

# Cross-country comparisons of hospital services, costs and efficiency

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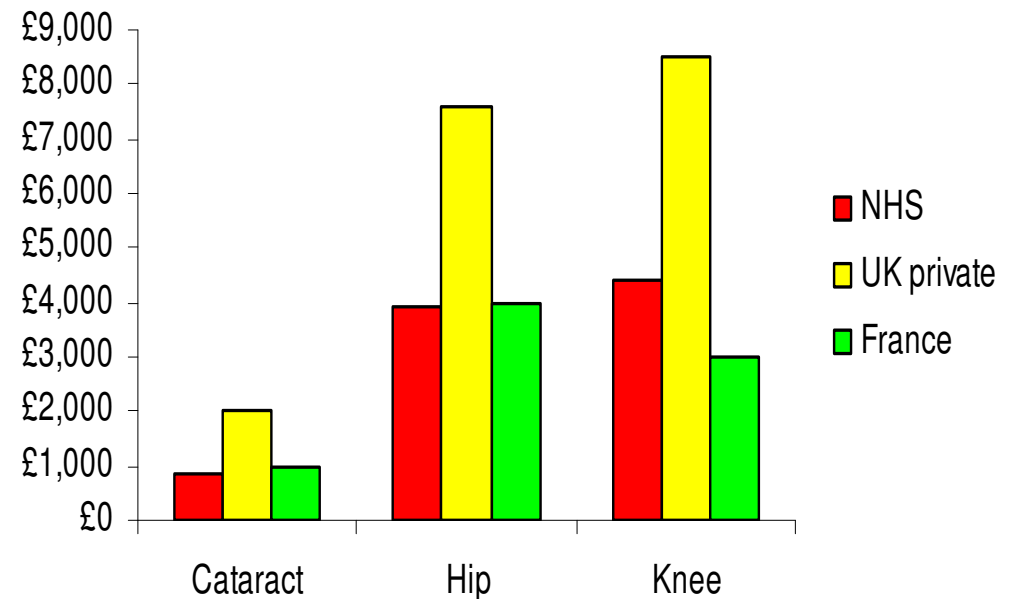
European  
**Observatory**   
on Health Systems and Policies



- **The policy question:** Why do costs of health services differ among EU countries at the micro level?
- **Our research questions:**
  1. What is a “health service“ and how is it defined?
  - 2. How are prices (and underlying costs) calculated per service? (Phase II -> special issue on DRGs of *Health Care Management Science*)
  - 3. Do prices/ reimbursement rates differ (for similar patients)? Are differences explained by systematic factors (e.g. in/exclusion of capital costs), differences in service intensity/ technologies used or costs per service?



The first nine patients sent to France by the English NHS (not shown: the 40 journalists who accompanied them)



**ARE THESE DATA REALISTIC?  
ARE THEY REPRESENTATIVE?  
HOW CAN THE DIFFERENCE BY EXPLAINED?**

# Countries involved in study



## Phase I findings (1)

- clear trend towards a more explicit definition of **benefit baskets** and benefit catalogues in European health care systems.
- only minor variations exist between countries if covered benefits are analysed by categories
- Taxonomy differs largely from country to country – even if most tend to sort **ambulatory care by physician specialty** and **inpatient care by diagnosis and procedure** (DRGs/ HRGs/ DBCs ...)



## Phase I findings (2)

- motivation to establish an explicit benefit basket of services is not always cost-containment or rationing but e.g. to assure equity among the regions
- Conclusion: a **uniform taxonomy** (“European Classification of Health Services“) to explore and describe differences (not to standardise the baskets!) **is urgently needed** for both practical and scientific purposes



## Phase II findings

- Most countries have installed activity-based remuneration schemes for in- and outpatient services; often lacking for long-term care, rehabilitation etc.
- clear trend towards the use of micro-costing data (especially for inpatient services -> DRGs) to determine remuneration rates, reflecting actual costs of providers
- problems:
  - insufficient quality of data delivered by providers
  - recommendations in methodological guidelines vary

