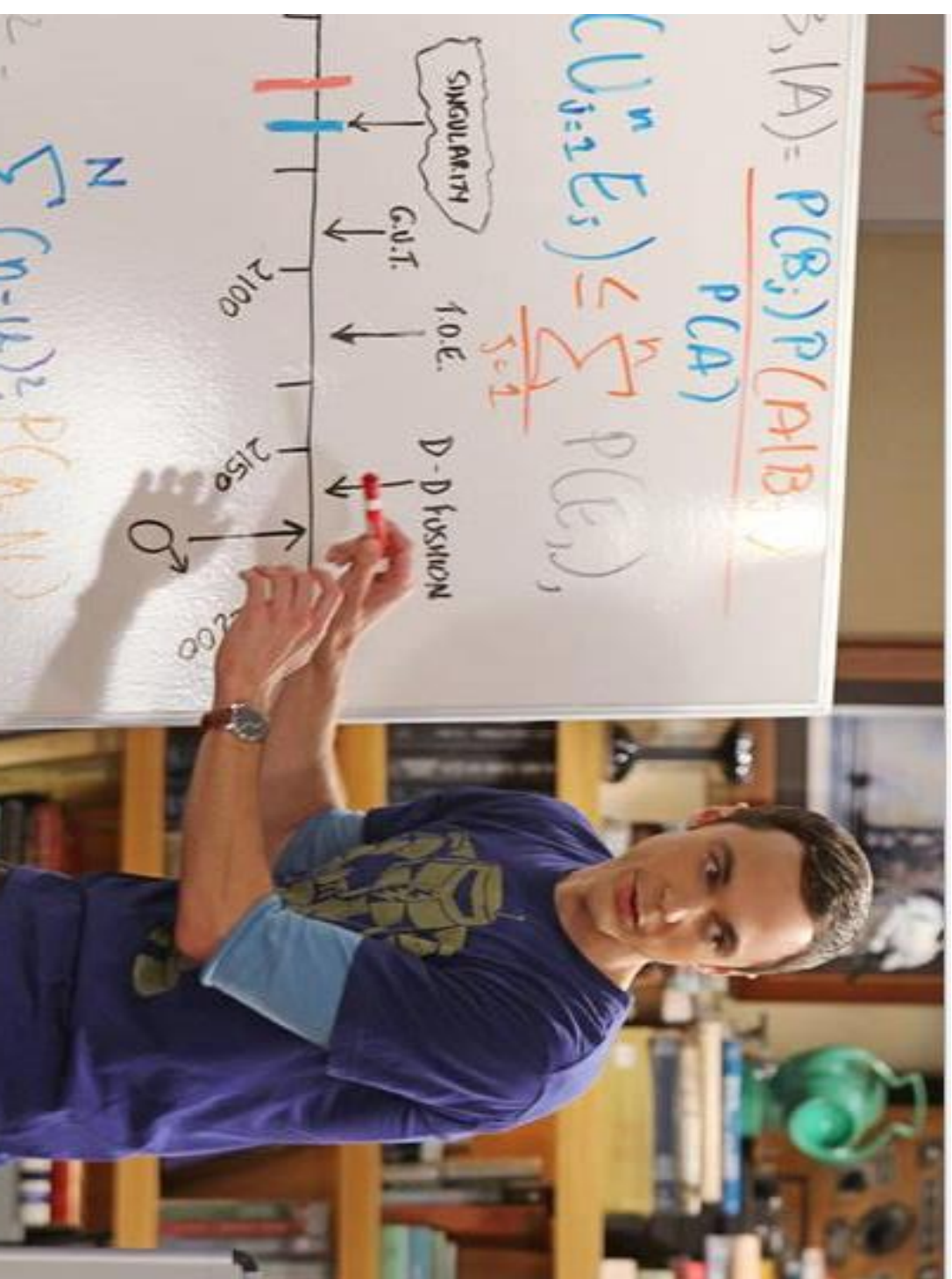- Bespoke software /models

Modelling Return on Investment

Examples of actions – work for Public Health England

Simulation models look at potential costs and benefits of investing promotion, prevention

ROI to different stakeholders/sectors & different timelines

PHE model designed England or local levels

Conservative assumptions used

PHE highlights 8 ways for local areas to prevent mental ill health

New tool identifies the most cost-effective programmes to help prevent mental ill health in local communities.

From: **Public Health England**

Published 30 August 2017

Public Health
England

Public Health
England

Commissioning Cost-Effective Services for Promotion of Mental Health and Wellbeing and Prevention of Mental Ill-Health

LSE
PSSRU
Personal Social Services Research Unit

Our approach: Return on Investment Modelling

- Looked at **evidence-based** interventions (NHS and non-NHS): must have well-established outcomes

- 8 interventions modelled

- These 15 are not necessarily the priority areas

- For each ... what **economic consequences** could we measure – different sectors and over different time periods

- Measured economic impacts by system/budget

- ... and by year, discounted back

- If in doubt, conservative in estimates

- **NOTE** Any 'economic pay-offs' are over and above the **health, QOL and wellbeing benefits** to individuals

McDaid, Park & Knapp 2017;

Our approach – 1

Aim Rapid reviews for evidence on costs effectiveness & systematic reviews / meta analysis on effects

- Look at **evidence-based** mental health interventions (incl. non-NHS) – must have well-established outcomes

  o Linear decision analytic **modelling**

As far as the robust evidence base allows:

  o Include **promotion and primary prevention**
  o Look at **widest range** of economic impacts
  o Estimate impacts over long **time periods**
  o If in doubt, adopt **conservative perspective**

Our approach – 2

o Examine interventions from different perspectives:

