

THE IMPACT OF NEW DRUG LAUNCHES ON LONGEVITY IN NINE MIDDLE EASTERN AND AFRICAN COUNTRIES

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DISCLOSURE



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The manuscript is currently under review by the journal the [Journal of Epidemiology and Global Health](#).

PREVIOUS RESEARCH



LEADING ARTICLE

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Contribution of Pharmaceutical Innovation to Longevity Growth in Germany and France, 2001–7

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ORIGINAL PAPER

The impact of new (orphan) drug approvals on premature mortality from rare diseases in the United States and France, 1999–2007

Frank R. Lichtenberg

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The impact of cardiovascular drug innovation on the longevity of elderly residents of Switzerland, 2003–2012

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FINDINGS FROM PREVIOUS RESEARCH



- Real-world evidence from numerous countries indicates that **pharmaceutical innovation** has been the **principal cause of longevity growth**.
- In the U.S., the **value** of reductions in **work loss days and hospital admissions** attributable to pharmaceutical innovation was estimated to be **three times as large as the cost of new drugs consumed**.
- Countries in which new drugs are **launched earlier** obtain greater benefits from pharmaceutical innovation.

GOAL OF THE STUDY



- This study provides econometric evidence about the impact that **new chemical entity (NCE)** launches had on **premature mortality** in 9 Middle Eastern and African countries during the period 2007-2015.
 - General analysis of **18 diseases**
 - Specific analysis of **20 cancer sites (types)**
- A “**triple-differences**” research design is used; this controls for all determinants of mortality (e.g. GDP, education, average health expenditure) that were invariant across diseases within a country, and for all determinants that were invariant across countries within a disease.

PART I: GENERAL ANALYSIS OF 18 DISEASES

Diseases

1. Infectious and parasitic diseases
2. Respiratory infections
3. Maternal conditions
4. Neonatal conditions
5. Nutritional deficiencies
6. Malignant neoplasms
7. Other neoplasms
8. Diabetes mellitus
9. Endocrine, blood, immune disorders
10. Mental and substance use disorders
11. Neurological conditions
12. Cardiovascular diseases
13. Respiratory diseases
14. Digestive diseases
15. Genitourinary diseases
16. Skin diseases
17. Musculoskeletal diseases
18. Congenital anomalies

Countries

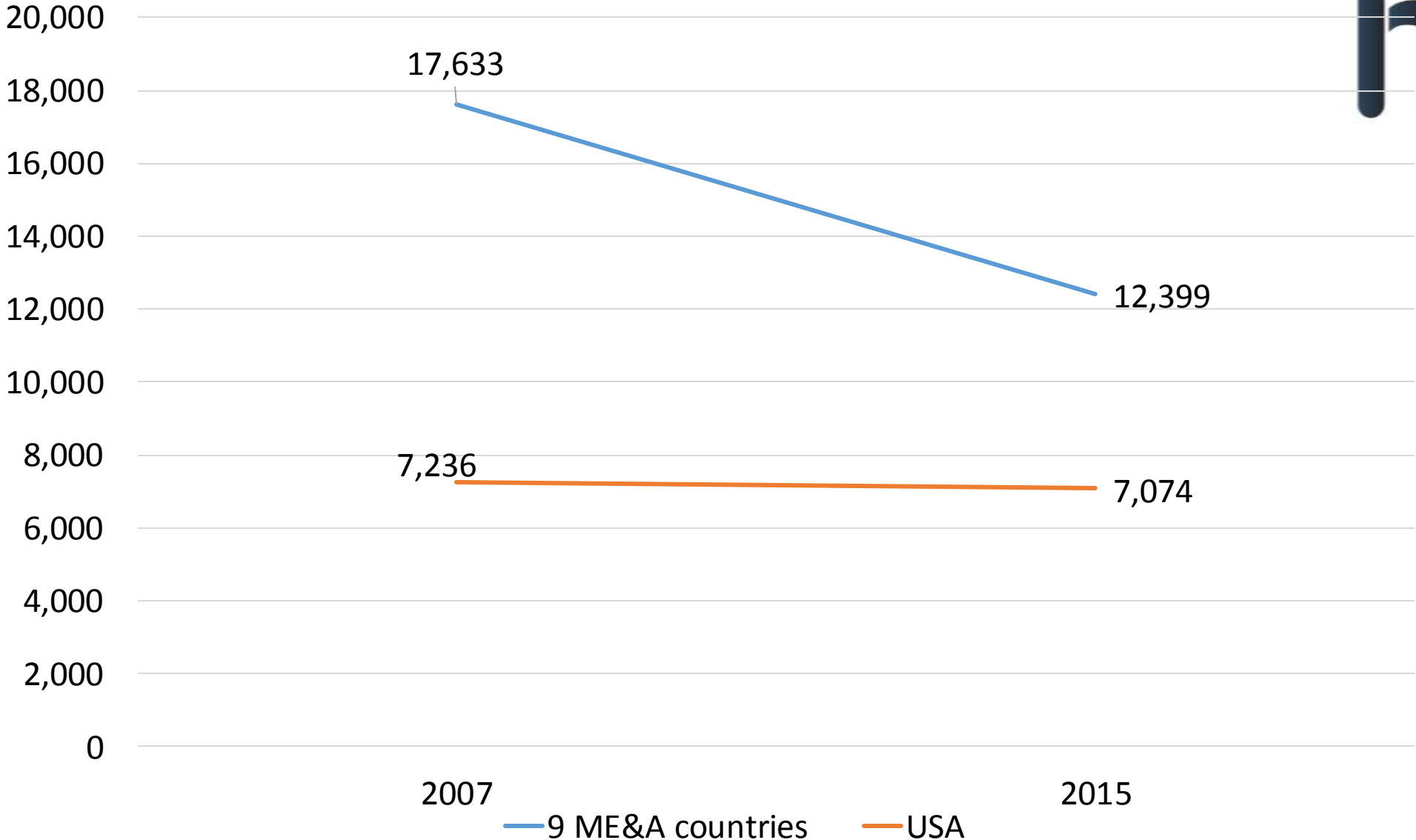
1. Egypt
2. Jordan
3. Kuwait
- 4. Lebanon**
5. Morocco
6. Saudi Arabia
7. South Africa
8. United Arab Emirates
9. Tunisia

