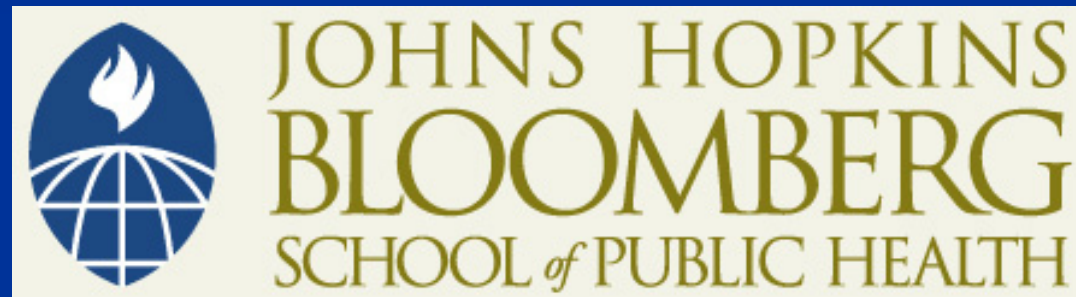


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Discounting, inflation and capital costs (and converting costs into IUS\$)

Lecture 5

Damian Walker

Aim of the lecture

- To provide conceptual and practical insight into how to adjust costs for differential timing

Structure of lecture

- Discounting: costs and benefits
- Annualising capital costs
- Adjusting for inflation
- Purchasing power parity: converting costs into IUS\$

Time preference

- Would you prefer to have \$100 now or in the future?
- Positive rate of time preference
- Why?
 - 'live now, pay later' attitude
 - future is uncertain
 - might expect to be wealthier in the future

Discounting costs

- Future streams of costs are discounted to reflect time preference and presented in terms of their present value
- We do this by using a discount factor
- Discount factor = $1 / (1+r)^n$
 - where n = years in the future, r = discount rate
- Costs of year n multiplied by discount factor

Discount factors for present value: discount rate (r) = 5%

Year	$(1+r)^n$	Discount factor $1 / (1+r)^n$
1	$(1 + 0.05)^1 = 1.050$	0.952
2	$(1 + 0.05)^2 = 1.103$	0.907
3	$(1 + 0.05)^3 = 1.158$	0.864
4	$(1 + 0.05)^4 = 1.216$	0.823
5	$(1 + 0.05)^5 = 1.276$	0.784

Example

- If cost was the only deciding factor, which project would you invest in?
- Assume a 5% discount rate
- Also assume costs are incurred at the beginning of each time period

	Y1	Y2	Y3	Y4	Y5	Total
Project A	\$100	\$100	\$100	\$100	\$100	\$500
Project B	\$500	-	-	-	-	\$500
Project C	-	-	-	-	\$500	\$500

Example

	Y1	Y2	Y3	Y4	Y5	Total
Discount factor (5%)						
Project A						
Project B						
Project C						

Which discount rate?

- Interest rate on a risk-free investment
- Rate used by a particular country or agency
- Rate used in literature: range 3-10%
- Rate recommended by guidelines
- Carry out sensitivity analysis