- pay-offs to **society as a whole, different public sectors and health sector** and

- Identifying realisable cash savings as we as benefits of freeing up resources

o Over and above the economic pay-offs there are **health, QOL and non-health benefits** to individuals

o The wider impacts are important , given the high 'external' costs of many MH problems ... even if not always considered in decision-making

a. Findings are <u>not</u> definitive: a **platform for discussion**

b. Need adapting to different contexts;

c. Interventions modelled are **not** necessarily the only ones that are economically attractive

Mental health promotion ROI Tool

LSE Personal Social Services Research Unit | **PSSRU** | Public Health England

Intervention Choice Menu

Click on cell in yellow to the right to select England as a whole, or a specific English Local Authority or NHS Clinical Commissioning Group (CCG) area. If no area selected model default values will be used

Click on links below to select area for potential investment

England

Children: Whole school anti-bullying programme

Collaborative Care for Physical Health Problems

Children: Social and Emotional Learning

Older People: Tackling Loneliness through Volunteering and Social Activities

Workplace: Wellbeing Programme

Adults: Debt and welfare advice

Workplace: Stress Prevention
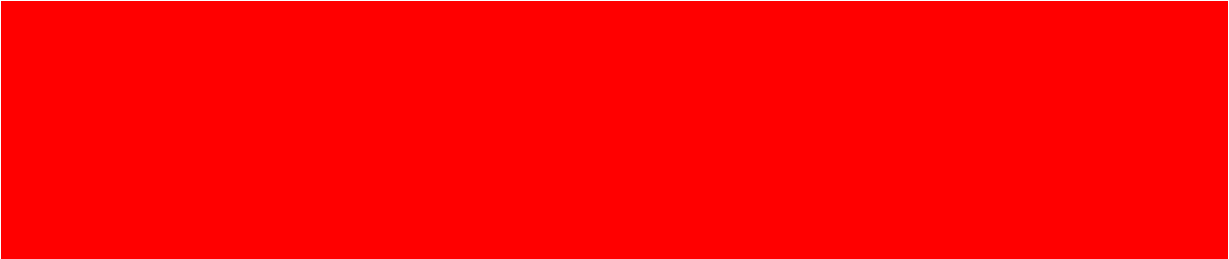
Adults: Suicide Prevention

Tackling Loneliness

Intervention considered in model

Target	All community dwelling older adults (aged 65 plus)
Intervention / Funder	Signposting service to social activities provided in public locations in England, then participation in social activities and / or volunteering. Local Authorities fund cost of signposting & initial participation in activities.
Outcome evidence	Impacts on likelihood of being lonely 9% reduction in loneliness – reduction in risk of depression, cardiovascular disease & developing dementia through avoidance of severe levels of loneliness over 5 years
Economic pay-offs	Impacts on use of primary and secondary health services including of avoidance of self-harm, social care for dementia, informal care & value of volunteering

Identifying economic costs of loneliness for model

Review results

- Rapid literature review across several databases and grey literature

- Examined over 2000 papers looking at different aspects of resource use, cost and loneliness

- Limited discussion of impact on economic cost

- But literature from high income country settings of studies on loneliness as risk factor for health concerns and resource utilisation used to inform model development

Loneliness associated with poor health & wellbeing

Loneliness
Loss of social networks

- Risks to cognitive health
- Accident & Emergency
- Strokes
- Coronary Heart Disease
- Depression
- Self-harm
- Unplanned hospital admissions
- GP Consultations
- Lower wellbeing

