

The economics of prevention

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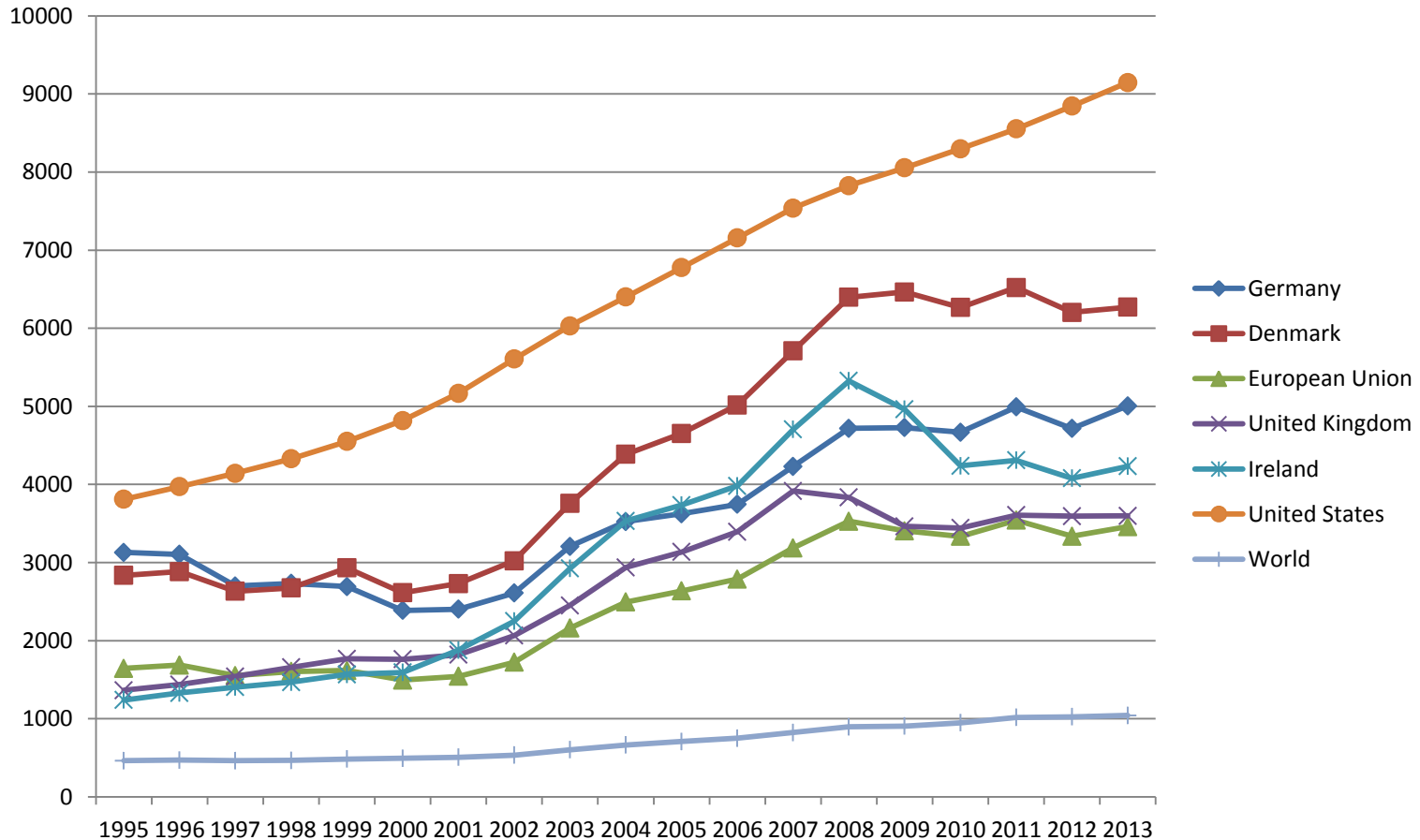


- Background

- Increasing health care expenditures related to:

- Population ageing
 - Rising expectations
 - Poor life style choices
 - The separation of budgetary consequences from consumption decisions
 - Technological advance and bias toward “big ticket” technology
 - Failure to decommission obsolete technology/over capacity