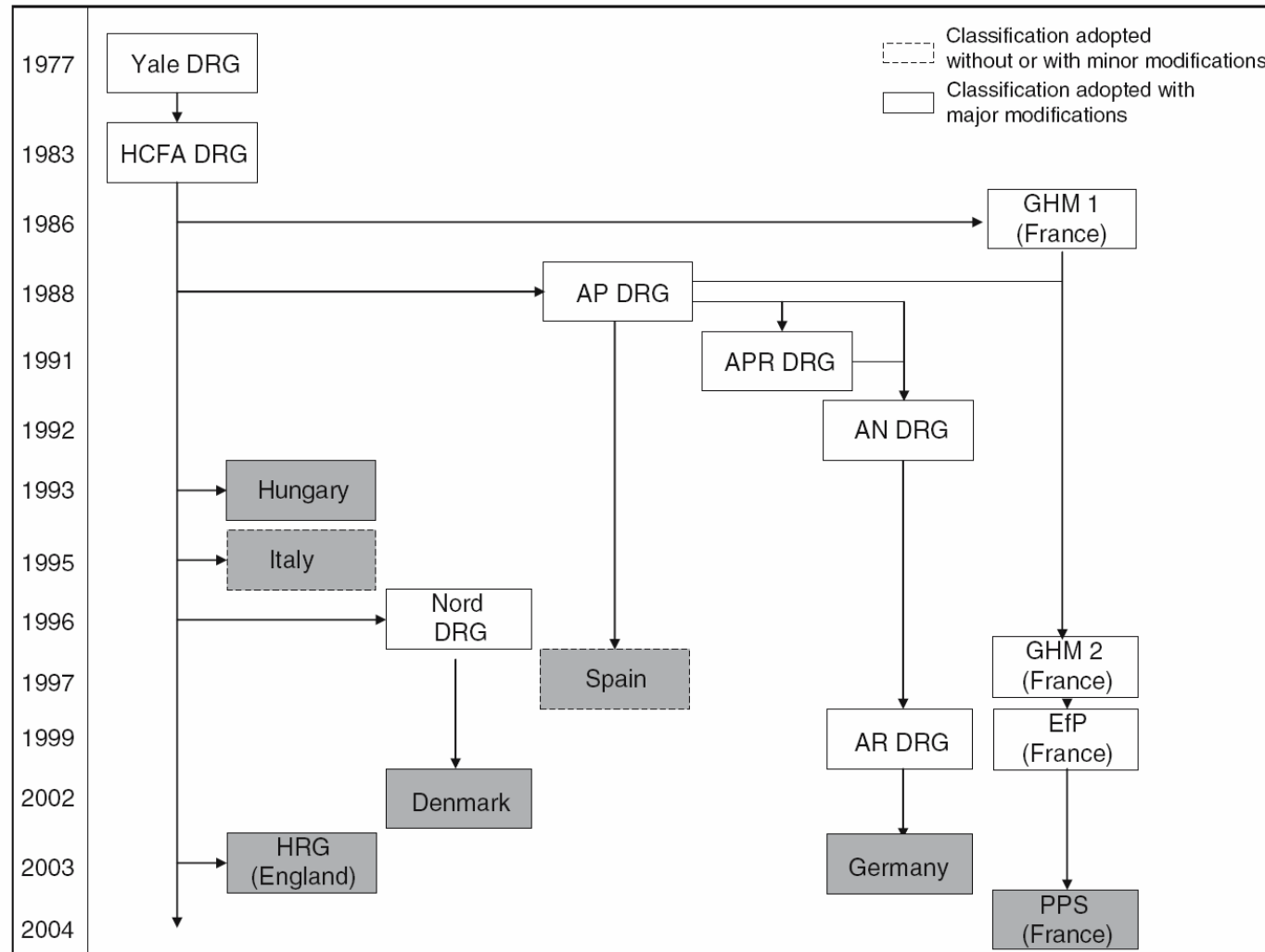
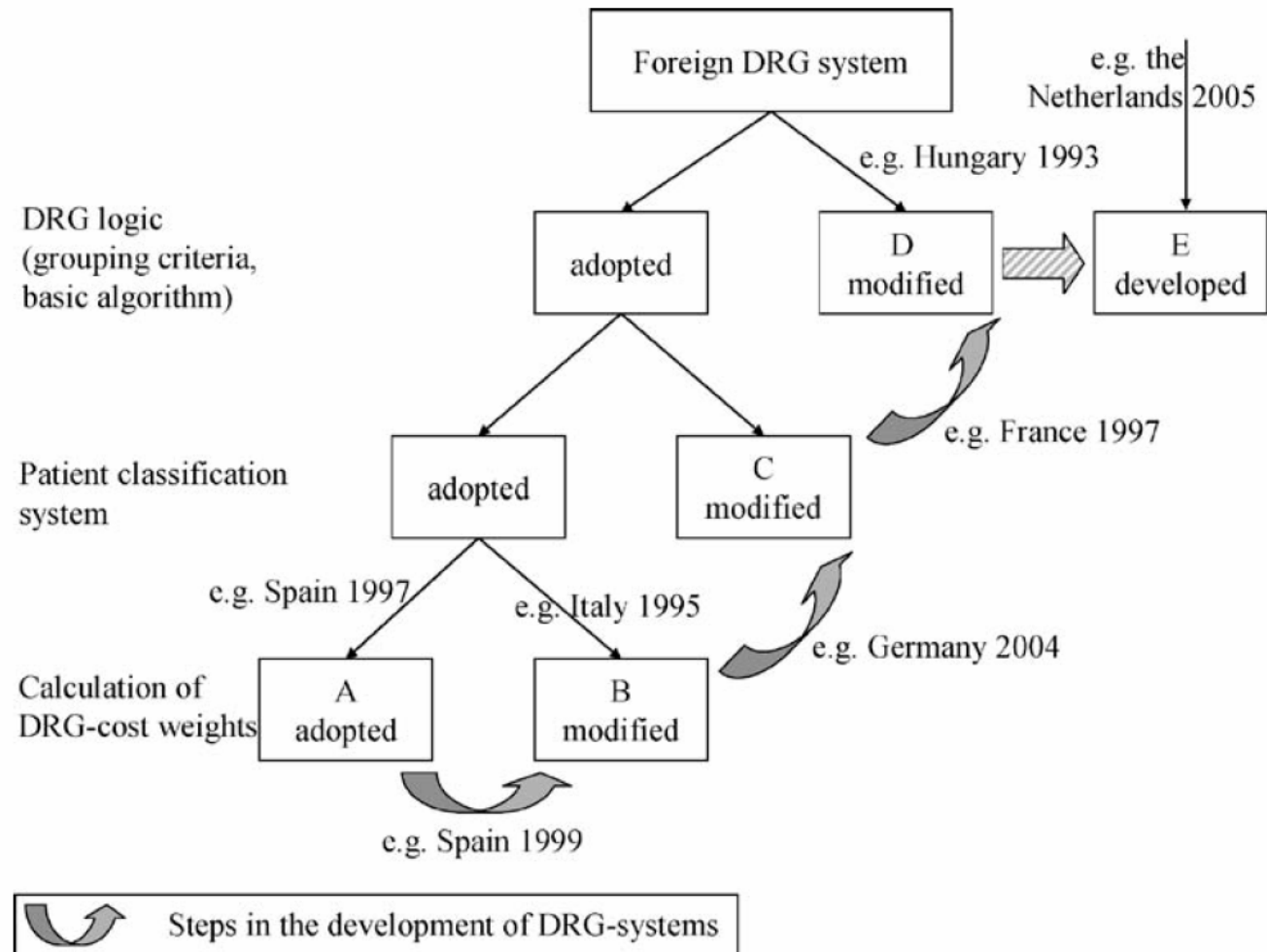