PSSRU   LSE
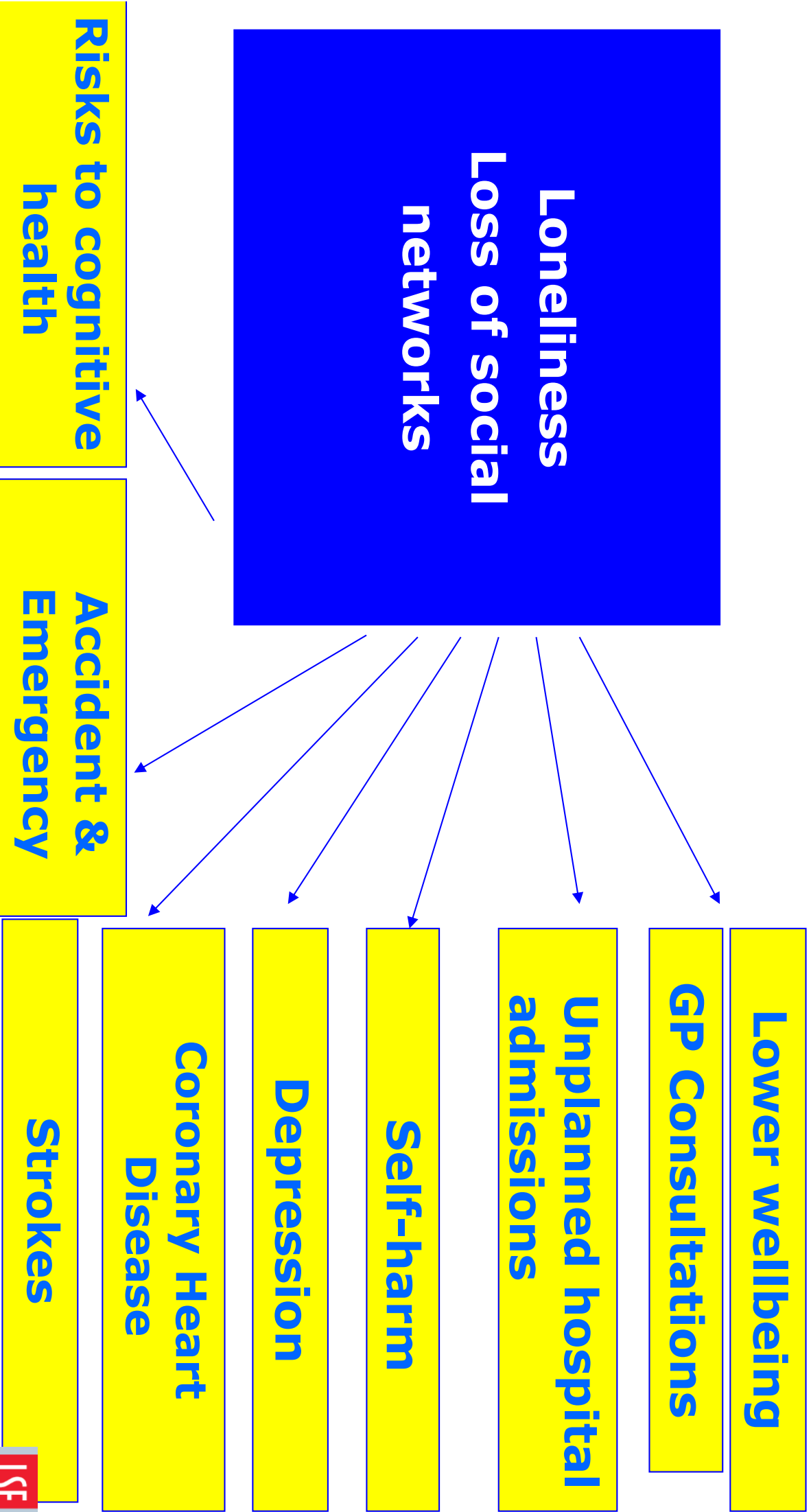
Loneliness and Dementia
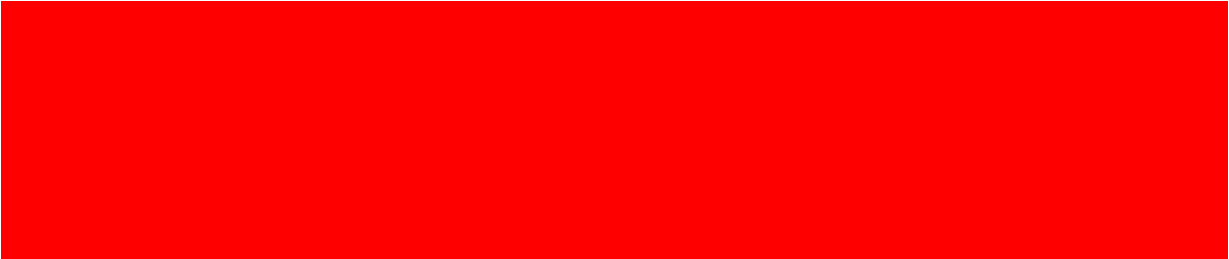
- Meta analysis and European studies provide good evidence on longitudinal risk of dementia in lonely population

- Holwerda, T. J., et al. (2014). "**Feelings of loneliness, but not social isolation, predict dementia onset:** results from the Amsterdam Study of the Elderly (AMSTEL)." J Neurol Neurosurg Psychiatry **85**(2): 135-142.

- 1.64 times greater (1.05 – 2.64) in sample of 2,173 non-demented older people

- Kuiper, J. S., et al. (2015). "**Social relationships and risk of dementia: A systematic review and meta-analysis of longitudinal cohort studies**." Ageing Res Rev 22: 39-57.

- Subsets of 19 studies on found relative risk of dementia 1.58 times greater in lonely population.

Unplanned Hospital Contacts

- Links between loneliness and increased rates of hospital inpatient admission on the island of Ireland

- Valued at rate of short stay hospital admission using national tariffs

- Increased rates of accident and emergency (ER) contact rates from loneliness based on observations in Swedish context

- Valued at rate for English National Tariff for Emergency Medicine Category 2 investigation with Category 3 treatment.

Depression, Stroke, Coronary Heart Disease

- Some evidence in literature that loneliness & depression correlated & some evidence that loneliness increases risk of depression

- Model accounts of increased risk of depression, but also that only 1 in 6 people who are depressed contact health services.

- Recent meta analysis of longitudinal studies also supports associations between poor social relationships and increased risk of incident coronary heart disease (29%) and stroke (32%) (Valtorta et al 2016).

- Modest and conservative costs for CHD (drug therapy), depression (basic time limited psychological therapy) and stroke (outpatient & inpatient costs) used in model

Return on Investment Results

Excerpt of model structure

invest in measures to tackle loneliness

invest in navigation for loneliness alleviation

makes use of loneliness intervention — p_uptake

does not make use of loneliness intervention

always lonely — #

not lonely

sometimes lonely — p_initial_sometime_lonely

always lonely — p_initial_always_lonely

not lonely — #

dead — 0

always lonely — p_initial_always_lonely

sometimes lonely — p_initial_sometime_lonely

dead — 0

not lonely — #

stays not lonely

becomes always lonely — p_always_lonely_int

becomes sometimes lonely — p_sometimes_lonely_int

dies — p_death

not lonely

always lonely

sometimes lonely

dead

Small scale navigation studies in England point to potential reduction in loneliness risk ~ 9%