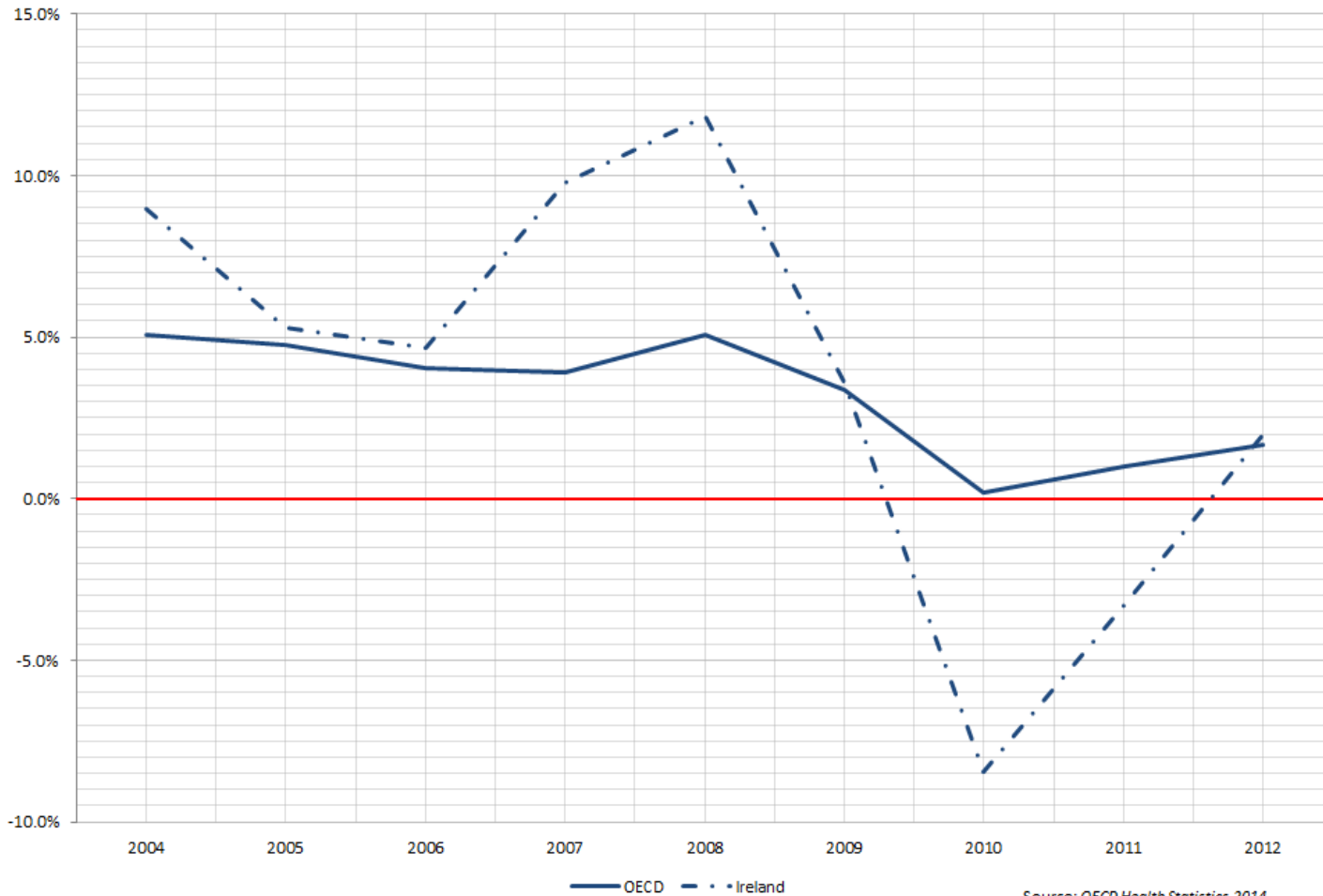
Per capita expenditure selected entities constant prices



Source World Bank 2016:

<http://data.worldbank.org/indicator/SH.XPD.PCAP>

Health expenditure growth rates (in real terms) since 2004, Ireland and OECD average



Source: OECD briefing note

file:///C:/Users/0108712s/Documents/Briefing-Note-IRELAND-2014.pdf

- Interest in cost containment
 - Protocols and evidence based incentives
 - GP gatekeeping
 - Deinstitutionalization
 - HTA
 - Retrenchment – privatise
- Prevention – “an ounce of prevention is better than a pound of cure” – morbidity compression

- The contribution of chronic diseases— Estimated Annual Direct Medical Expenditures*
 - Cardiovascular disease and stroke** \$313.8 billion in 2009
 - Cancer \$89.0 billion in 2007
 - Smoking \$96 billion in 2004***
 - Diabetes \$116 billion in 2007
 - Arthritis \$80.8 billion in 2003
 - Obesity \$61 billion in 2000*

* Different methodologies were used in calculating costs.