Fig. 1 Development and history of DRG systems



**Fig. 3** Strategies and paths of development in establishing a DRG system. *Boxes A to D* represent the different degrees to which existing DRG systems have been adopted or modified, and *box E* represents a de novo development



**Table 2** Trimming methods used to calculate upper LOS-threshold

Country	Method Used
Germany	$LOS\text{-threshold}_i = \text{round}[\min[\text{mean}_i + 2*SD_i; \text{mean}_i + 17]]$
England/Denmark	$LOS\text{-threshold}_i = Q75_i + (Q75_i - Q25_i)*1.5$
Italy	$LOS\text{-threshold}_i = (\sqrt[3]{Q75_i} + (\sqrt[3]{Q75_i} - \sqrt[3]{Q25_i})*1.0)^3$
France	$LOS\text{-threshold}_i = \min[15; \exp^{\text{mean}[\log(\text{los}_i)] + SD[\log(\text{los}_i)] + Q95_i - \text{median}[\log(\text{los}_i)]}]$ (if $\text{mean}_i > 8$ days) $= \min[2.5*\text{mean}_i; \exp^{\text{mean}[\log(\text{los}_i)] + SD[\log(\text{los}_i)] + Q95_i - \text{median}[\log(\text{los}_i)]}]$ (else)
Spain	$LOS\text{-threshold}_i = \text{median}_i + 3*SD_i$ or, $LOS\text{-threshold}_i = Q75_i + (Q75_i - Q25_i)*1.5$ or, $LOS\text{-threshold}_i = Q75_i + (Q75_i - Q25_i)*2.0$

*i* refers to the standard deviation (SD), mean, median or LOS-threshold of the *i*th DRG.

**Table 3** Trimming methods used to calculate lower LOS-threshold

Country	Method Used
Germany	$LOS\text{-threshold}_i = \text{round}[\min[2; \text{Mean}_i/3]]$
France	$LOS\text{-threshold}_i = \min[(\text{Mean}_i/2.5); 7; (\text{mod} - 1)]$ (only if $\text{mean}_i \geq 8$ , else no lower LOS-threshold)

*i* refers to the mean, median or LOS-threshold of the *i*th DRG.

## Phase III: Methodology of „Case vignettes“ for episodes of care

<i>Need for care</i>	<i>Age group</i>	<i>Type of Care</i>			<i>ECHI*</i>
Appendectomy	14-25	In-patient	Surgery	Emergency	-
Normal delivery	25-35	In-patient	Obstetrics	Elective	+
Hip-replacement	65-75	In-patient	Surgery	Elective	+
Cataract	70-75	Out-patient (day case)	Surgery	Elective	+
Stroke	60-70	In-patient	Medical	Emergency	+
AMI (PTCA)	50-60	In-patient	Medical	Emergency	+
Cough	2	Out-patient	Paediatrics/GP	Emergency	-
Colonoscopy	60-70	Out-patient	Diagnostic	Elective	+
Tooth filling	25-35	Out-patient	Dental	Emergency	+
Physiotherapy (knee)	12	Out-patient	Rehabilitative	-	-

\*ECHI: related to European Community Health Indicators set (+ yes/ - no)



## An example: Hip replacement

Female, 65-75 years old, with hip osteoarthritis requiring hip replacement because of considerable impairment is finally (after waiting time if normal in the hospital) admitted for her first hip replacement (one side).

The patient is without co-morbidity (i.e. expensive drugs due to treating co-morbidity should be excluded), the surgeon uses the most frequently used implant for female patients; the operation is without severe complications.

End of case vignette: discharge  
(home or *to separate rehabilitation institution*).

Phase	Elements	Units	No. of units used/patient	Unit Cost	Total costs
	<b>Example: Hip replacement</b>				
Pre-operative (admission and planning)	<i>Diagnostic Procedures</i>				
	Imaging (e.g. X-Ray)	No.			
	Imaging (e.g. ultrasound)	No.			
	Imaging (e.g. CT)	No.			
	Laboratory (e.g. blood count)	No.			
	Laboratory (e.g. blood coagulation, C-reactive protein (CRP), etc.)	No.			
	Other (ECG, lung-function, etc.)	No.			
	<i>Care before OP</i>				
	Surgeon/Physician input	Patient days*			
	Nursing input	Patient days			
	Other (paramedical)	Patient days			
	<i>Drugs, infusions, injections, etc. Drug A, Drug B, etc.</i>	DD**			
Operation	<i>Devices (type of implant, stent, etc.) total price paid by hospital</i>	No.			
	OP-Team (altogether or separately)	Min.			
	Surgeon	Min.			
	Anaesthetist	Min.			
	OP-nurses etc.	Min.			
	Drugs (anaesthetics, other?)	DD			
	OP-Theatre running costs (e.g. sterilisation)***	Min.			
Wake-up room****					
Post-operative	<i>Intensive Care Unit</i>				
	Surgeon/Physician	Patient days			
	Nursing	Patient days			
	Other	Patient days			
	Drugs	DD**			
	Diagnostic Procedures (e.g. imaging, laboratory)	No.			
	Therapeutic Procedures (e.g. punctures, drainages, special wound dressing)	No.			
	<i>Normal Ward</i>				