Engagement rate of 6%

PSSRU LSE

ROI: Baseline Scenario for England

ROI: Tackling Loneliness and Social Isolation in Older Adults

Area Selected:
England

LSE PSSRU — Personal Social Services Research Unit

Total Net Costs / Payoffs (Default values 2015 prices)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total Cost / Saving
Group Activities	£11,653,886	£0	£0	£0	£0	£11,653,886
Signposting Service	£5,389,922	£0	£0	£0	£0	£5,389,922
Total cost intervention	£17,043,809	£0	£0	£0	£0	£17,043,809
GP Visits	£0	-£3,857,269	-£3,658,682	-£3,478,422	-£3,306,949	-£14,301,322
Depression Treatment	£0	-£483,721	-£459,960	-£438,393	-£417,833	-£1,799,907
Self-Harm Treatment	£0	-£32,907	-£31,334	-£29,900	-£28,531	-£122,672
CHD Treatment	£0	-£880	-£828	-£781	-£736	-£3,224
Stroke Treatment	£0	-£26,262	-£24,767	-£23,410	-£22,125	-£96,564
Dementia	£0	-£1,692,428	-£1,602,969	-£1,521,764	-£1,444,608	-£6,261,769
Hospital admissions	£0	-£13,860,401	-£13,188,998	-£12,579,596	-£11,998,270	-£51,627,265
A&E Admissions	£0	-£483,655	-£458,170	-£435,037	-£413,054	-£1,789,917
Additional Volunteering through Signposting	-£1,114,529	-£1,127,414	-£1,077,121	-£1,029,184	-£983,380	-£5,331,629
Total cost consequences (saving if negative value)	-£1,114,529	-£21,564,936	-£20,502,830	-£19,536,488	-£18,615,487	-£81,334,269
Total net costs (saving if negative value)	£15,929,280	-£21,564,936	-£20,502,830	-£19,536,488	-£18,615,487	-£64,290,460
Cumulative Return per Pound Invested	£0.07	£1.33	£2.53	£3.68	£4.77	£4.77
Loneliness Free Years Gained	0	33,140	32,246	31,435	30,644	127,466

ROI: Baseline Scenario Local Area

ROI: Tackling Loneliness and Social Isolation in Older Adults

LSE PSSRU Personal Social Services Research Unit

Area Selected:
Bedford

Total Net Costs / Payoffs (Default values 2015 prices)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total Cost / Saving
Group Activities	£34,372	£0	£0	£0	£0	£34,372
Signposting Service	£15,897	£0	£0	£0	£0	£15,897
Total cost intervention	£50,268	£0	£0	£0	£0	£50,268
GP Visits	£0	-£11,377	-£10,791	-£10,259	-£9,753	-£42,180
Depression Treatment	£0	-£1,427	-£1,357	-£1,293	-£1,232	-£5,309
Self-Harm Treatment	£0	-£97	-£92	-£88	-£84	-£362
CHD Treatment	£0	-£3	-£2	-£2	-£2	-£10
Stroke Treatment	£0	-£77	-£73	-£69	-£65	-£285
Dementia	£0	-£4,992	-£4,728	-£4,488	-£4,261	-£18,468
Hospital admissions	£0	-£40,879	-£38,899	-£37,102	-£35,387	-£152,268
A&E Admissions	£0	-£1,426	-£1,351	-£1,283	-£1,218	-£5,279
Additional Volunteering through Signposting	-£3,287	-£3,325	-£3,177	-£3,035	-£2,900	-£15,725
Total cost consequences (saving if negative value)	-£3,287	-£63,603	-£60,470	-£57,620	-£54,904	-£239,885
Total net costs (saving if negative value)	£46,981	-£63,603	-£60,470	-£57,620	-£54,904	-£189,616
Cumulative Return per Pound Invested	£0.07	£1.33	£2.53	£3.68	£4.77	£4.77
Loneliness Free Years Gained	0	98	95	93	90	376

ROI: Scenario Analysis

Tackling Loneliness and Social Isolation in Older Adults : Checking and/or Adjusting Model Parameters

You can use your own values rather than the model's predefined assumptions by inputing these into one or more of the blue coloured cells

LSE PSSRU Personal Social Services Research Unit

Area selected:	Bedford

Return to Volunteering Intervention Contents Page

Return to Intervention Choice Menu

Intervention Costs

	Default	Input your own value for costs if desired
Navigator cost per client reached	£9.25	
Initial year cost of group based activity per client reached	£20.00	

Other Costs

	Default	Input your own value for costs if desired
Annual (conservative) cost of managing coronary heart disease	19	
Annual cost of managing mild strokes	3000	
Average annual cost of managing dementia	32000	
Average cost of treating self-harm event	581	
Average cost of hospital admission	608	
Average cost of A&E contact	170	
Annual average cost of managing depression	£961.00	

Other parameters

	Default	Input your own value if desired
Initial engagement rate with service	0.06	