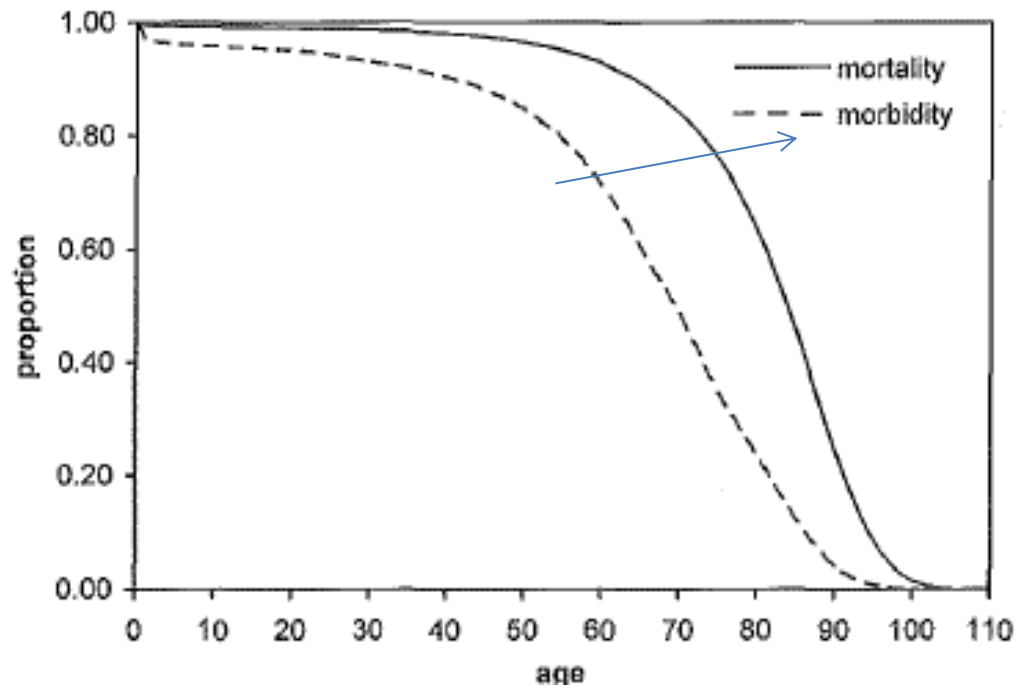
** Includes heart diseases, coronary heart disease, stroke, hypertensive disease, and heart failure combined.

*** Average annual expenditure, 2001–2004.

Source: The power of Prevention (CDC, 2009).

<http://www.cdc.gov/chronicdisease/pdf/2009-Power-of-Prevention.pdf>

Morbidity compression: the rectangularization of morbidity and mortality survival curves



- Can prevention work?
 - Not smoking and quitting if smoking – roughly 400,00 SAD in US each year
 - Regular screening for colorectal cancer can reduce mortality. When colorectal cancer is found early and treated, the 5-year relative survival rate is 90%.
 - For women aged 40 years or older, mammograms every 12–33 months significantly reduce mortality from breast cancer.
 - For women who have been sexually active and have a cervix, screening with a Pap test reduces incidence of, and mortality from, cervical cancer.
 - Females aged 11–26 years can help prevent cervical, vaginal, and vulvar cancers by getting the HPV vaccine.
 - Community water fluoridation results in fewer cavities among community members. In one study of communities with at least 20,000 residents, every \$1 invested in community water fluoridation yielded about \$38 in savings from fewer cavities treated.

Source: The power of Prevention (CDC, 2009).

<http://www.cdc.gov/chronicdisease/pdf/2009-Power-of-Prevention.pdf>

- Does prevention work
 - Which multiple risk-factor interventions are effective and cost effective in the primary prevention of CVD within a given population?
 - “This review suggests that there is some support that primary preventative population programmes involving education, mass media and screening in members of general populations can be effective in improving some CVD risk factors and behaviours. Considerable uncertainty is left about the size of these effects and the effect on health outcomes summarised across all programmes...Whether the observed findings of the programmes that were conducted many years ago remain generally applicable in the UK at the current time is not clear.
 - Source: <https://www.nice.org.uk/guidance/ph25/evidence/reviews-and-primary-studies-3-effectiveness-374840749>

- If it does work, is it cost-effective? does it save money?
 - “[A]lthough some preventive measures do save money, the vast majority reviewed in the health literature do not. Careful analyses of the costs and benefits of specific interventions, rather than broad generalizations, is critical.”

Source: Cohen, S. T., Neumann P.J., et al. (2008). "Does Preventive Care Save Money? Health Economics and the Presidential Candidates."
The New England Journal of Medicine 358(7): 661-663.