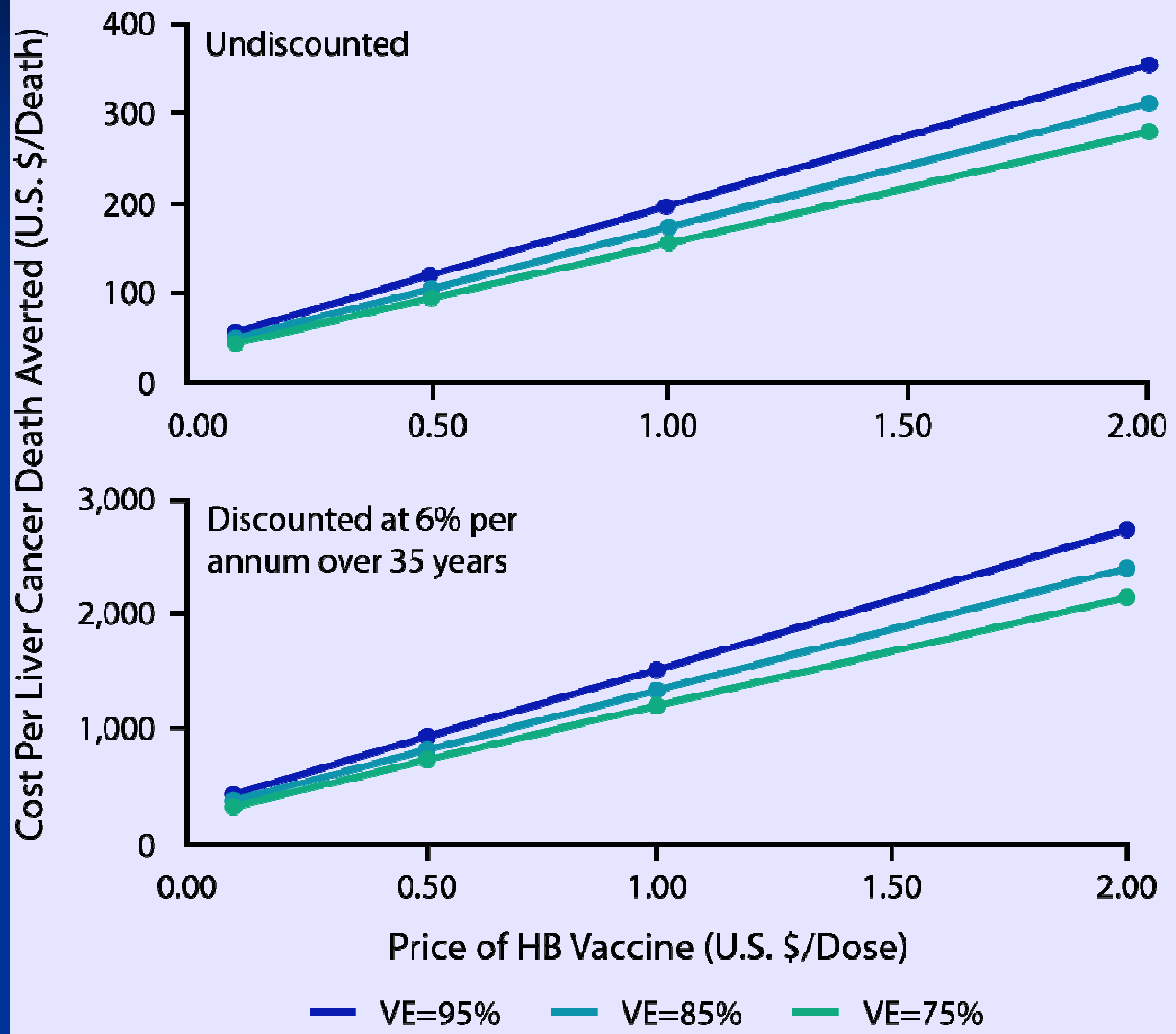
Discounting health outcomes

- General consensus that future costs should be discounted
- However, economists do not agree that health outcomes should be discounted
- And those who agree, disagree about the rate
- But if discount at lower rate than costs projects become more desirable if we delay their implementation (Keeler & Cretin 1983)
- So soft recommendation is to discount at same rate as costs and carry out sensitivity analysis

Keeler & Cretin paradox

Programme	Costs			Effects			CE ratio
	Now	Year 1	Year 2	Now	Year 1	Year 2	
Implemented today	200	100	0	300	200	0	0.59
Delayed 1 year	0	200	100	0	300	200	0.56

The Cost of Averting a Death from Hepatocellular Carcinoma by Vaccine Price and Efficacy (VE)



Adapted by CTLT from Hall et al. 1993.