Example: varying effectiveness & cost of navigation

Return on Investment

Reduction in relative risk of loneliness

Legend: 50 (green), 20 (black), 15 (yellow), 9.25 (brown), 5 (blue)
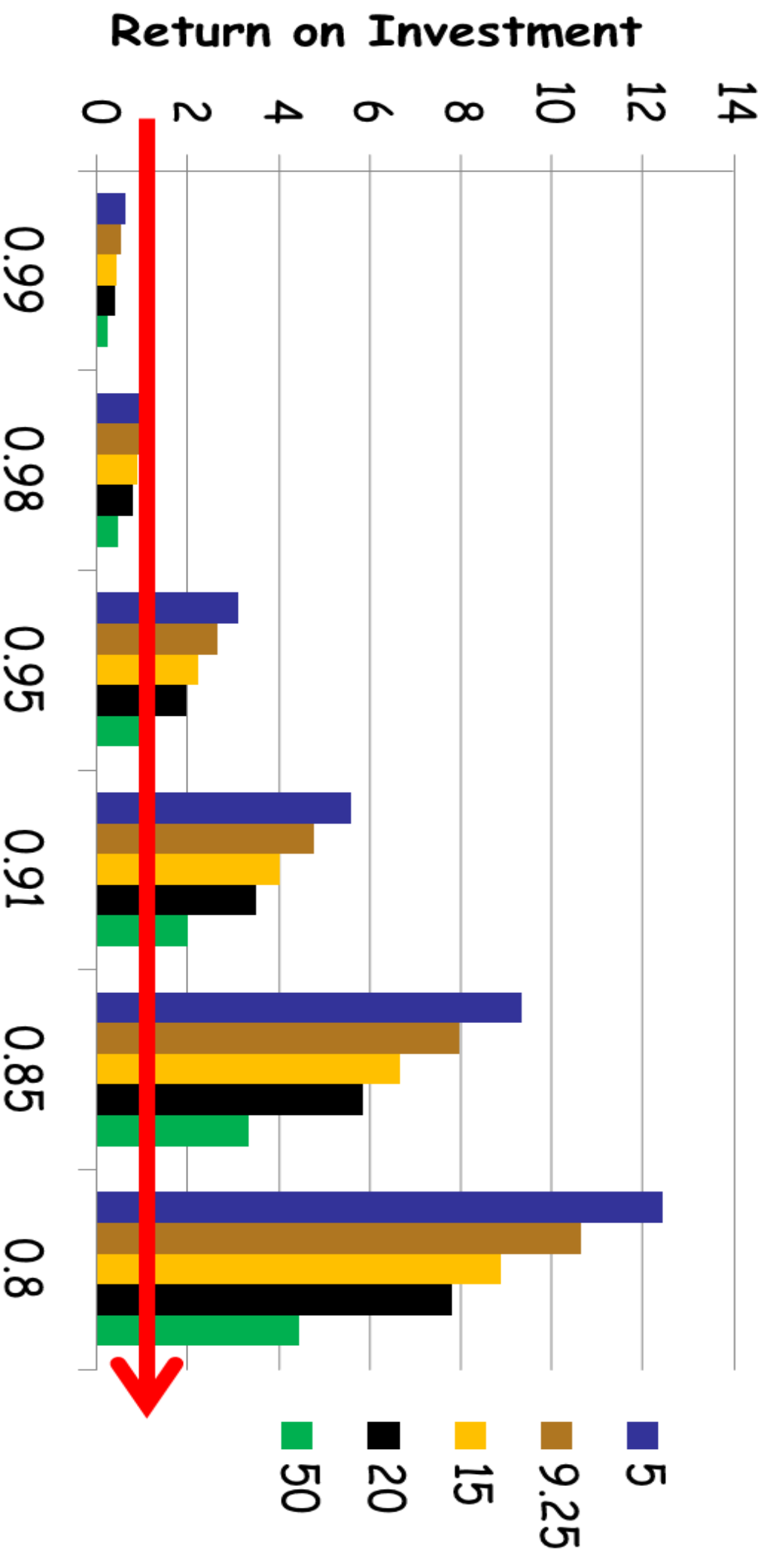
Importance of local context in models

Access to transport and to volunteers with transport an issue

Cost an issue in rural areas – limited public transport

Identifying activities that appeal to men and women;

Challenges in sustainable financing and willingness of participants to pay small charges to support group activities.

Recruitment/retention of volunteers who are lifeblood of intervention;

Capturing all aspects of the impact of loneliness intervention; more than just measurement of changes in recorded levels of loneliness

Bullying

Bullying interventions: effects

- **_KiVa_**: evidence-based school-set programme

- Developed in Finland; delivered by teaching staff

- KiVa focuses on enhancing empathy, self-efficacy, & anti-bullying attitudes of classroom peers. Positive changes in behaviour of pupils who are neither bullies nor victims can reduce rewards that bullies perceive they receive … and so _reduce incentives for bullying_

- Addresses _'traditional' & cyberbullying_

- Research shows that it _significantly reduces_ bullying victimisation & perpetration …

- … and is strongly _cost-effective_.

Karna et al _J Consulting & Clinical Psychology_ 2014; McDaid et al _PSSRU/MQ report_ 2017

Structure of Model

Invest in KIVA bullying prevention programme?

- KIVA+usual action
- usual action only

KIVA+usual action:

- not bullied (#)
  - becomes bullied intermittently
  - stays not bullied — p_bully_kiva
    - bullied intermittently
    - not bullied
- bullied intensely (0)
  - becomes bullied intermittently
  - stays bullied intensely — p_bully_kiva_intense
    - bullied intermittently
    - bullied intensely
  - becomes not bullied — p_bully_kiva_intense_int...
    - not bullied
- bullied intermittently — p_bully_kiva
  - becomes bullied intermittently
  - becomes bullied intensely — p_bully_kiva_intermitten...
    - bullied intensely
  - stays bullied intermittently (#) — p_bully_kiva_intermitten...
    - bullied intermittently
  - becomes not bullied — p_bully_kiva_intermitten...
    - bullied intermittently

usual action only:

- not bullied (#)
  - stays not bullied — p_bullying_usualcare
    - not bullied
  - becomes bullied intermittently — p_bullying_usualcare
    - bullied intensely
- bullied intensely (0)
  - becomes bullied intermittently
  - becomes not bullied — p_bully_usualcare_intense
    - bullied intermittently
  - stays bullied intensely — p_bullying_usual_intense...
    - bullied intermittently
- bullied intermittently — p_bullying_usualcare
  - becomes not bullied
  - becomes bullied intensely — p_bullying_usual_intense...
    - not bullied
  - stays bullied intermittently (#) — p_bullying_usual_intermi...
    - bullied intermittently
  - becomes bullied intensely — p_bullying_usual_intermi...
    - bullied intensely