**Cost-Effectiveness of selective primary, secondary and tertiary preventive measures
(2006 Dollars)***

	Cost-Effectiveness Ratio
Primary prevention measures	
<i>Haemophilus influenzae</i> type b vaccination of toddlers	Cost-saving
One-time colonoscopy screening for colorectal cancer in men 60-64 years old	Cost-saving
Newborn screening for medium-chain acyl-coenzyme A dehydrogenase deficiency	\$160/QALY
High-intensity smoking-relapse prevention program, as compared with low-intensity program	\$190/QALY
Intensive tobacco-use prevention program for seventh- and eighth-graders	\$23,000/QALY
Screening all 65-year-olds for diabetes as compared with screening 65-year-olds with hypertension for diabetes	\$590,000/QALY
Antibiotic prophylaxis (amoxicillin) for children with moderate cardiac lesions who are undergoing urinary catheterization	Increases cost and worsens health
Secondary and tertiary prevention	
Cognitive-behavioral family intervention for patients with Alzheimer's disease	Cost-saving
Cochlear implants in profoundly deaf children	Cost-saving
Combination antiretroviral therapy for HIV-infected patients	\$29,000/QALY
Liver transplantation in patients with primary sclerosing cholangitis	\$41,000/QALY
Implantation of cardioverter-defibrillators in appropriate populations, as compared with medical management alone	\$52,000/QALY
Left ventricular assist device, as compared with optimal medical management, in patients with heart failure who are not candidates for transplantation	\$900,000/QALY
Surgery in 70-year-old men with a new diagnosis of prostate cancer, as compared with watchful waiting	Increases cost and worsens health

*The cost-effectiveness ratio is the incremental costs divided by the incremental benefits, relative to a comparator. The comparator is omitted from the intervention's description if it was no treatment or current treatment or if the intervention was added to, rather than substituted for, another treatment. Source: (Cohen, Neumann P.J. et al. 2008).

Cohen, S. T., Neumann P.J., et al. (2008). "Does Preventive Care Save Money? Health Economics and the Presidential Candidates." *The New England Journal of Medicine* 358(7): 661-663.

- Some specific examples of why it may not work
 - Prostate cancer screening:

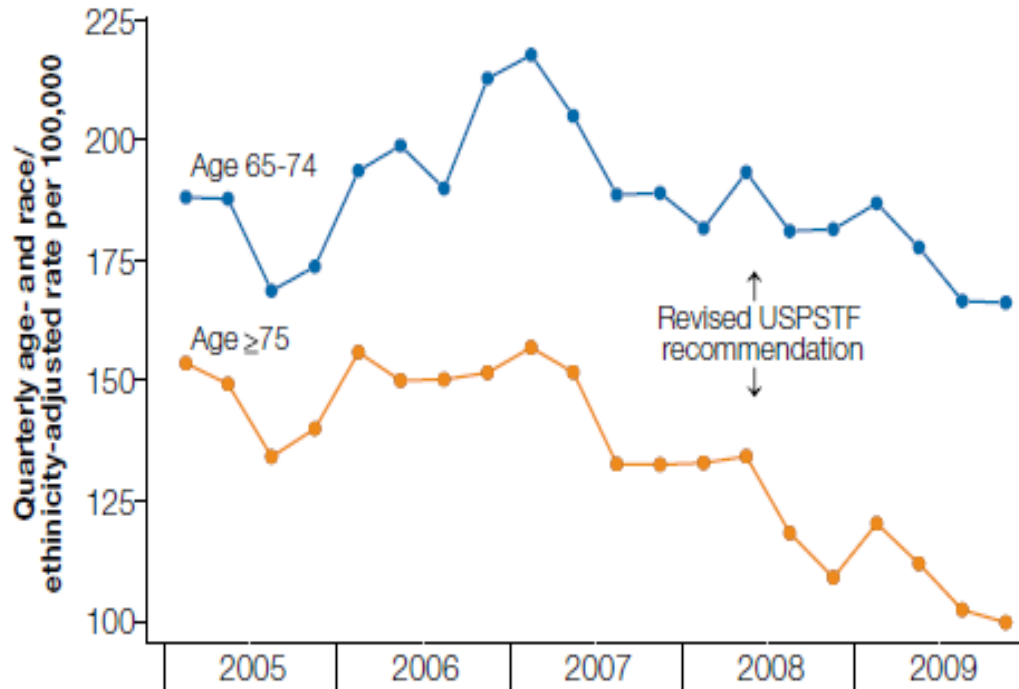
About two-thirds of prostate tumors detected via PSA screening are over diagnosed (i.e., in the absence of PSA screening, the tumor would not have become clinically apparent during the patient's remaining lifetime)