Do discount rates differ in LDCs? (Poulos & Whittington 2000)

- Individuals' time preferences for saving lives were measured in Bulgaria, Ethiopia, Indonesia, Mozambique Uganda and Ukraine using a stated-preference method
- Households in LDCs attach *much less* value to lives saved in the future than to lives saved today
- Relationship between time preference and income, life expectancy and education not consistent across countries. Other factors are important, e.g. perceived mortality risk, political instability and culture

Topical example: the Stern report

www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

- The Stern report was commissioned by the British government to review the economics of climate change
- It became controversial among economists because of Sir Nicholas' decision to choose a social discount rate of 0.1%
- Sir Nicholas argued that, because climate change economics requires a time horizon of centuries, the use of a typical discount rate would assign almost no current value to benefits accruing in, say, the 23rd century
- But how can we say that our great-great-great-grandchildren are worth less than we are worth ourselves?

Intergenerational equity

- Therefore, he argues for a discount rate of 0.1%
- Such a near-zero rate places a much higher present-day value on benefits accruing centuries into the future, and thus makes a stronger case for spending money now
- What do you think?

Individual's time preference

- Well-known men discount the future more steeply than women
- But assumed way person discounts a stable personality trait and arbitrary
- Wilson & Daly (2003) assumed men discount more steeply due to male reproductive imperative
 - score often, score early and, above all, score when you can!

Carpe diem?

- Developed an experiment
 - men who had seen pictures of attractive women discounted the future more steeply than they had before
 - an “I want-that-now” pathway had been activated in their brains
 - (women who had seen pictures of ‘hot’ cars discounted the future more steeply than they had before. But the statistical significance of this finding disappeared after routine adjustments)

Opportunity costs

- Recall from Monday's lecture that we need to estimate shadow prices / social value of resources:
 - where goods have a yield over a period of time:
capital goods

Annualisation

- Capital items purchased in previous years have a cost today
- Annualisation permits capital costs to be converted to their annual equivalent, or implicit rental value, and thus added to annual recurrent costs
- It involves spreading the cost of the capital item over its life, but also takes into account the possible earnings that the money could have made if it had not been tied up in the purchase of the capital item

Annualisation of capital items

- Annual financial cost = cost / expected length of life
- Annual economic cost = cost / annualising factor
- $AF = (1 - DF) / r$
 - where $DF = 1 / (1 + r)^n$, $n =$ expected length of life and $r =$ discount rate