YEARS OF POTENTIAL LIFE LOST (YPLL) (PREMATURE MORTALITY)



- Suppose:
 - 10 people die at age 60
 - 20 people die at age 70
 - 10 people die at age 80
- Years of potential life lost before age 75 = $(10 * (75 - 60)) + (20 * (75 - 70))$
= 250
- Years of potential life lost before age 65 = $(10 * (65 - 60)) = 50$

Premature (before age 75) mortality rate



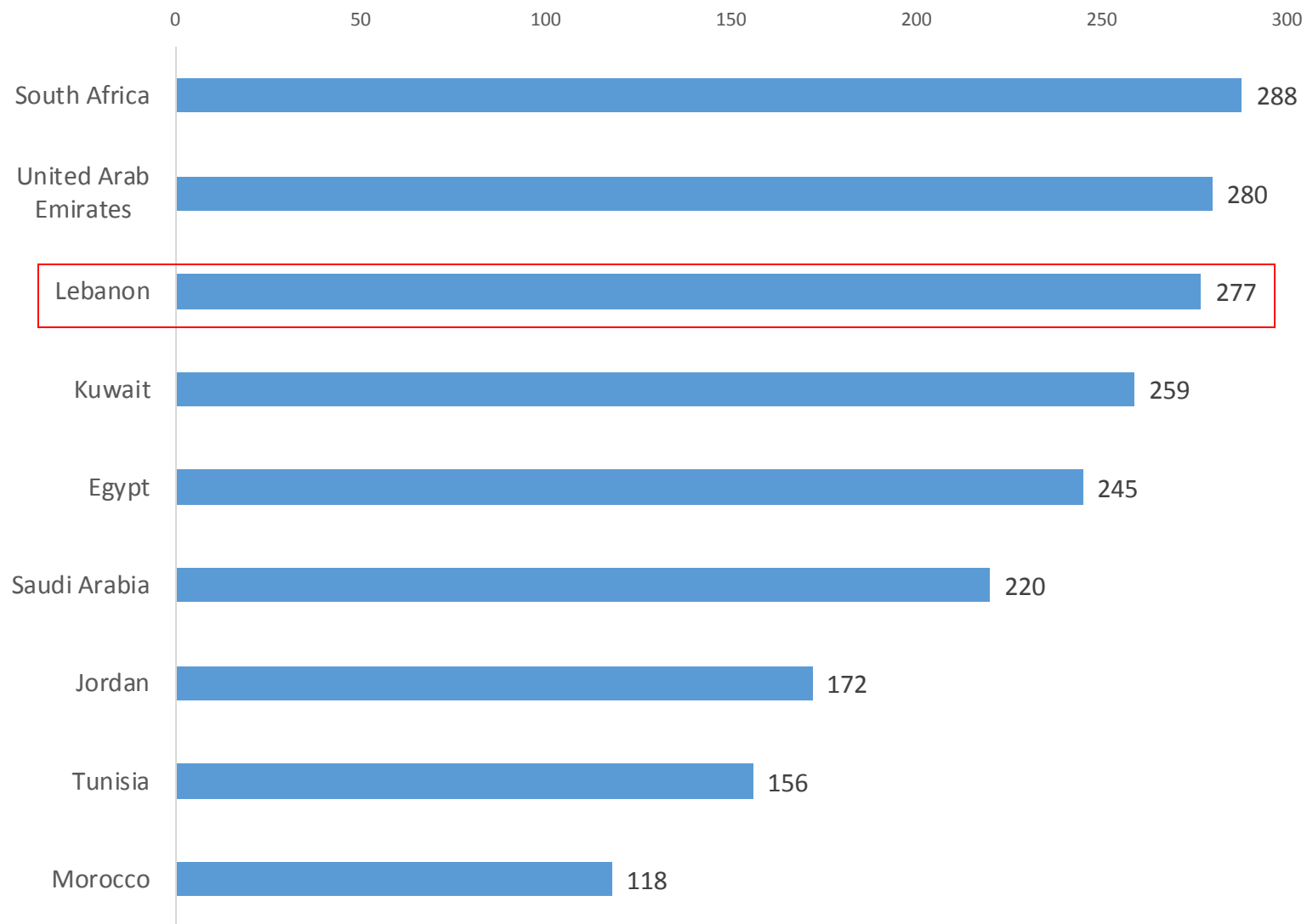
Source: Author's calculations, based on data from World Health Organization (2016) and U.S. Centers for Disease Control (2017).