Example of ROI

ROI: Whole School Anti-Bullying Programme

Area Selected:

Bedford

**Total Net Costs / Payoffs (Default values 2015 pri[...]**

	Total Cost / Saving
Incremental cost of KIVA intervention	£7,198
CAMH cost	-£3,520
GP cost	-£37
Pupil Absenteeism	-£6,492
Self-Harm	-£1,332
Total cost (saving if negative value)	-£11,381
Overall Return per Pound Invested	£1.58

Intense Bullying Victimisation Free Years Gained	32	36	40	42	150
		[...]89	£1.28	£1.58	£1.58
				-£3,699	-£11,381

Conservative analysis: several different long term studies reported better adult outcomes for children who are not bullied: for children, work, lower rate of education, work, lower rate of depression. These increase long term, return on investment

Estimating long term ROI of bullying intervention

New research shows the benefit of bullying interventions in schools
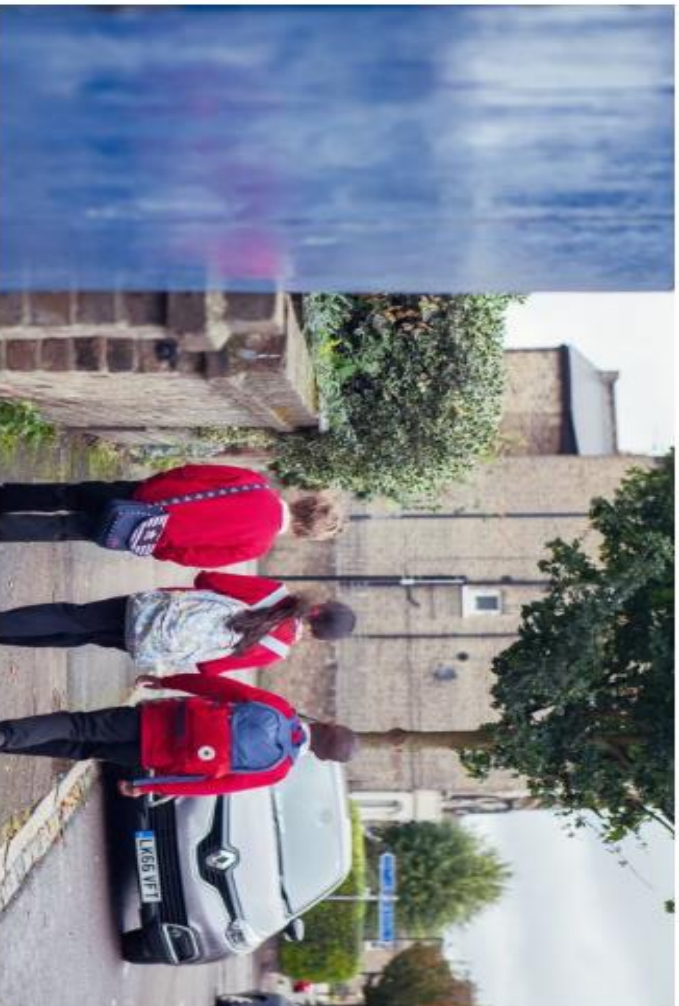
- Expanded PHE model to link with new evidence on the long term wider economic impacts of bullying to age 50

- Potential very long term return of £146:1

- But need to be cautious as long term data for children in the early 1970s.

- Bullying associated with adverse outcomes in more recent child cohorts

Potential long term impacts of bullying intervention

	Age 7-8	Age 8-9	Age 9-10	Age 10-11	Age 50	Total Cost / Saving
Incremental cost of KIVA intervention	£320	£116	£112	£108	£0	£656
CAMH cost	£0	-£83	-£112	-£126	£0	-£321
GP cost	-£1	-£1	-£1	-£1	£0	-£3
Pupil Absenteeism	-£129	-£143	-£158	-£162	£0	-£592
Self-Harm	£0	-£30	-£41	-£46	£0	-£118
Lost Adult Earnings to Age 50					-£2,932	-£2,932
Health Service Costs to Age 50					-£971	-£971
Lost Wealth Accumulation to Age 50 (Savings)					-£15,332	-£15,332
Lost Home Ownership					-£76,047.43	-£76,047
					£0	£0
Total cost (saving if negative value)	-£129	-£257	-£312	-£336	-£95,282	-£96,316
Overall Return per Pound Invested	£0.40	£0.89	£1.27	£1.58	£146.78	£146.78

LSE PSSRU

Debt

Debt and mental health

Estimated that 16.1% of UK adults (8.25 million people) were over-indebted – regularly missing monthly payments in at least three of the last six months or finding meeting commitments a heavy burden. (Money Advice Service 2016).

Unmanageable debt associated with increased risk of common mental health problems, relative risk 1.33 compared to general population.

Analysis of coroner records of 300 people who died by suicide in England in 2010 and 2011 revealed "4% of suicides entirely related to the recession, employment or financial-related difficulties and a further 9% where such difficulties contributed a lot to the suicide" Coope 2015.

Debt and welfare advice services

Target

General population without mental health problems at risk of unmanageable debt or welfare problems

Intervention

Debt advice services, provided on face to face, telephone or internet basis; including GP practice training to increase referral to debt advice services

Funder

Complex: Subsidies from finance industry (Fair Share), Debt Advice Levy, Creditors, Local Authorities & CCGs

Outcome evidence

Trial based and observational evidence on value of debt and welfare advice services.