Discount rate

Number of remaining years of useful life

n	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.90	0.90	0.89	0.88	0.877	0.870	0.862	0.855	0.847	0.84	0.83
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.73	1.71	1.69	1.66	1.647	1.626	1.605	1.585	1.566	1.54	1.52
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.48	2.44	2.40	2.36	2.322	2.283	2.246	2.210	2.174	2.14	2.10
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.17	3.10	3.03	2.97	2.914	2.855	2.798	2.743	2.690	2.63	2.58
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.79	3.69	3.60	3.51	3.433	3.352	3.274	3.199	3.127	3.05	2.99
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.35	4.23	4.11	3.99	3.889	3.784	3.685	3.589	3.498	3.41	3.32
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.86	4.71	4.56	4.42	4.288	4.160	4.039	3.922	3.812	3.70	3.60
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.33	5.14	4.96	4.79	4.639	4.487	4.344	4.207	4.078	3.95	3.83
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.75	5.53	5.32	5.13	4.946	4.772	4.607	4.451	4.303	4.16	4.03
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.14	5.88	5.65	5.42	5.216	5.019	4.833	4.659	4.494	4.33	4.19
11	10.36	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.49	6.20	5.93	5.68	5.453	5.234	5.029	4.836	4.656	4.48	4.32
12	11.25	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.81	6.49	6.19	5.91	5.660	5.421	5.197	4.988	4.793	4.61	4.43
13	12.13	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.10	6.75	6.42	6.12	5.842	5.583	5.342	5.118	4.910	4.71	4.53
14	13.00	12.106	11.296	10.56	9.899	9.295	8.745	8.244	7.786	7.36	6.98	6.62	6.30	6.002	5.724	5.468	5.229	5.008	4.80	4.61
15	13.86	12.849	11.938	11.11	10.380	9.712	9.108	8.559	8.061	7.60	7.19	6.81	6.46	6.142	5.847	5.575	5.324	5.092	4.87	4.67
16	14.71	13.578	12.561	11.65	10.838	10.106	9.447	8.851	8.313	7.82	7.37	6.97	6.60	6.265	5.954	5.668	5.405	5.162	4.93	4.73
17	15.56	14.292	13.166	12.16	11.274	10.477	9.763	9.122	8.544	8.02	7.54	7.12	6.72	6.373	6.047	5.749	5.475	5.222	4.99	4.77
18	16.39	14.992	13.754	12.65	11.690	10.828	10.05	9.372	8.756	8.20	7.70	7.25	6.84	6.467	6.128	5.818	5.534	5.273	5.03	4.81
19	17.22	15.678	14.324	13.13	12.085	11.158	10.33	9.604	8.950	8.36	7.83	7.36	6.93	6.550	6.198	5.877	5.584	5.316	5.07	4.84
20	18.04	16.351	14.877	13.59	12.462	11.470	10.59	9.818	9.129	8.51	7.96	7.46	7.02	6.623	6.259	5.929	5.628	5.353	5.10	4.87
21	18.85	17.011	15.415	14.02	12.821	11.764	10.83	10.017	9.292	8.64	8.07	7.56	7.10	6.687	6.312	5.973	5.665	5.384	5.12	4.89
22	19.66	17.658	15.937	14.45	13.163	12.042	11.06	10.201	9.442	8.77	8.17	7.64	7.17	6.743	6.359	6.011	5.696	5.410	5.14	4.90
23	20.45	18.292	16.444	14.95	13.489	12.303	11.27	10.371	9.580	8.88	8.26	7.71	7.23	6.792	6.399	6.044	5.723	5.432	5.16	4.92
24	21.24	18.914	16.936	15.24	13.799	12.550	11.46	10.529	9.707	8.98	8.34	7.78	7.28	6.835	6.434	6.073	5.746	5.451	5.18	4.93
25	22.02	19.523	17.413	15.62	14.094	12.783	11.65	10.675	9.823	9.07	8.42	7.84	7.33	6.873	6.464	6.097	5.766	5.467	5.19	4.94
26	22.79	20.121	17.877	15.98	14.375	13.003	11.82	10.810	9.929	9.16	8.48	7.89	7.37	6.906	6.491	6.118	5.783	5.480	5.20	4.95
27	23.56	20.707	18.327	16.33	14.643	13.211	11.98	10.935	10.027	9.23	8.54	7.94	7.40	6.935	6.514	6.136	5.798	5.492	5.21	4.96
28	24.31	21.281	18.764	16.66	14.898	13.406	12.13	11.051	10.116	9.30	8.60	7.98	7.44	6.961	6.534	6.152	5.810	5.502	5.22	4.97
29	25.06	21.844	19.188	16.98	15.141	13.591	12.27	11.158	10.198	9.37	8.65	8.02	7.47	6.983	6.551	6.166	5.820	5.510	5.22	4.97
30	25.80	22.396	19.600	17.29	15.372	13.765	12.40	11.258	10.274	9.42	8.69	8.05	7.49	7.003	6.566	6.177	5.829	5.517	5.23	4.97

Source: UNAIDS. Costing Guidelines for HIV Prevention Strategies, 2000.

Question

- Single \$5,000 piece of capital equipment (no resale value)
 - useful life of 7 years
 - discount rate of 5%
- What is the annual financial cost?
- What is the annual economic cost?