## Example: Hip replacement

Table 2: Total cost, cost components and reimbursement of total hip replacement

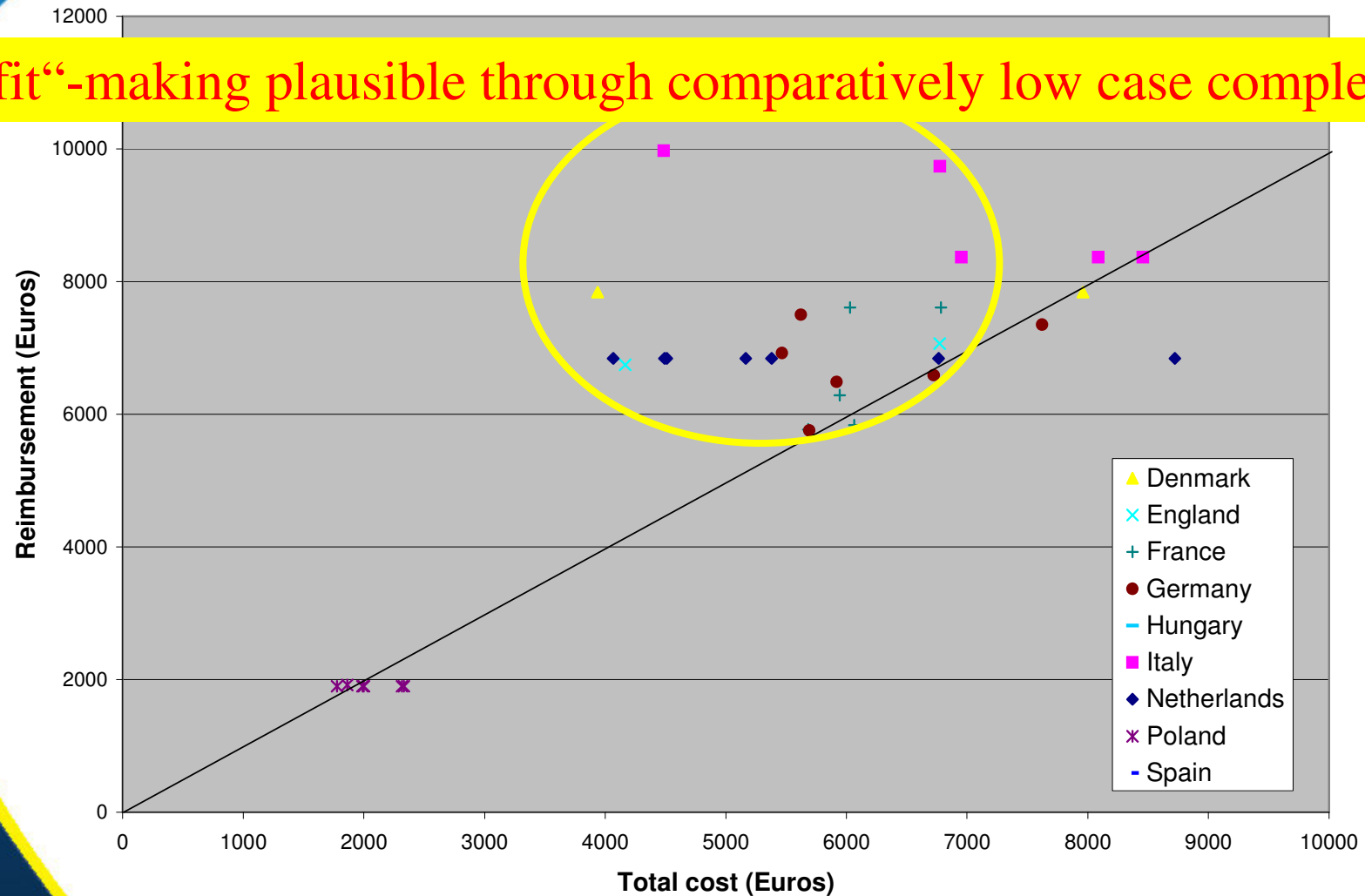
	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain
<b>Diagnostic Procedures</b>									
- Imaging	€ 141.00	€ 87.95	€ 60.01	€ 79.83	€ 7.82	€ 63.37	€ 32.90	€ 33.80	€ 42.53
- Laboratory	€ 35.01	€ 5.74	€ 100.58	€ 137.00	€ 10.02	€ 58.42	€ 45.12	€ 14.00	€ 54.62
- Other	a)	€ 6.22	€ 0.00	€ 107.39	€ 2.87	€ 18.06	€ 19.07	€ 15.30	€ 2.52
<b>Normal/Intensive Ward</b>									
- Physician	€ 18.04	€ 450.88	€ 88.80	€ 414.40	€ 135.49	€ 171.90	a)	€ 236.62	€ 203.67
- Nursing	€ 470.98	€ 1,237.22	€ 428.14	€ 1,167.56	€ 341.15	€ 104.58	€ 538.40	€ 192.42	€ 278.19
- Other Staff	€ 111.37	€ 274.78	€ 193.11	€ 249.24	€ 0.51	€ 78.00	€ 189.64	€ 45.97	€ 0.00
- Material	a)	a)	€ 6.40	€ 129.46	a)	€ 5.78	a)	€ 16.75	€ 1.27
<b>Operation (including wake-up room)</b>									
- Anaesthetist / Surgeon	€ 202.04	€ 534.55	€ 728.15	€ 596.34	€ 93.25	€ 228.51	€ 669.47	€ 52.08	€ 400.16
- Nursing	€ 136.90	€ 123.47	€ 171.78	€ 283.77	€ 18.53	€ 99.57	€ 200.50	€ 9.64	€ 108.69
- Other Staff	€ 42.52	€ 0.00	€ 44.75	€ 133.18	a)	€ 11.42	€ 177.69	€ 0.00	€ 0.00
- Implant	a)	€ 657.50	€ 1,852.24	€ 963.46	€ 481.75	€ 3,416.05	€ 1,825.00	€ 978.38	€ 1,780.00
- Material	€ 115.61	€ 106.63	€ 154.54	€ 249.13	a)	€ 22.31	a)	€ 35.00	€ 0.18
<b>Drugs</b>	€ 59.63	€ 571.28	€ 60.99	€ 178.85	€ 72.50	€ 74.30	€ 104.12	€ 175.13	€ 46.20
<b>Overhead</b>	€ 4,599.14	€ 1,634.72	€ 2,211.60	€ 1,675.59	€ 129.92	€ 2,629.63	€ 1,803.01	€ 320.27	€ 680.99
% overhead of total	<b>77.5%</b>	<b>28.7%</b>	<b>36.2%</b>	<b>26.3%</b>	<b>10.0%</b>	<b>37.7%</b>	<b>32.2%</b>	<b>15.1%</b>	<b>18.9%</b>
<b>TOTAL COST</b>	<b>€ 5,932.24</b>	<b>€ 5,690.94</b>	<b>€ 6,101.09</b>	<b>€ 6,365.20</b>	<b>€ 1,293.81</b>	<b>€ 6,981.90</b>	<b>€ 5,604.92</b>	<b>€ 2,125.36</b>	<b>€ 3,599.02</b>
<b>Total cost (adjusted by PPP)</b>	<b>€ 4,401.10</b>	<b>€ 5,273.78</b>	<b>€ 5,679.66</b>	<b>€ 6,047.12</b>	<b>€ 2,147.05</b>	<b>€ 6,795.04</b>	<b>€ 5,328.38</b>	<b>€ 3,861.48</b>	<b>€ 3,964.99</b>
<b>Reimbursement</b>	€ 7,840.00	€ 6,905.45	€ 6,622.14	€ 6,767.36	€ 1,794.93	€ 8,963.60	€ 6,842.00	€ 1,903.17	b)