Mortality rate per 100,000 population below age 75

Thousands of years of potential life lost before age 75, by country and cause, 2007 and 2015

	Egypt		Jordan		Kuwait		Lebanon		Morocco		Saudi Arabia		South Africa		Tunisia		UAE		TOTAL	
	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015
20 Infectious and parasitic diseases	626	567	20	19	2	3	10	9	350	233	79	55	12796	6167	32	26	6	8	13921	7087
380 Respiratory infections	835	769	32	32	5	9	5	5	300	220	117	99	1149	885	48	39	5	7	2495	2065
420 Maternal conditions	36	37	4	5	0	0	1	1	39	24	5	5	53	65	5	6	0	0	143	141
490 Neonatal conditions	1994	2092	135	132	16	14	22	30	923	768	373	298	1098	852	117	105	22	22	4699	4311
540 Nutritional deficiencies	66	48	1	1	0	0	0	0	16	12	2	1	266	179	1	1	0	0	352	243
610 Malignant neoplasms	951	1129	54	67	11	15	47	62	323	378	158	201	741	870	91	103	21	37	2397	2863
790 Other neoplasms	42	58	2	3	0	0	2	3	17	23	6	10	17	20	4	5	0	0	90	122
800 Diabetes mellitus	148	177	10	13	2	3	7	11	107	95	15	19	270	306	32	42	4	9	594	676
810 Endocrine, blood, immune disorders	202	237	7	8	1	2	2	3	21	17	29	28	139	156	11	12	3	4	414	467
820 Mental and substance use disorders	48	56	2	3	0	1	1	2	38	26	5	10	39	38	6	8	4	6	143	152
940 Neurological conditions	65	83	5	8	2	3	3	5	38	31	28	30	120	144	13	16	4	6	279	326
1100 Cardiovascular diseases	1813	2089	59	82	29	54	63	90	454	382	298	359	673	726	126	152	50	107	3565	4042
1170 Respiratory diseases	157	161	6	7	1	2	5	7	62	52	24	27	191	180	21	23	12	19	478	478
1210 Digestive diseases	737	806	9	11	2	5	6	8	87	69	29	34	178	180	24	29	5	9	1077	1151
1260 Genitourinary diseases	236	258	11	15	2	4	5	8	75	62	51	63	116	134	20	23	7	12	522	579
1330 Skin diseases	4	5	0	0	0	0	0	0	4	4	3	4	25	30	1	2	0	0	38	46
1340 Musculoskeletal diseases	6	8	2	3	0	0	0	1	5	3	5	5	12	15	2	3	0	1	32	38
1400 Congenital anomalies	911	1117	61	69	21	19	15	20	214	209	241	222	292	292	64	61	15	17	1833	2026
TOTAL	8875	9696	419	477	96	134	192	267	3071	2608	1468	1471	18173	11238	618	656	159	265	33072	26812

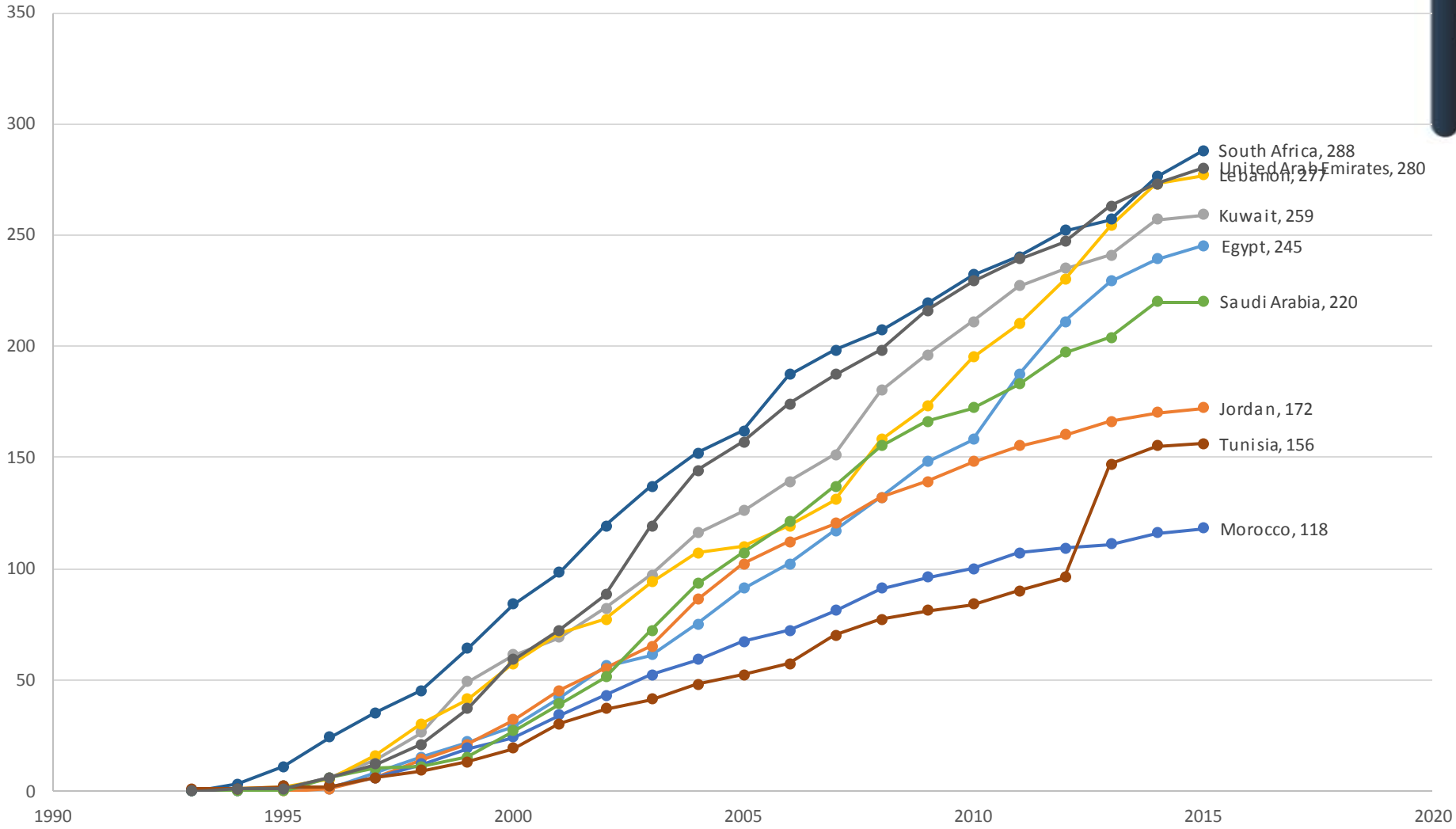
Number of post-1992 NCEs launched during 1993-2015, by country