In 2008 US Preventive Services Task Force recommends against screening those aged 75+ with some effect

In 2012 USPSTF formally recommends against routine use of PSA in screening

In the US

Trends in the incidence of early stage prostate tumours by age 2005-2009

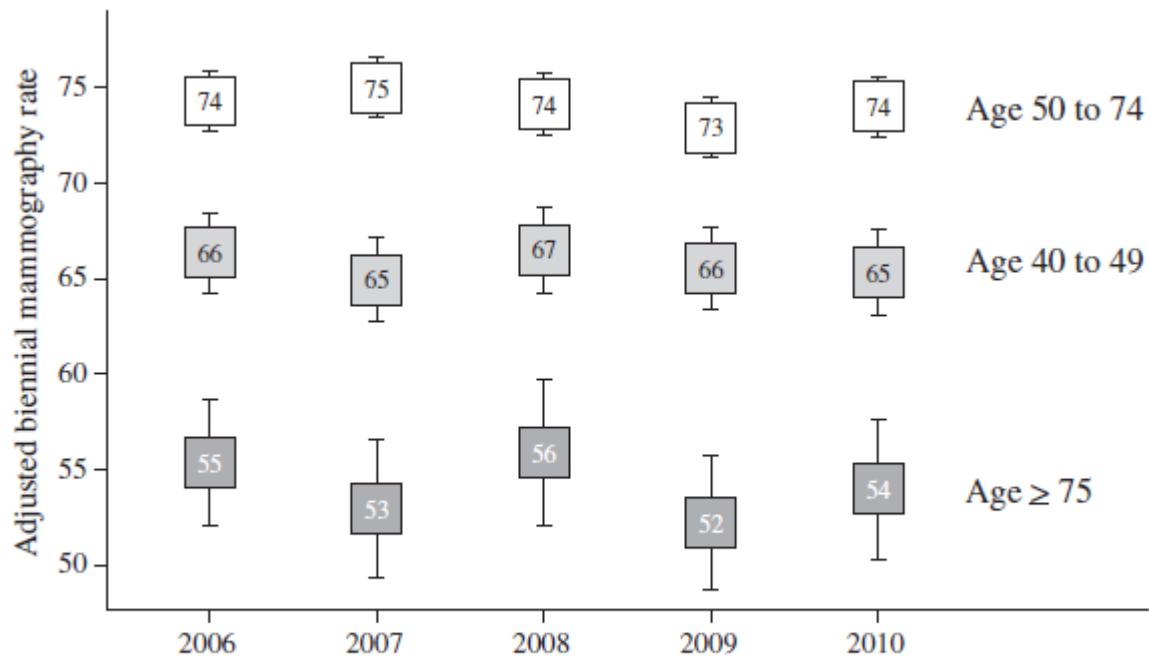


Source: Analysis of SEER 18 registry data, Joy Howard et al.
Rates are standardized by 5 Year age groups and race/ethnicity to the 2009 population.

Also in the US

USPSTF recommends in 2009 that women aged under 50 and over 75 are not routinely screened for breast cancer is largely ignored

Why? ACA requires Medicare and private insurers to cover mammography based on earlier recommendations



The graph displays the proportion of women who received a mammogram in the past 2 years, adjusted for demographics, socioeconomic status, and region. Error bars represent 95% CIs

Source: Howard and Adams [Preventive Medicine 55 \(2012\) 485–487](#)

- Behaviour, economics and prevention – efficiency and equity
 - In economics we assume individuals are *utility* not *health* maximisers
 - Individuals may choose *rationally* to engage in appropriate levels of prevention based on self-interest - not smoking, screening, compliance with medication
 - Some (Becker and Murphy) argue individuals may choose *rationally* not to engage in “appropriate” levels of prevention based on self-interest
 - There may exist sources of “market failure” which mean not everyone can choose appropriate levels of prevention

- With rational addiction there is still potential to change behaviour: “smacks” “shoves” and “nudges”
 - Smack – the smoking ban (see later)
 - Shove – taxation on tobacco
 - On average, a price increase of 10% on a pack of cigarettes would reduce demand for cigarettes by about 4% for the general adult population in high income countries (Source: Jha P., Chaloupka F.J. Curbing the Epidemic: Governments and the Economics of Tobacco Control. World Bank Publications; Washington, DC, USA: 1999)
 - Nudge – changing the environment
 - Increased pedestrian walking connectivity is associated with longer walking distances and increased likelihood of walking as a means of transport (Source Sun G, Oreskovic NM and Lin H. How do changes to the built environment influence walking behaviors? a longitudinal study within a university campus in Hong Kong. International Journal of Health Geographics 2014**13**:28)