a) subsumed in overhead costs

b) hospitals are receive budget. It only partly depends on the number of cases treated.

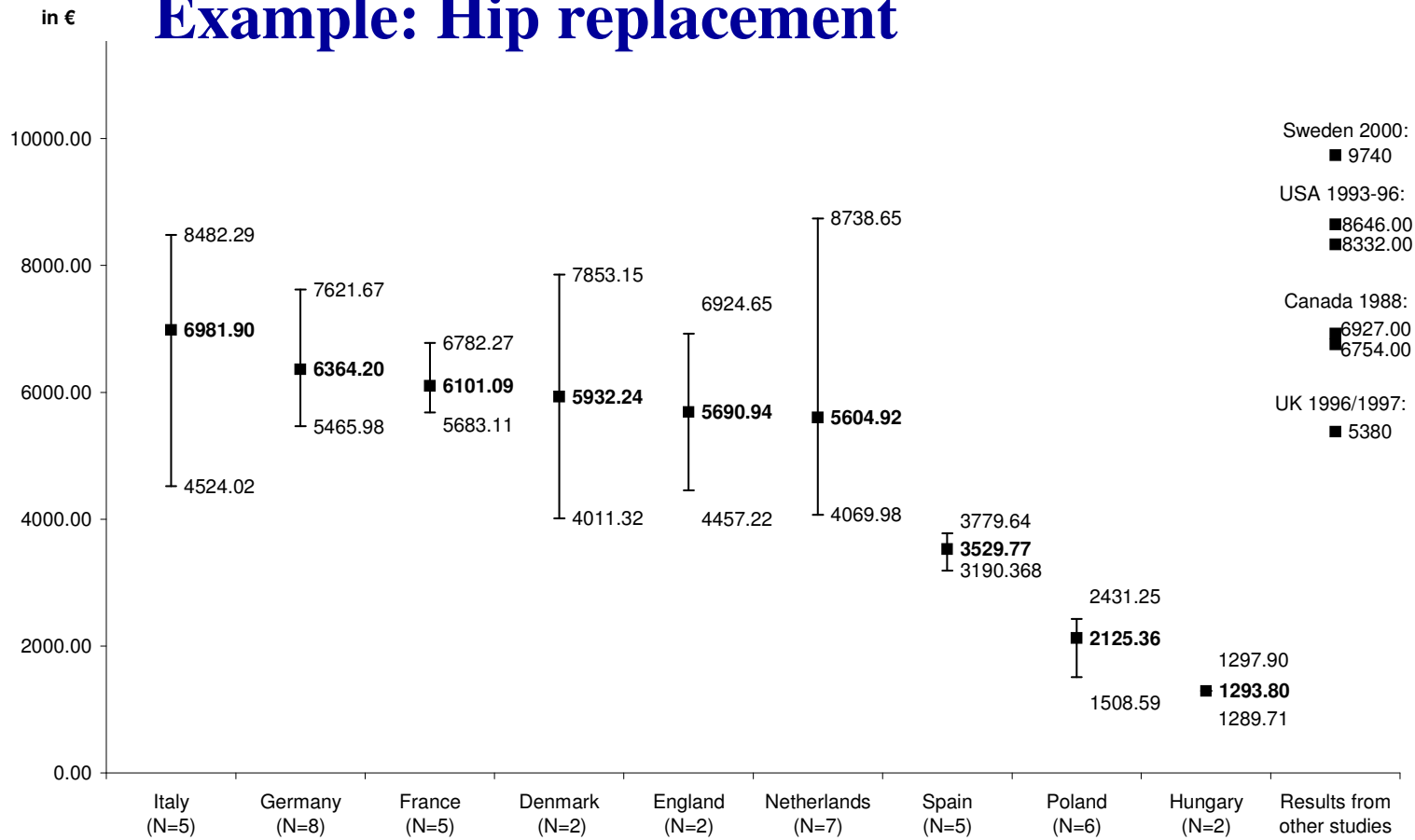
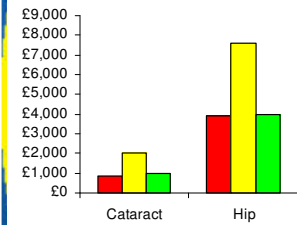
## Example: Hip replacement