Source: Author's calculations, based on data from IMS Health New Product Focus database.

All diseases

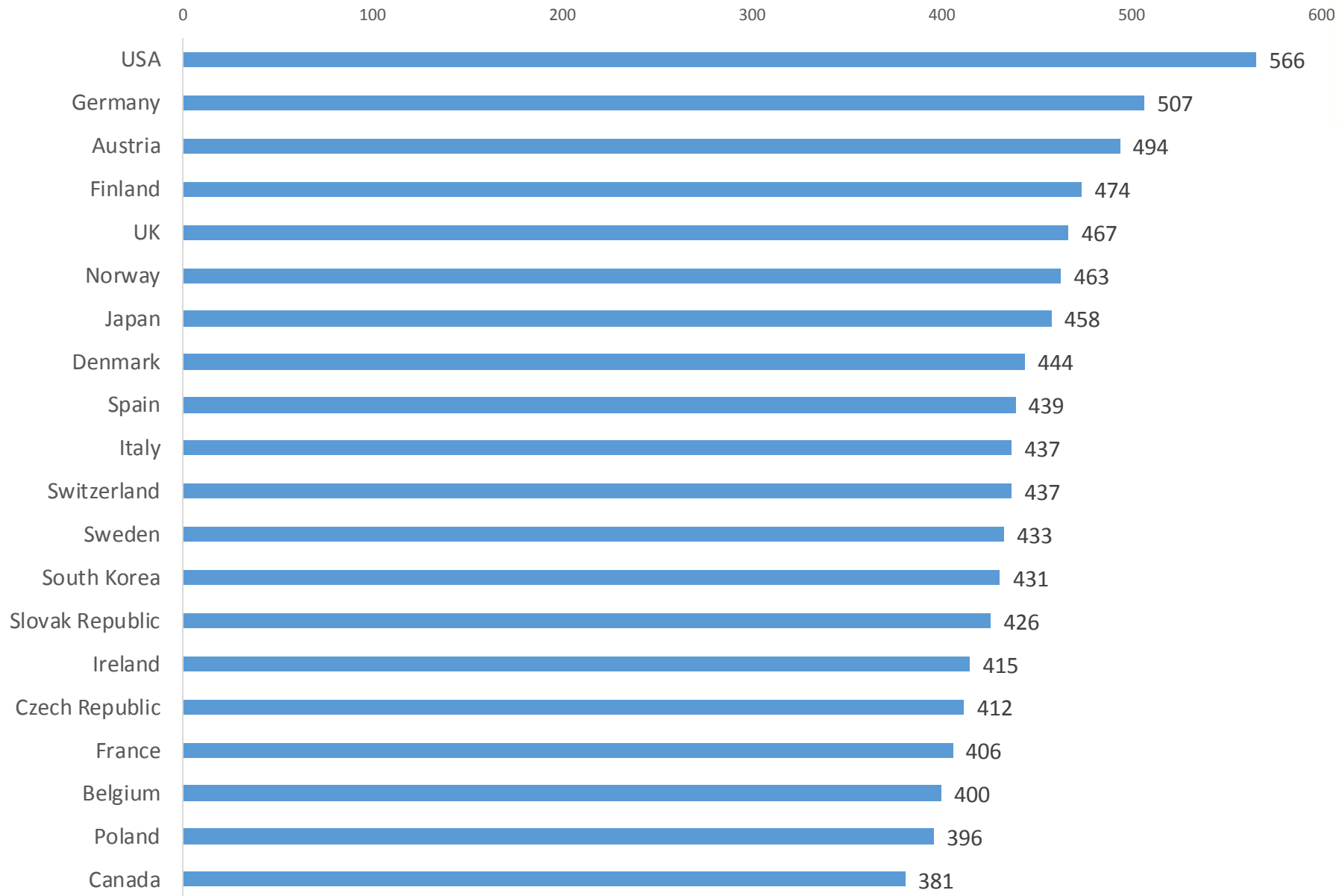
Number of post-1992 NCEs ever launched, by country and year, 1993-2015



- Egypt
- Jordan
- Kuwait
- Lebanon
- Morocco
- Saudi Arabia
- South Africa
- Tunisia
- United Arab Emirates

Source: Author's calculations, based on data from IMS Health New Product Focus database.