Economic pay-offs

Avoidance of costs to health and social care services; legal system; productivity losses; local economy; reduction in suicidal behaviour

Example of ROI

ROI: Providing support for people in debt

Area Selected:
Bedford
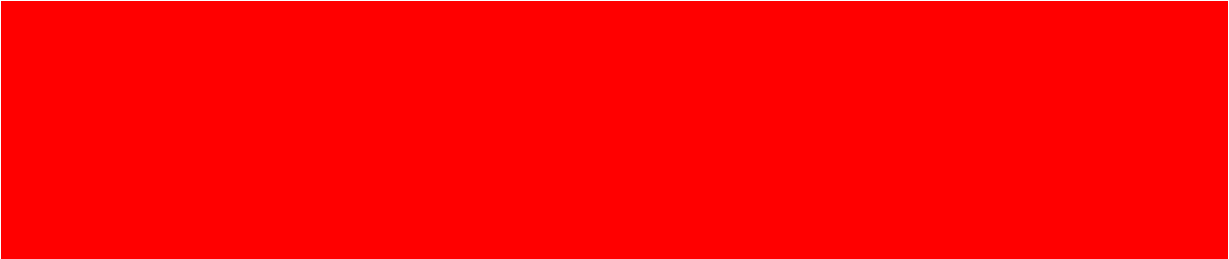
Total Net Costs / Payoffs (Default values 2015 prices)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total Cost / Saving
Total cost intervention	£1,560,858					
including GP Awareness Training	£88,940	£0	£0	£0	£88,940	£88,940
including Face to Face Debt Advice Service	£1,471,917	£0	£0	£0	£1,471,917	£1,471,917
GP Visits	-£56,922	-£49,997	-£48,306	-£46,673	-£45,095	-£246,993
Depression Treatment	£0	-£24,418	-£25,967	-£25,546	-£24,760	-£100,691
Legal and Debt Administration	£0	-£333,315	-£322,043	-£311,153	-£300,631	-£1,267,141
Workplace Stress Absence due to Debt	-£215,012	-£173,192	-£165,957	-£159,997	-£154,499	-£868,656
Depression Productivity Losses	£0	-£384,071	-£405,625	-£400,157	-£388,585	-£1,578,438
Total cost consequences (saving if negative value)	-£271,933	-£964,992	-£967,899	-£943,525	-£913,569	-£4,061,919
Total cost	£1,288,924	-£964,992	-£967,899	-£943,525	-£913,569	-£2,501,061
Cumulative Return per Pound Invested	£0.17	£0.79	£1.41	£2.02	£2.60	£2.60
Cumulative QALYs gained	0.00	8.14	8.82	8.85	8.75	34.55

McDaid, Park, Knapp et al forthcoming 2017

Economic pay-offs per £1 invested

	NHS	Other public sector	Other	Total
Whole school anti-bullying programme	0.68	-	0.90	1.58
School social and emotional learning (impacts on depression only)	0.35	0.02	4.71	5.08
Workplace wellbeing	0.05		2.31	2.37
Workplace stress alleviation	0.30	0.18	1.52	2.00
Collaborative care for physical health problems	0.26		1.26	1.52
Loneliness alleviation for older people	0.95	0.31	0.31	1.26
Debt and Welfare Advice	0.22	0.81	1.57	2.60
Suicide prevention	2.17	0.76	36.18	39.11

Programmes in yellow not funded outside of NHS.
Very conservative analysis.
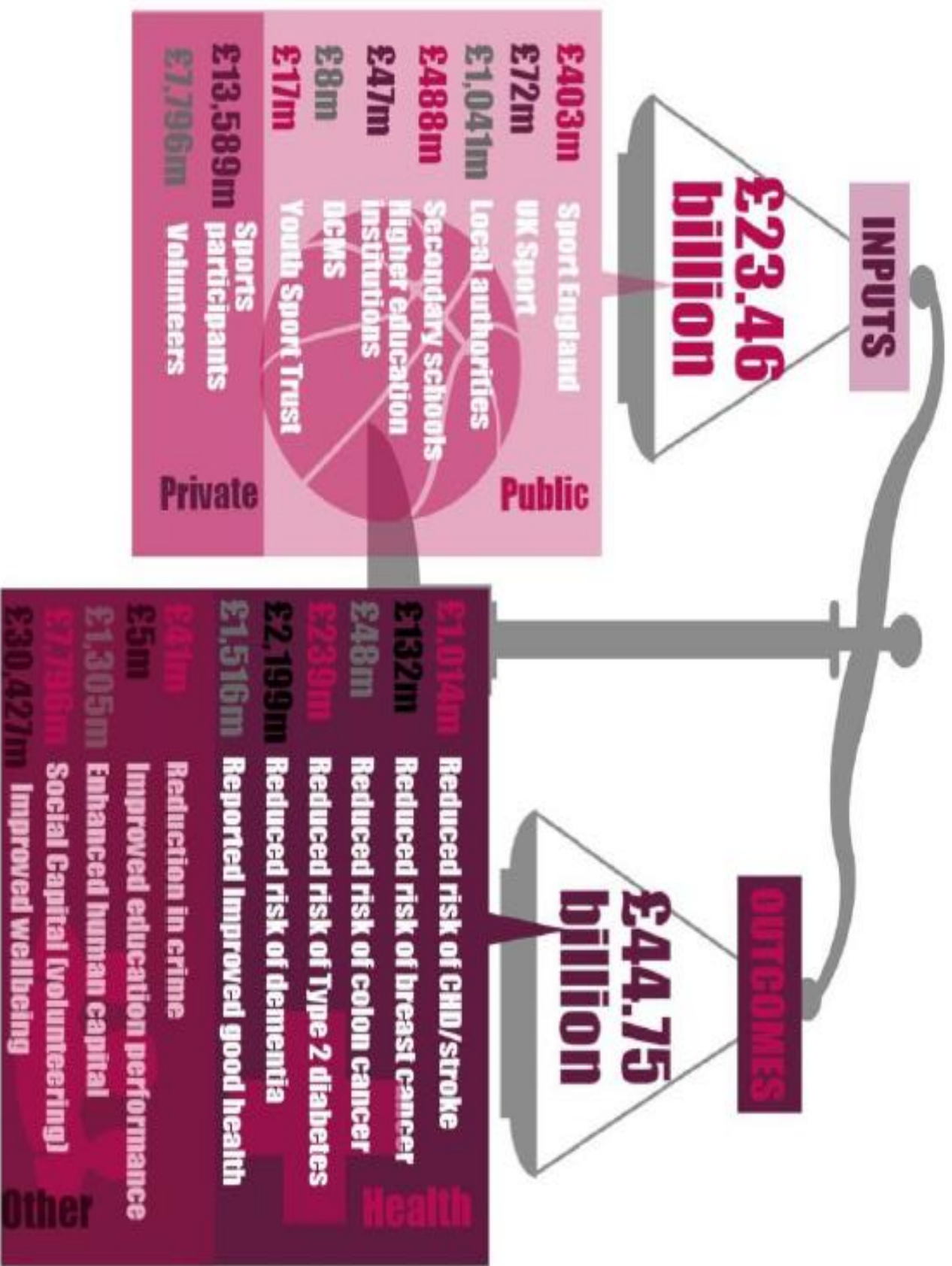Not all long term impacts or non mental health impacts included in analysis