- With market failure exists the potential to take corrective action:

- Information deficiencies, asymmetries and bounded rationality

- Breast cancer screening

“The breast screening programmes in the United Kingdom, inviting women aged 50–70 every 3 years, probably prevent about 1300 breast cancer deaths a year, equivalent to about 22 000 years of life being saved; a most welcome benefit to women and to the public health. (emphasis added)

But there is a cost to women's well-being...mammographic screening detects cancers, proven to be cancers by pathological testing, that would not have come to clinical attention in the woman's life were it not for screening - called overdiagnosis...

Estimates abound of overdiagnosis, from near to zero to 50%, but there are no reliable data to answer this question.”

(Source: Marmot et al 2012 British Journal of Cancer (2013) 108, 2205–2240 | doi: 10.1038/bjc.2013.177)

- But with chronic illness a partnership model may be possible

- Externalities
 - Vaccination, informal carer and “caring” externalities – equity
 - NHS 1948:
 - that it meet the needs of everyone
 - that it be free at the point of delivery
 - that it be based on clinical need, not ability to pay
- Habitual behaviours – “investment” in being wrong
 - Failure to review what may have been right: in prescribing - O'Neill C, Groom L, Avery AJ, Boot D, Thornhill K. *J Clin Pharm Ther.* 1999 Dec;24(6):427-32.
- Failures in rationality of choices – inconsistent time preferences, discrepancies between “social” and “personal”
 - (Time preferences for health gains: an empirical investigation. *Olsen JA Health Econ.* 1993 Oct; 2(3):257-65)

- Correction of market failures: empirical examples with respect to cancer screening
 - Information – typically a programme will undergo a rigorous HTA before being approved for reimbursement – issues considered and value for money assessed; Raises “appropriate” uptake and improves efficiency
 - Externalities – reduced barriers to access and thereby under-consumption, transaction costs (organising a screen reduced also) – lowers barriers that are likely to be unevenly distributed and improves equity

- **Screening for prostate cancer \$73,000 per QALY**
(Source: Heijnsdijk et al, 2015 “best case” JNCI J Natl Cancer Inst (2015) 107(1): dju366)
- **Screening for lung cancer \$81,000 per QALY**
(Source Black et al, 2014 n engl j med 371;19 nejm.org November 6, 2014)
- **Screening for ovarian cancer \$88,993 per LYS**
(Source: Drescher et al 2012 Cancer Prevention Research July 2, 2012; DOI: 10.1158/1940-6207.CAPR-11-0468)
- **Screening for cervical cancer in the UK between \$5,500 and \$13,800 based on HPV triage and cytology used in combination with HPV**
(Source: Kim et al, 2005 Journal of the National Cancer Institute, Vol. 97, No. 12, June 15, 2005)
- **Screening for colorectal cancer in Ireland 55-64 age group €1,696**
(Source:
https://www.hiqa.ie/system/files/HTA_population_based_colorectal_cancer_screening_programme.pdf

- What about equity?
 - Opportunistic and population based screening
 - Walsh et al (2011) uptake of breast and cervical screening programmes differentiated by opportunistic versus population based programmes in EU 15 – education and socio-economic status relevant
 - Source: Walsh et al (2011) [Health Policy 101 \(2011\) 269–276](#)

Multivariate analysis using logistic odds ratios and Wald joint significance statistic.