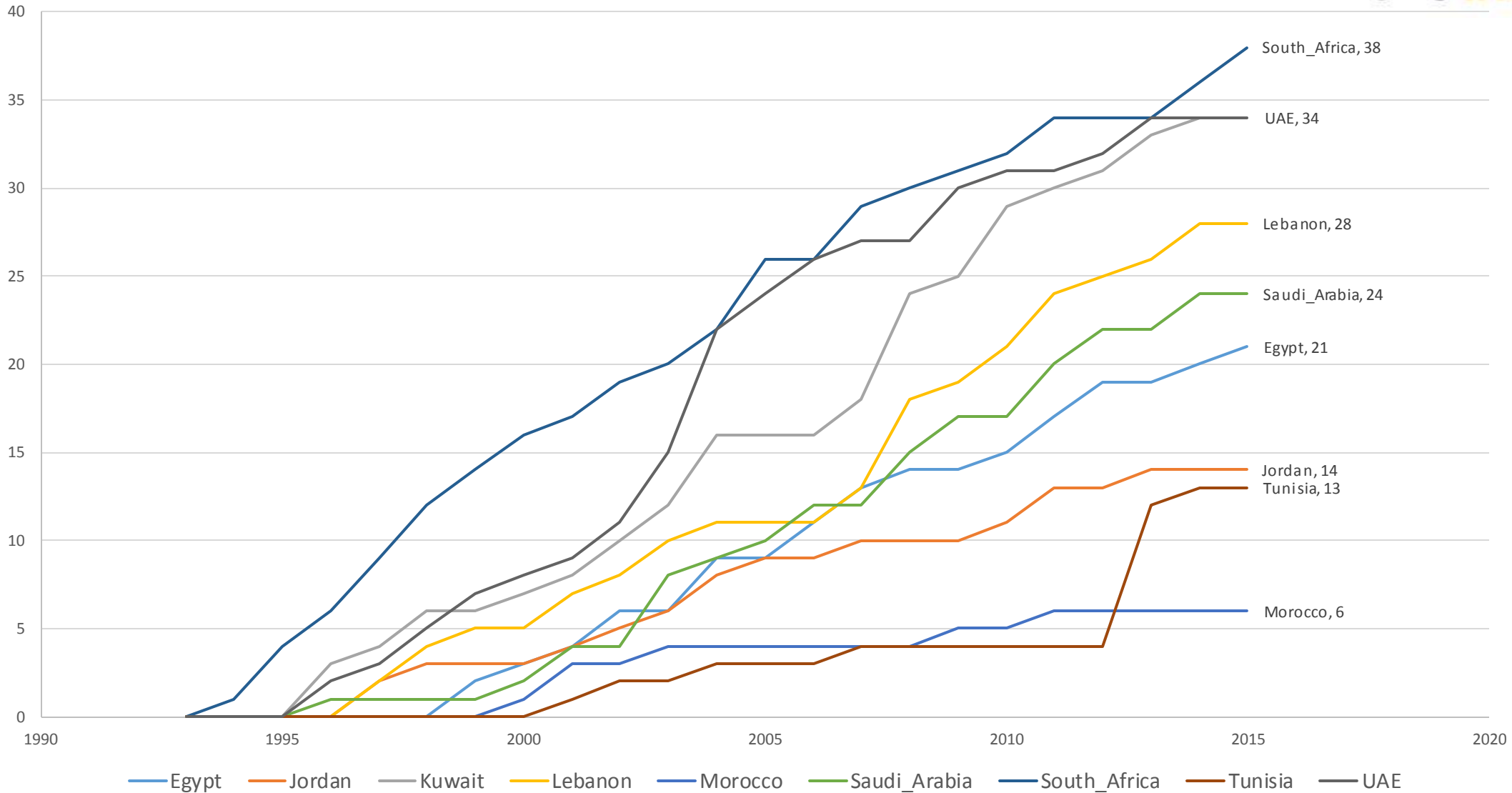
Top 20 countries, by number of post-1992 NCEs launched during 1993-2015



Source: Author's calculations, based on data from IMS Health New Product Focus database.