“Profit“-making plausible through comparatively low case complexity





## Example: Hip replacement

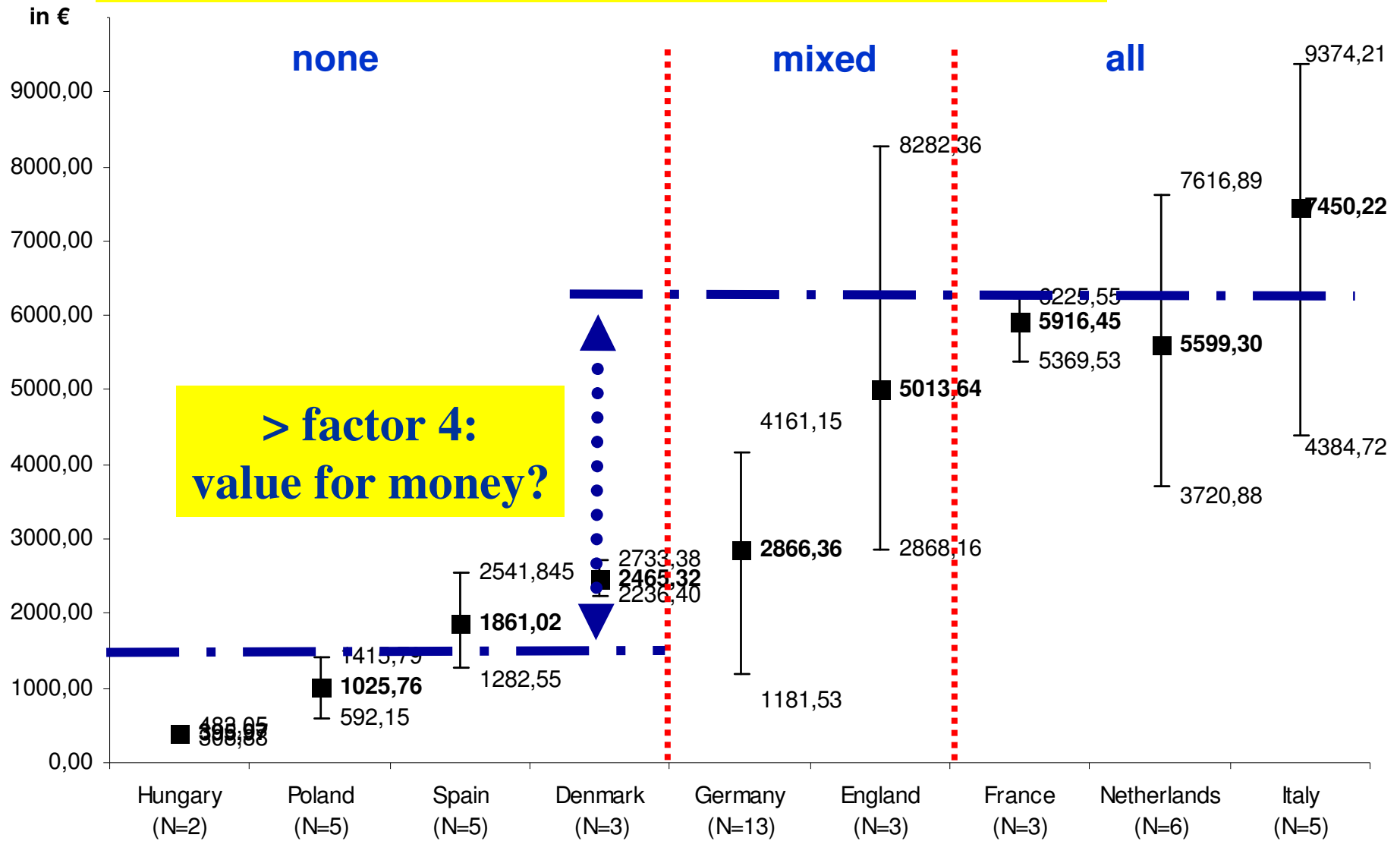


Country/Study	Italy (N=5)	Germany (N=8)	France (N=5)	Denmark (N=2)	England (N=2)	Netherlands (N=7)	Spain (N=5)	Poland (N=6)	Hungary (N=2)	Results from other studies
average length of stay	8.2	16.2	9.3	5.9	7.1	5.9	7.0	11.8	12.9	