	Breast		Cervical	
	Opportunistic or not fully rolled out organised 1196	Organised and fully rolled out 1027	Opportunistic 3689	Organised and fully rolled out 1336
Age group				
20-29	-	-	0.73** (0.10)	2.00** (0.48)
30-39	-	-	0.86 (0.09)	1.97** (0.32)
40-49	0.89 (0.27)	-	1.01 (0.10)	1.76*** (0.28)
50-59	1	1	1	1
60-69	0.61*** (0.08)	0.77* (0.11)	0.54*** (0.07)	0.88 (0.21)
70-75	0.14*** (0.07)	0.32*** (0.10)	0.18*** (0.07)	-
Socio-economic group				
Professionals; Business owners; Higher managers	1	1	1	1
Intermediate managerial; junior non-manual	0.69 (0.16)	1.12 (0.26)	0.91 (0.11)	1.11 (0.22)
Non Professionals, Service job; State job	0.63* (0.15)	0.75 (0.18)	0.95 (0.12)	0.81 (0.17)
Semi-skilled	0.73 (0.17)	0.90 (0.22)	0.75** (0.09)	0.94 (0.21)
Have never worked	0.51** (0.14)	1.03 (0.34)	0.64*** (0.09)	0.86 (0.40)
Health Fair or poor	1	1	1	1
Good or excellent	1.02 (0.14)	1.01 (0.15)	1.19** (0.11)	1.13 (0.17)
Age finished schooling 22-25				
19-21	1 1.18 (0.32)	1 1.36 (0.37)	1 0.87 (0.11)	1 1.11 (0.18)
17-18	0.91 (0.22)	1.06 (0.27)	0.66*** (0.08)	0.87 (0.16)
15-16	0.71 (0.18)	1.04 (0.28)	0.62*** (0.08)	0.90 (0.17)
10-14	0.86 (0.23)	1.61 (0.47)	0.60*** (0.08)	0.70 (0.27)
Marital Status Single, divorced or widowed				
Married	1 1.35** (0.16)	1 1.61*** (0.23)	1 1.42** (0.10)	1 1.42** (0.1442)
Wald test statistic				
Joint significance of socio-economic group	chi ² (4) = 6.90 P > chi ² = 0.141	chi ² (4) = 5.11 P > chi ² = 0.270	chi ² (4) = 12.90 P > chi ² = 0.011	chi ² (4) = 4.82 P > chi ² = 0.306
Wald test statistic				
Joint Significance of age finished schooling	chi ² (4) = 4.16 P > chi ² = 0.384	chi ² (4) = 6.46 P > chi ² = 0.167	chi ² (4) = 18.33 P > chi ² = 0.000	chi ² (4) = 2.07 P > chi ² = 0.557

Standard errors in brackets.

- * Significant to the 90 percentile.
- ** Significant to the 95 percentile.
- *** Significant to the 99 percentile.

- Carney et al (2013) – what impact does past screening decisions have upon current screening decisions
- Source [Social Science & Medicine 82 \(2013\) 108–114](#)
- Past screening decisions are a significant predictor of recent decisions

Table 2
Average partial effects from dynamic probit model using balanced sub-panel.

Variable	Balanced		Variable	Balanced	
	N 29,955	Average partial effect (Standard error)		N 29,955	Average partial effect (Standard error)
Base category: 0 GP visits	5878	N/A	1st lag	4234	0.018*** (0.005)
1–3 GP visits	10,847	0.035*** (0.005)	2nd lag	4146	–0.010** (0.004)
4–6 GP visits	7043	0.042***	3rd lag	4094	0.143*** (0.007)
7–9 GP visits	3575	0.053*** (0.007)	1st initial condition	4005	0.023*** (0.007)
10 or more GP visits	2612	0.061*** (0.009)	2nd initial condition	3900	0.001 (0.006)
Base category: Pre 2005: Aged 50–64	5604	N/A	3rd initial condition	3795	0.021*** (0.007)
Pre 2005: Aged 16–49	11,029	–0.215*** (0.009)	Income	29,955	–0.003 (0.002)
Pre 2005: Aged 65–70	1521	–0.160*** (0.010)	Income Mundlak term	29,955	0.005* (0.002)
Pre 2005: Aged 70+	1816	–0.226*** (0.009)	Base category: Excellent	5955	N/A
Post 2005: Aged 16–49	3241	–0.213*** (0.010)	Health status: Good	14,398	0.005 (0.003)
Post 2005: Aged 50–64	3893	0.002 (0.011)	Health status: Fair	6847	0.002 (0.006)
Post 2005: Aged 65–70	964	–0.112*** (0.015)	Health status: Poor	2186	0.010 (0.008)
Post 2005: Aged 70+	1887	–0.227*** (0.011)	Health status: Very poor	569	–0.009 (0.013)
Dependent aged under 16	9372	–0.014** (0.006)	Smoker	6310	0.0002 (0.005)
Base category: Married	19,781	N/A	Base category: London	2261	N/A
Separated	542	–0.021 (0.015)	North England	8233	–0.001 (0.009)
Divorced	3199	–0.021*** (0.007)	South England	8177	–0.003 (0.009)
Widowed	3054	–0.008 (0.007)	Midlands	7199	–0.008 (0.009)
Never married	3379	–0.04*** (0.007)	Wales	1684	–0.006 (0.013)
Base category: Primary level education	10,245	N/A	Scotland	2401	–0.008 (0.011)
Lower secondary	10,188	0.004 (0.006)			
Upper secondary	4010	0.015* (0.008)			
Third level	5512	0.01 (0.007)			

* 00% significance ** 05% significance *** 00% significance

- Interpreting some of the other findings
 - The role of education – information issues?
 - The SES gradient – equity issues
 - The role of marital status – concern over informal carer externalities
 - The relative poorer performance of opportunistic programmes – only to be expected?
 - Past behaviour predicting current – habituation?