Social Return on Investment Modelling
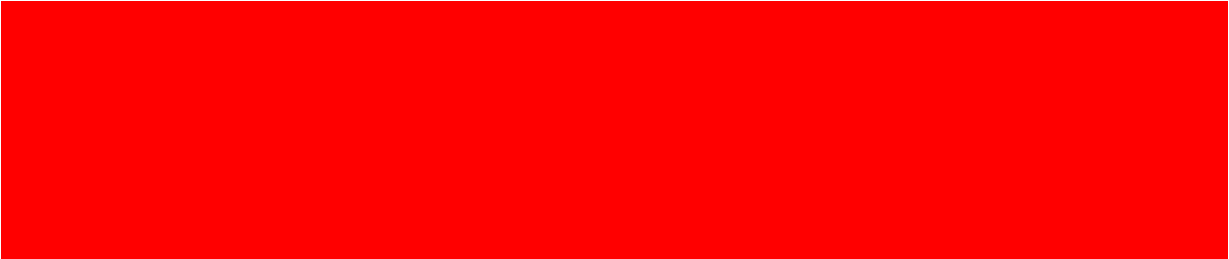
The impact map below outlines the first three stages of the SROI analysis.

STAGE 1:

IDENTIFY STAKEHOLDERS

- Central government
- Local government
- Participants
- Volunteers
- Sports organisations
- Educational institutions

STAGE 2:

QUANTIFY INPUTS

- Money (investment from stakeholders including revenue and capital spend and expenditure by participants
- Time (volunteering)

AUDIT OF ACTIVITIES

- Volunteering
- Organised activities
- Open access
- Informal participation
- Mass / elite participation

MEASURE OUTPUTS

- Increased / decreased participation in sport and exercise
- Hours worked volunteering

STAGE 3:

VALUE OUTCOMES

- Improved health
- Improved education / enhanced academic performance
- Reduced crime
- Improved subjective wellbeing
- Improved social capital

Social Return on Investment in Sport: A participation wide model for England 2016
Sheffield Hallam University

Social Return on Investment in Sport: *A participation wide model for England 2016*
Sheffield Hallam University

INPUTS

£23.46 billion

Public

£403m — Sport England
£72m — UK Sport
£1,041m — Local authorities
£488m — Secondary schools
£47m — Higher education institutions
£8m — DCMS
£17m — Youth Sport Trust

Private

£13,589m — Sports participants
£7,796m — Volunteers

OUTCOMES

£44.75 billion

Health

£1,014m — Reduced risk of CHD/stroke
£132m — Reduced risk of breast cancer
£48m — Reduced risk of colon cancer
£239m — Reduced risk of Type 2 diabetes
£2,199m — Reduced risk of dementia
£1,516m — Reported Improved good health

Other

£41m — Reduction in crime
£5m — Improved education performance
£1,305m — Enhanced human capital
£7,796m — Social Capital (volunteering)
£30,427m — Improved wellbeing

Other considerations when modelling

Intersectoral activity

- Many actions take place across sectors

- Multiple sectors may pay, multiple sector may benefit

- Focus on specific issues around making an economic case in language relevant to other sectors

- Help inform discussions re implementation of intersectoral activities

Speaking the right language

- Make arguments using the language of the sector in question e.g. workplaces, schools

- For school based programmes any impacts on education outcomes: truancy rates, exam performance, classroom disruption, teacher absenteeism rates, reputation

- For workplaces: creativity, innovation, absenteeism, reduction in work accidents, performance at work

Linking to registries and datasets

Look for opportunities to use registries to identify long term effects.

Ongoing evaluation to assess exposure to loneliness alleviation in UK and use of health, social and long term care services

Understanding Society Data on arts and sports engagement used to help determine monetary value of wellbeing

To summarise

Modelling can play an important role in making the economic case for wellbeing promoting interventions

Particularly in showing long term impacts & impacts across sectors

Important to be transparent and conservative in assumptions made