# Acute myocardial infarction: Hospitals performing PCI (PTCA/ Stenting)



# Acute Myocardial Infarction

**Table 1. Sample Characteristics**

	England	France	Germany	Netherlands	Hungary	Italy	Poland	Spain	Denmark*
Hospitals included (no.)	3	3	13	6	2	5	5	5	3
<i>Treatment characteristics</i>									
PTCA (%)	0.33 ± 0.58	0.95 ± 0.05	0.43 ± 0.49	0.91 ± 0.15	0 ± 0	1 ± 0	0 ± 0	0 ± 0	/
PTCA & Stenting (%)	0.33 ± 0.58	0.95 ± 0.05	0.34 ± 0.39	0.91 ± 0.15	0 ± 0	1 ± 0	0 ± 0	0 ± 0	/
Drug eluting Stents	0.05 ± 0.09	0 ± 0	0.08 ± 0.12	0.83 ± 0.41	0 ± 0	0.32 ± 0.34	0 ± 0	0 ± 0	/
Length of stay (days)	6.0 ± 0.08	6.0 ± 1.5	6.9 ± 2.1	5.7 ± 0.08	8.9 ± 2.1	7.0 ± 2.9	11.0 ± 3.0	8.2 ± 1.1	5.9 ± 2.7
<i>Hospital characteristics</i>									
Beds per hospital (no.)	776.3 ± 192.5	486.3 ± 148.5	436.5 ± 193.0	533.3 ± 250.3	608.5 ± 181.7	794.6 ± 312.9	359.4 ± 211.9	401.8 ± 275.6	585.3 ± 175.3
Physicians per hospital bed (no.)	0.34 ± 0.06	0.35 ± 0.04	0.22 ± 0.07	0.27 ± 0.11	0.14 ± 0.06	0.59 ± 0.03	0.27 ± 0.04	0.67 ± 0.09	0.68 ± 0.22
Nurses per hospital bed (no.)	1.56 ± 0.10	1.39 ± 0.22	0.56 ± 0.12	2.62 ± 0.84	0.79 ± 0.09	1.26 ± 0.14	0.76 ± 0.22	2.31 ± 1.37	2.18 ± 1.02
Beds per dept. (no.)	57.8 ± 0	32.0 ± 8.0	90.1 ± 22.9	26.0 ± 10.4	71.5 ± 12.0	34.6 ± 17.1	51.7 ± 4.6	57.8 ± 0	47.6 ± 22.5
Physicians per dept. bed (no.)	0.23 ± 0	0.29 ± 0.05	0.17 ± 0.06	0.22 ± 0.06	0.09 ± 0.11	0.61 ± 0.14	0.17 ± 0.05	0.23 ± 0	0.45 ± 0.14
<i>Country characteristics</i>									
Eurostat Purchasing Power Parities	1.0791	1.0742	1.0526	1.0519	0.6026	1.0275	0.5504	0.9077	1.3479

a) subsumed in overhead costs b) no data available \* for information only; excluded from the further analysis

## Acute Myocardial Infarction

**Table 3. Two-level random intercept regression model**

<b>Independent variable</b>	<b>Coefficient</b>	<b>S.E.</b>	<b>t-value</b>	<b>p-value</b>
<i>Treatment characteristics</i>				
PTCA and stenting	0.5249	0.1619	3.24	0.0028***
Length of stay	0.0725	0.0238	3.04	0.0048***
<i>Hospital characteristics</i>				
Urbanity	0.2488	0.1025	2.43	0.0212**
<i>Country characteristics</i>				
PPPs	3.8327	0.6900	5.55	<.0001***

\*\*\*P<0.01, \*\*P<0.05

\*\*\* The coefficient is significant (1%)

\*\* The coefficient is significant (5%)



## Our analyses show that ...

- use of technology is a major explanation for certain vignettes (hip replacement, acute myocardial infarction, appendectomy ...)
  - skills mix and usage intensity may make a difference (delivery ...)
  - length of stay plays a role (especially if shortened by early discharge to rehabilitation; e.g. stroke)
  - costs per resource unit (especially for personnel) do differ – as much or more than technology usage
- > *for efficiency comparisons, adjustment of input costs necessary*

## Adjustment for differences in input costs

- Exchange rate
- GDP per head (OECD)
- General/ GDP purchasing power parities (Eurostat)
- Medical purchasing power parities (Eurostat)
  - > our objective to create and test „Episode specific PPPs“ with constant cost categories
- „Technology specific PPPs“

## Sample of hospitals per case vignette and per country

Care episode	Country							
	Germany	England	France	Hungary	Italy	Netherlands	Poland	Spain
<i>Hip</i>	8	2	5	2	5	7	6	5
<i>AMI</i>	13	3	3	2	5	6	5	5
<i>Appendectom.</i>	14	5	5	3	5	10	6	4
<i>Delivery</i>	9	5	4	3	5	7	5	5
<i>Stroke</i>	15	5	4	2	5	7	6	5

## Definition of homogeneous cost categories

- material costs
  - drug costs
  - physician costs
  - nursing costs
  - costs related to diagnostic procedures
- } Constitute  
> 50% of  
total costs