- Other literature
 - The existence of socio-economic gradients in uptake is well documented
 - The role of past choices on current choices is well documented
 - That the decision to screen is a function not just of screening but of its implications for the entire care pathway has been suggested
 - Carney et al (2013)
Carney P, Gavin A, O'Neill C. BMJ Open 2013;3:e004074. doi:10.1136/bmjopen-2013-004074
 - Walsh et al (2012)
The role of private medical insurance in socioeconomic inequalities in cancer screening uptake in the Republic of Ireland. Walsh B, Silles M, O'Neill C. Health Economics 2012 ;21(10):1250-6.

- Case study

- Colorectal cancer screening in 27 European countries

- Data source Eurobarometer 72.3

- http://www.gesis.org/eurobarometer-data-service/survey-series/standard-special-eb/study-profiles/eurobarometer-723-za-4977-oct-2009/?tx_eurobaromater_pi1%5Bvol%5D=2659&tx_eurobaromater_pi1%5Bpos1%5D=525&cHash=d14a2953f47f5b7726432371ab067eb3

- Data

- Age, Gender, education (completed 22 years of education), self reported social class, children, marital status, smoking status (never smoked), within eligible age range for screen (where appropriate), categorization of programme based on European report

- http://ec.europa.eu/health/ph_determinants/genetics/documents/cancer_screening.pdf

- Methods – logit at level of individual country, collectively and estimation of concentration indices.

Categorization of programmes

Country	Population based programme	Incomplete popn based, non-popn based	Opportunistic	Eligible age
Austria		Yes		>50
Belgium			Yes	NA
Bulgaria		Yes		>31
Cyprus		Yes		50 and 55
Czech Rep		Yes		>50
Denmark			Yes	NA
Estonia			Yes	NA
Finland	Yes			60-69
France	Yes			50-74
Germany		Yes		>50
Greece		Yes		>50
Hungary		Yes		50-70
Ireland				NA
Italy	Yes			varies
Latvia		Yes		>50
Lithuania			Yes	NA
Lux			Yes	NA
Malta			Yes	NA
Neth.			Yes	NA
Poland	Yes			50-65
Portugal		Yes		50-70
Romania		Yes		50-74
Slovak Rep		Yes		>50
Slovenia		Yes		50-69
Spain		Yes		50-69
Sweden		Yes		60-69
UK	Yes			60-69

- Results

- Logits based on analyses of individual countries

- 0% of population based programmes exhibited socio-economic gradient based on social class
 - 43% of countries with mixed programmes exhibited a socio-economic gradient
 - 50% of countries with no programmes exhibited socio-economic gradient
 - Concentration indices show different patterns of pro-rich/pro-poor inequality but not evident in population based programmes. Poor ranking variable though with too few categories
 - Eligible age was statistically significant in 4 of the 5 population based programmes
 - Caution – low sample size, self reported social class, weighted but may be an issue, programmes are 2007, data is 2009, choice of regressors

- **Conclusions**

- “An ounce of prevention is better than a pound of cure”
among those for whom the benefits outweigh the costs, know this to be the case and how to take appropriate action
- Among others, there are things third parties can do to lower costs and increase information but whether this increases efficiency and/or improves equity must be examined not assumed
- Constructing a business case for prevention will encounter particular problems
 - Benefits may take a longer time to become evident and will be diffuse
 - Costs will take a short time to become evident and will be specific (acute care)
 - The electoral cycle is short

- What happened following the introduction of the smoking ban in NI?
 - Ban introduced in 2007
 - Northern Health Survey 2005 and 2010 used for analysis
 - 2005 percentage smoking 27.06 (95% CI: 25.49 – 28.69)
 - 2010 percentage smoking 25.24 (95% CI: 23.63 – 26.92)
 - 2005: -0.1595 (95% CI: -0.1252, -0.1938)
 - 2010: -0.1860 (95% CI: -0.1522, -0.2198)
 - Income quintile 5 percentage smoking 2005
 - 15.85 (95% CI: 13.02 – 19.17)
 - Income quintile 5 percentage smoking 2010
 - 10.06 (95% CI: 7.85 – 12.81)
 - Acknowledgement: HRB Research Leader Award RL-2013-16