Infectious and parasitic diseases

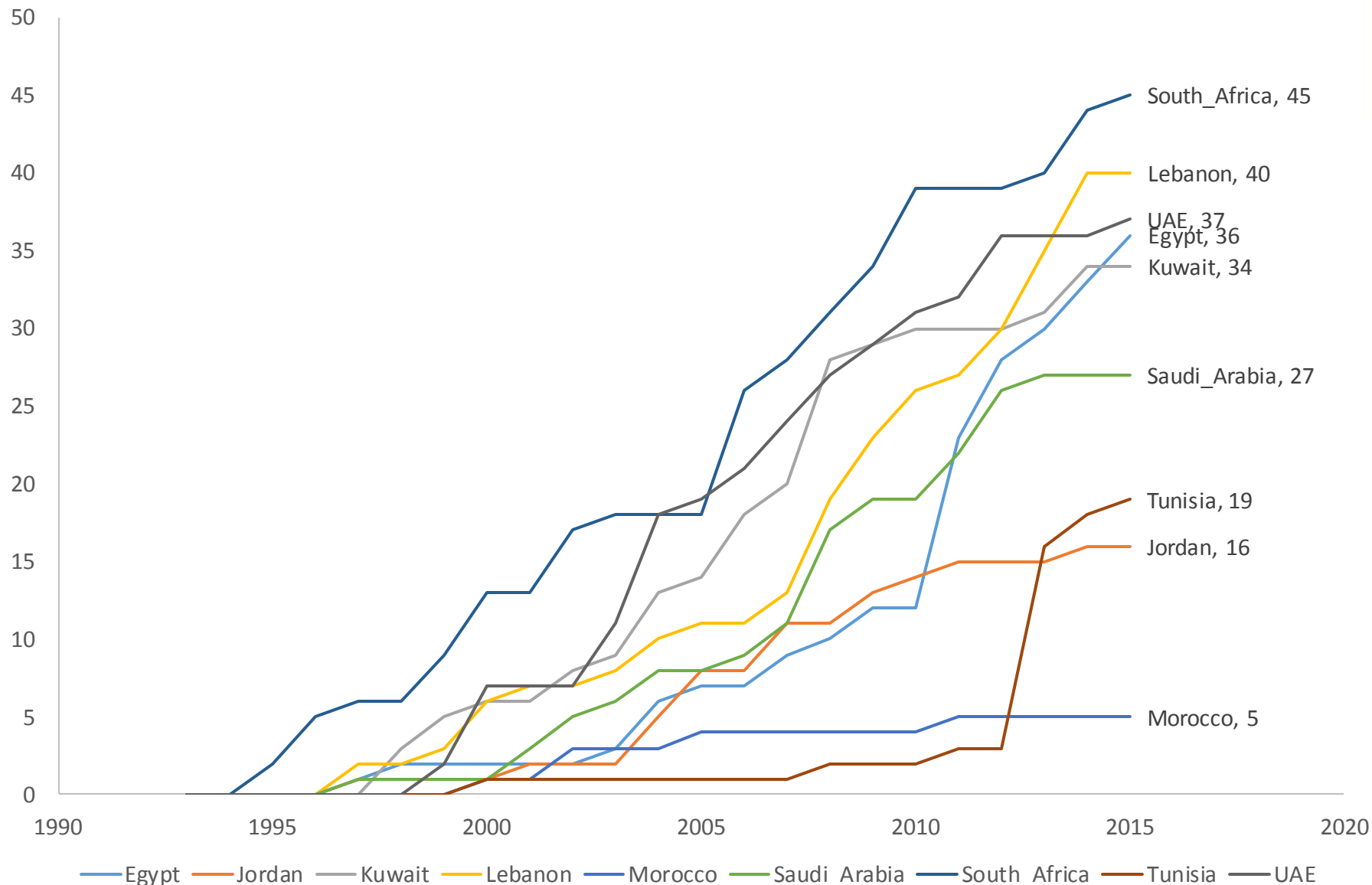
Number of post-1992 NCEs ever launched, by country and year, 1993-2015



Source: Author's calculations, based on data from IMS Health New Product Focus and Theriaque databases.