Answer

Adjusting for inflation

- Inflation: process by which general prices increase and money loses value
- When comparing data from different years adjust to constant / real terms
- Inflate / deflate prices by inflation adjustment factor (IAF)
- $IAF = \text{indicator of inflation in base year} / \text{indicator of inflation in past year}$
- Examples: CPI (www.bls.gov/cpi/), GDP deflator (www.imf.org/external/pubs/ft/weo/2006/02/data/index.aspx), both and more (<http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20899413~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html>)

Example

- Cost per bed-day in 2003 costs = \$45
- How much is this in 2006 costs?
- CPI in 2003 = 160.8
- CPI in 2006 = 181.2

Answer

Concept of purchasing power parity

- Captures the notion that a dollar should buy the same amount in all countries
- Exchange rate should move towards the rate that equalises the prices of an identical basket of goods and services in each country
- The Economist uses a McDonald's Big Mac, and more recently a Starbucks tall-latte, as their 'basket'
 - the Big Mac PPP is the exchange rate that would mean Big Macs cost the same in America as abroad
 - comparing official exchange rates with PPPs indicates whether a currency is under- or over-valued

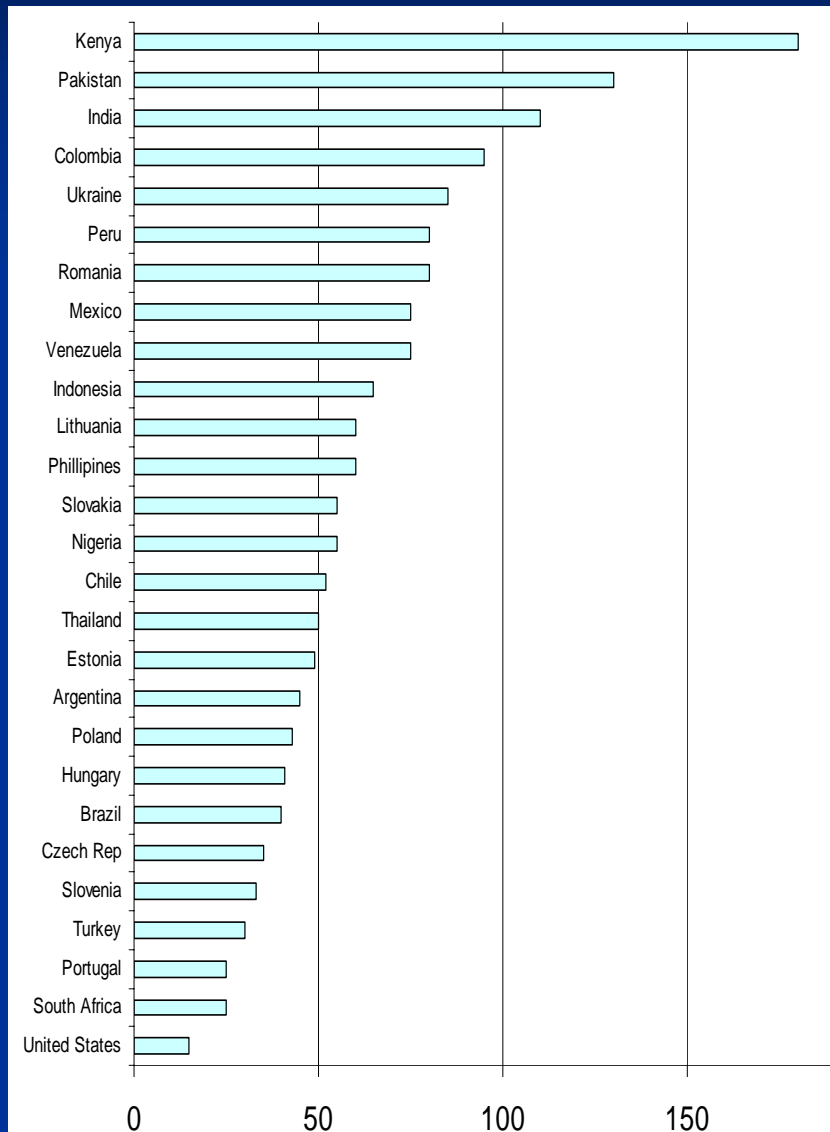
Question

- A Big Mac cost \$3.10 in the US on 22nd May 2006
- In China, it cost 10.5 Yuan
- Using the actual exchange rate the Big Mac cost only \$1.31 ($\$1 = 8.02$ Yuan)
- What is the implied PPP of the dollar?
- Is the Yuan over- or under-valued?