Care episode	Country								Average
	Germany	England	France	Hungary	Italy	Netherlands	Poland	Spain	
<i>Hip</i>	0.68	0.66	0.60	0.90	0.61	0.61	0.83	0.81	0.71
<i>AMI</i>	0.73	0.68	0.74	0.76	0.55	0.85	0.73	0.74	0.72
<i>Appendectomy</i>	0.64	0.41	0.39	0.68	0.45	0.62	0.46	0.76	0.55
<i>Delivery</i>	0.78	0.43	0.39	0.40	0.34	0.64	0.63	0.78	0.55
<i>Stroke</i>	0.64	0.32	0.52	0.52	0.34	0.39	0.57	0.76	0.51



## Methodology of calculating Episode-specific Fisher-type PPPs following Wordsworth & Ludbrook (2005; Health Economics 14: 93-9)

**„Price relatives“ x „Expenditure weights“**



## Matrix of transitive “Episode-specific” PPPs (ESPPP) after EKS transformation – the example of Total Hip Replacement

	Transitive ESPPPs							
	Germany	England	France	Hungary	Italy	Netherlands	Poland	Spain
Germany	1.000	0.992	1.291	3.848	0.992	1.371	2.509	1.603
England	1.008	1.000	1.302	3.879	1.000	1.382	2.530	1.616
France	0.774	0.768	1.000	2.979	0.768	1.062	1.943	1.241
Hungary	0.260	0.258	0.336	1.000	0.258	0.356	0.652	0.417
Italy	1.008	1.000	1.302	3.880	1.000	1.383	2.531	1.617
Netherlands	0.729	0.723	0.942	2.806	0.723	1.000	1.830	1.169
Poland	0.398	0.395	0.515	1.533	0.395	0.546	1.000	0.639
Spain	0.624	0.619	0.806	2.400	0.619	0.855	1.565	1.000

## Conversion rates (index country = Germany)

Conversion rate	Country							
	Germany	England	France	Hungary	Italy	Netherlands	Poland	Spain
Euro Exchange rate	1.000	0.684	1.000	247.097	1.000	1.000	4.000	1.000
GDP per head	1.000	1.059	1.019	0.304	0.898	1.117	0.215	0.730
GDP PPP	1.000	1.025	1.020	0.572	0.976	0.999	0.523	0.862
Medical care PPP	1.000	1.106	0.977	0.465	1.223	0.995	0.415	0.843
Hip PPP	1.000	1.008	0.774	0.260	1.008	0.729	0.398	0.624
AMI PPP	1.000	2.086	2.169	0.192	1.551	2.257	0.476	0.928
Appendectomy PPP	1.000	0.924	0.706	0.344	0.727	0.959	0.192	0.408
Delivery PPP	1.000	0.423	0.443	0.065	0.363	0.299	0.158	0.253
Stroke PPP	1.000	1.139	1.124	0.195	0.905	1.537	0.371	0.777

**Average  
adjusted  
costs per  
case by  
country  
and care  
episode**

Care episode/ Conversion approach	Country							
	Germany	England	France	Hungary	Italy	Netherlands	Poland	Spain
<i>Hip</i>								
Exchange rate	6,365	5,691	6,101	1,294	6,982	5,605	2,125	3,599
GDP per head	6,365	5,372	5,985	4,251	7,771	5,016	9,866	4,929
GDP PPP	6,365	5,551	5,979	2,260	7,152	5,609	4,065	4,174
Medical care PPP	6,365	5,146	6,245	2,782	5,709	5,633	5,121	4,269
ESPPP	6,365	5,646	7,880	4,979	6,924	7,687	5,334	5,770
<i>AMI</i>								
Exchange rate	2,866	5,014	5,916	396	7,450	5,599	1,026	1,861
GDP per head	2,866	4,732	5,803	1,301	8,292	5,011	4,762	2,549
GDP PPP	2,866	4,891	5,798	692	7,632	5,603	1,962	2,158
Medical care PPP	2,866	4,533	6,056	852	6,092	5,627	2,472	2,208
ESPPP	2,866	2,403	2,728	2,060	4,804	2,481	2,154	2,006
<i>Appendectomy</i>								
Exchange rate	1,922	2,037	2,027	469	1,632	1,898	466	594
GDP per head	1,922	1,923	1,988	1,541	1,816	1,698	2,164	813
GDP PPP	1,922	1,987	1,986	819	1,672	1,899	891	688
Medical care PPP	1,922	1,842	2,074	1,008	1,334	1,907	1,123	704
ESPPP	1,922	2,203	2,872	1,362	2,246	1,979	2,429	1,454
<i>Delivery</i>								
Exchange rate	2,365	1,638	2,107	342	1,534	762	400	572
GDP per head	2,365	1,546	2,067	1,124	1,707	682	1,857	783
GDP PPP	2,365	1,598	2,065	597	1,571	763	765	663
Medical care PPP	2,365	1,481	2,157	735	1,254	766	964	679
ESPPP	2,365	3,868	4,751	5,239	4,226	2,552	2,538	2,257
<i>Stroke</i>								
Exchange rate	3,456	6,123	4,337	628	4,588	6,872	1,238	1,932
GDP per head	3,456	5,779	4,255	2,065	5,106	6,150	5,746	2,645
GDP PPP	3,456	5,972	4,250	1,098	4,700	6,877	2,367	2,240
Medical care PPP	3,456	5,536	4,440	1,352	3,751	6,907	2,983	2,291
ESPPP	3,456	5,378	3,859	3,220	5,072	4,473	3,337	2,486

## Discussion

- ESPPPs reflect input costs more accurately than conventional approaches
- > reflected by conversion rate differences between labour- and technology-intensive care episodes
- For comparison at aggregate level, identification of basket of important/ cost-relevant care episodes necessary
- For „performance“ comparisons, data on quality/ outcomes are necessary (in our approach outcomes were standardized)