The Hamburger Standard

Country	BigMac Price		Actual Exchange Rate 1 USD =	Over(+) / Under(-) Valuation against dollar, %	Purchasing Power Price
	Local Currency	US dollars			
United States	\$3.10	3.1	1	-	-
Argentina	Peso 7.00	2.2554	3.1037	-27.1837	2.26
Australia	A\$3.25	2.5599	1.2696	-17.2968	1.05
Brazil	Real6.40	3.0047	2.13	-3.2864	2.06
Britain	£1.94	3.8039	1.9608‡	22.549	0.625
Canada	C\$3.52	3.0132	1.1682	-2.414	1.14
China	Yuan10.50	1.3552	7.7482	-56.2479	3.39
Euro area	2.94	3.8858	0.7566	25.8764	0.9524
Hong Kong	HK\$12.00	1.536	7.8124	-50.4634	3.87
Hungary	Forint 560	2.8938	193.516	-6.4677	181
Indonesia	Rupiah14,600	1.5987	9132.42	-48.4255	4,710
Japan	¥250	2.1121	118.367	-31.9067	80.6
Malaysia	M\$5.50	1.5693	3.5047	-49.4964	1.77
Mexico	Peso29.0	2.5925	11.186	-16.4134	9.35
Poland	Zloty6.50	2.1901	2.9679	-29.2429	2.1
Russia	Rouble48.00	1.8363	26.139	-40.7016	15.5
Singapore	s\$3.60	2.3546	1.5289	-24.1285	1.16
South Africa	Rand13.95	1.9232	7.2534	-37.9601	4.5
South Korea	Won2,500	2.6245	952.562	-15.3861	806
Sweden	Skr33.0	4.704	7.0153	51.0983	10.6
Switzerland	SFr6.30	5.1639	1.22	66.3934	2.03
Thailand	Baht60.0	1.7448	34.3886	-43.586	19.4

From purchasing power of currencies to purchasing power of local wages



Minutes of work required to buy a Big Mac (2003)

Converting costs into IUS\$

- WHO has developed PPPs
- www.who.int/choice/costs/ppp/en/
- An international dollar has the same purchasing power as the US\$ has in the United States
- To convert local currency units to international dollars, divide the local currency unit by the PPP conversion factor

Example using Bangladesh data

- 2000 PPP = 15.156
 - 1 international dollar is equal to 15.156 Taka for the year 2000
- 2000 official exchange rate (www.oanda.com)
 - US\$1 = 52.342
- Question
 - convert 10,000 Taka into US\$ and IUS\$ (all in 2000 prices)

Answer

Summary

■ Discounting

- costs should be discounted
- benefits less clear
- no consensus regarding appropriate discount rate, so use sensitivity analysis to assess robustness of findings to changes in the rate

■ Capital costs

- should be annualised to spread value of item over its lifetime and to capture opportunity cost of tying-up funds in the purchase of the item

Summary

- Inflation
 - CPI or GDP deflators can be used to adjust prices for inflation
- Purchasing power parity
 - IUS\$ is a hypothetical currency that has the same purchasing power that the US\$ has in the US at a given point in time
 - it is used to make comparisons both between countries and over time

Further reading

- Keeler, EB and Cretin S. Discounting of life saving and other non monetary effects. *Management Science* 1983; 29: 300-306
- Poulos C, Whittington D. Time preferences for life-saving programs: evidence from six less developed countries. *Environmental Science and Technology* 2000; 34: 1445-1455
- Wilson M, Daly M. Do pretty women inspire men to discount the future? *Proc Biol Sci.* 2003; 271 Suppl 4: S177-179