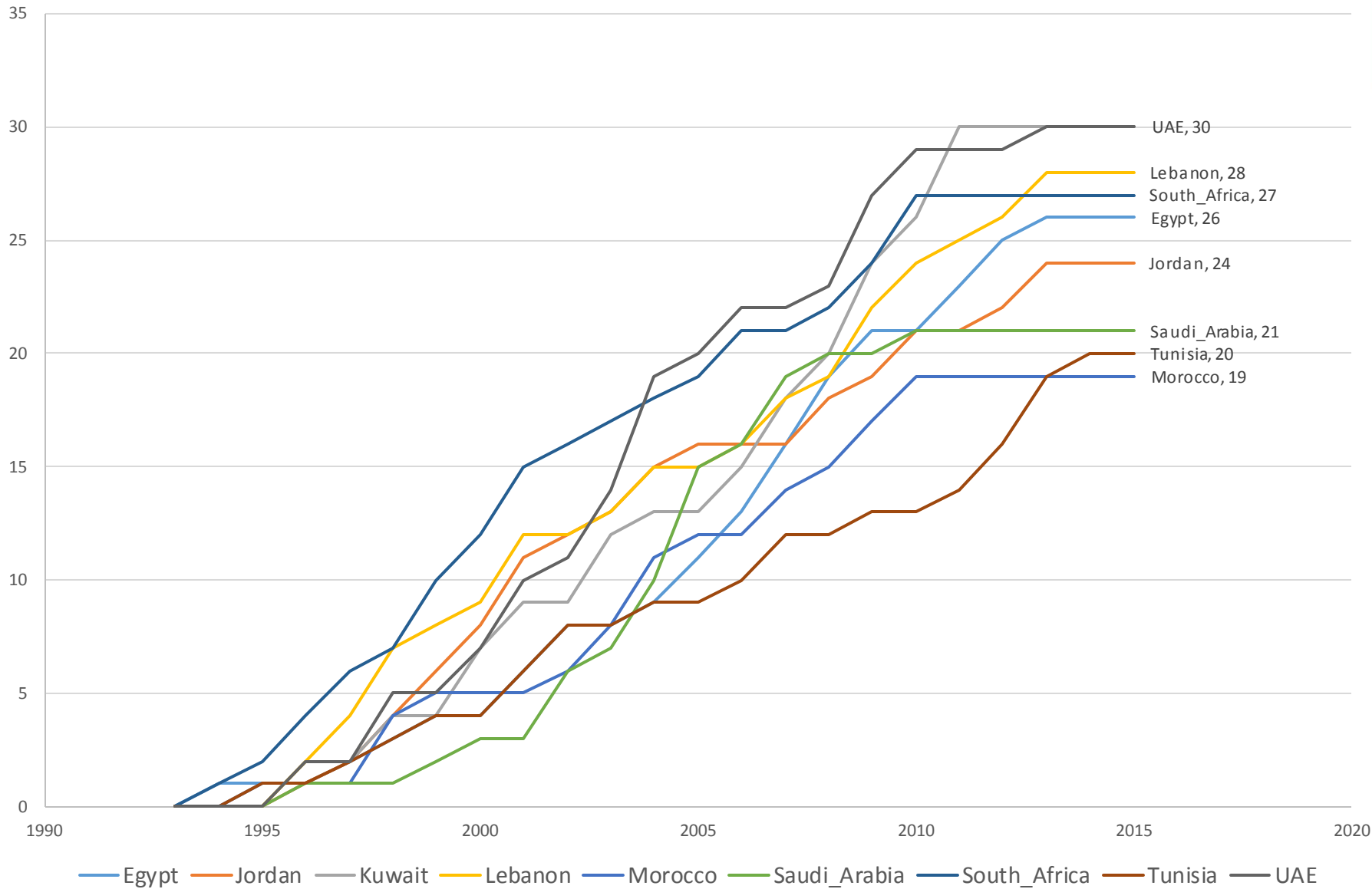
Malignant neoplasms

Number of post-1992 NCEs ever launched, by country and year, 1993-2015

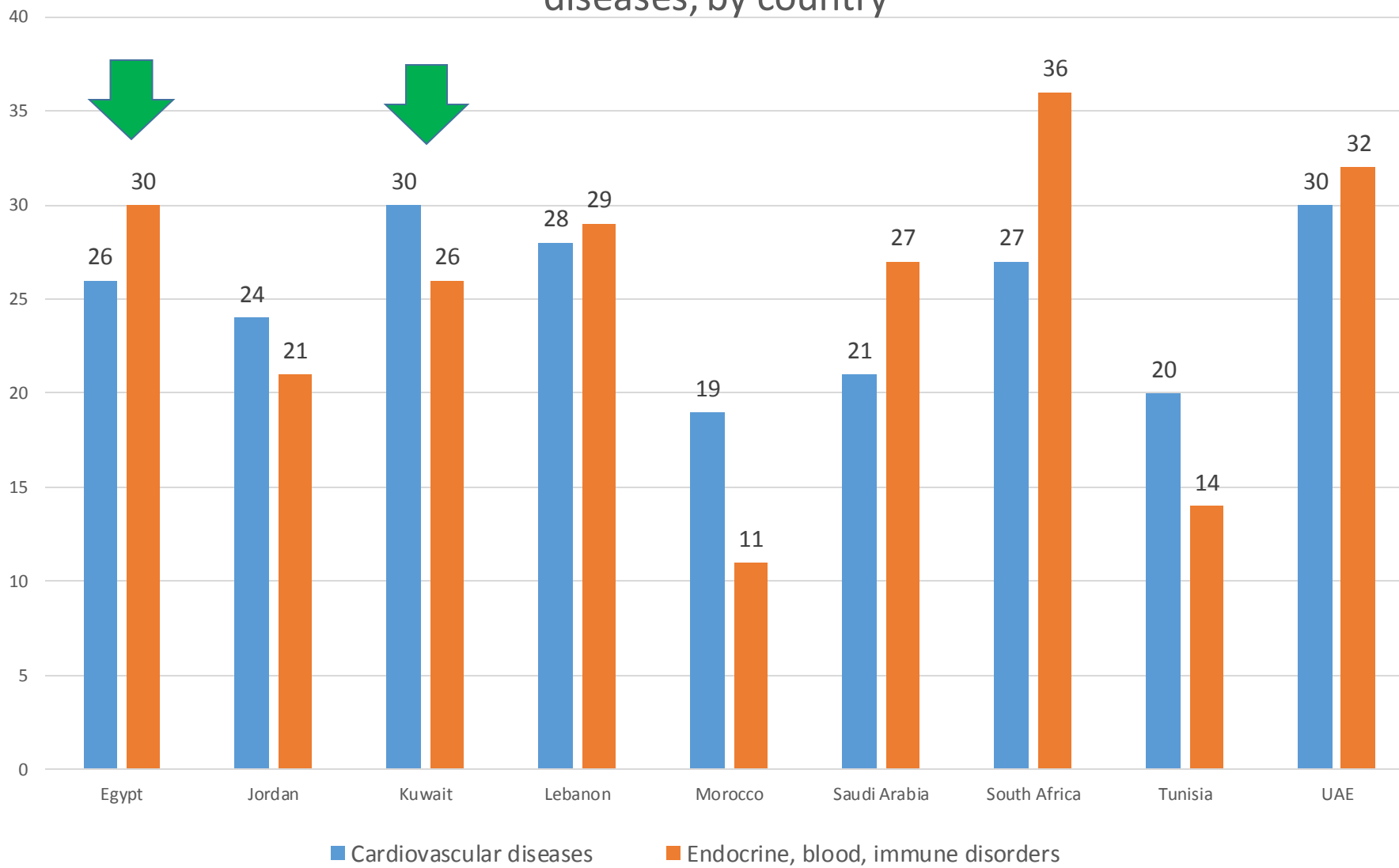


Cardiovascular diseases

Number of post-1992 NCEs ever launched, by country and year, 1993-2015



Number of post-1992 NCEs launched during 1993-2015 for 2 diseases, by country



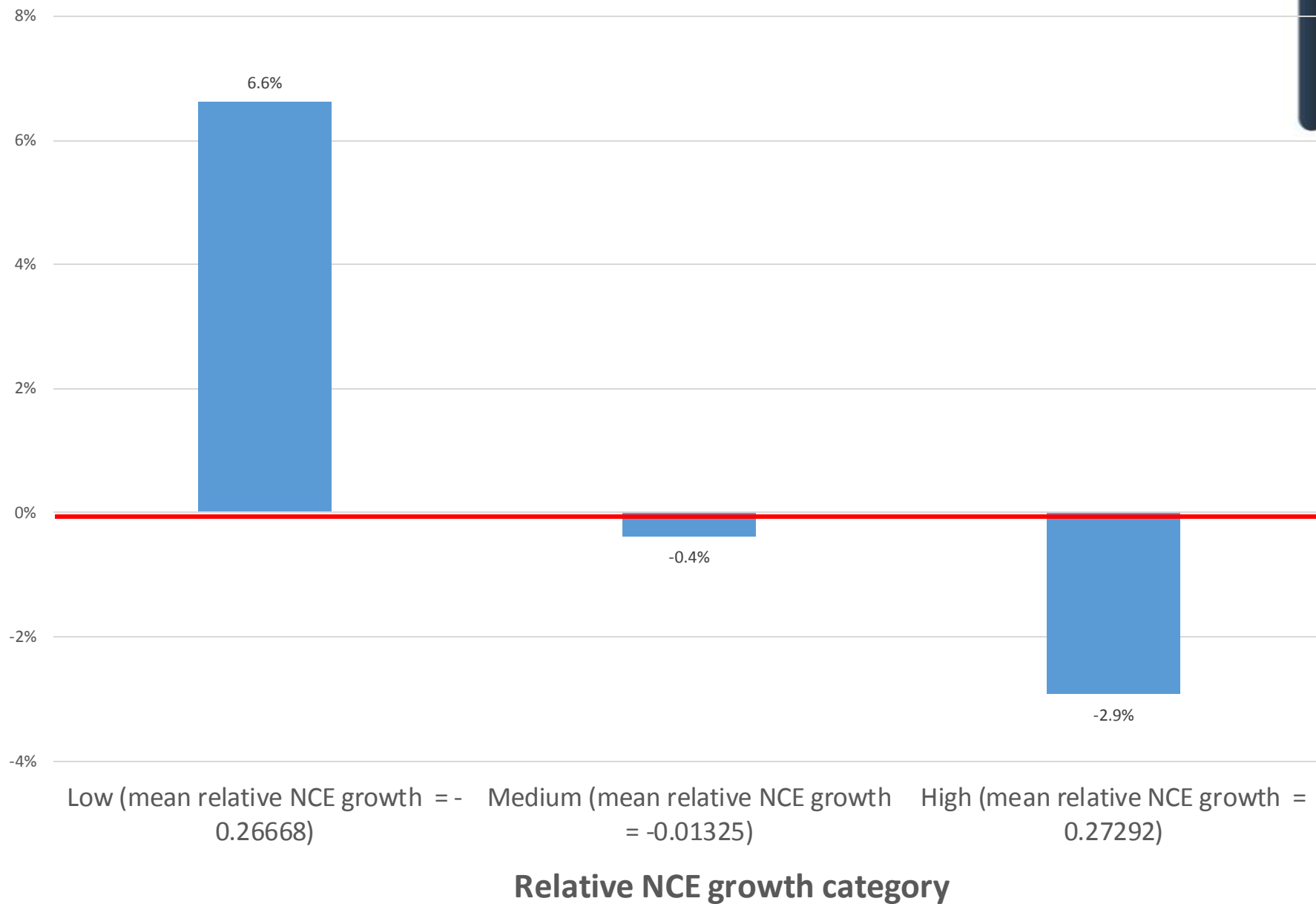
Source: Author's calculations, based on data from IMS Health New Product Focus and Theriaque databases.

RESULTS - GENERAL ANALYSIS



- Overall, the estimates are highly consistent with the hypothesis that **the greater the relative number of NCEs for a disease launched in a country, the greater the subsequent relative decline in premature mortality from that disease.**
- **In the absence of 8 previous years of NCE launches, 2.80 million additional YPLL before age 75 would have been lost in 2015.**
- **a 10% increase in the number of drugs ever launched resulted in a 2.4% reduction in the number of years of potential life lost before age 75 three years later.**
- **There is a highly significant inverse relationship between cumulative NCE launches and the number of years of potential life lost before age 75**

Mean 2007-2015 relative growth in YPLL75, by relative NCE growth category



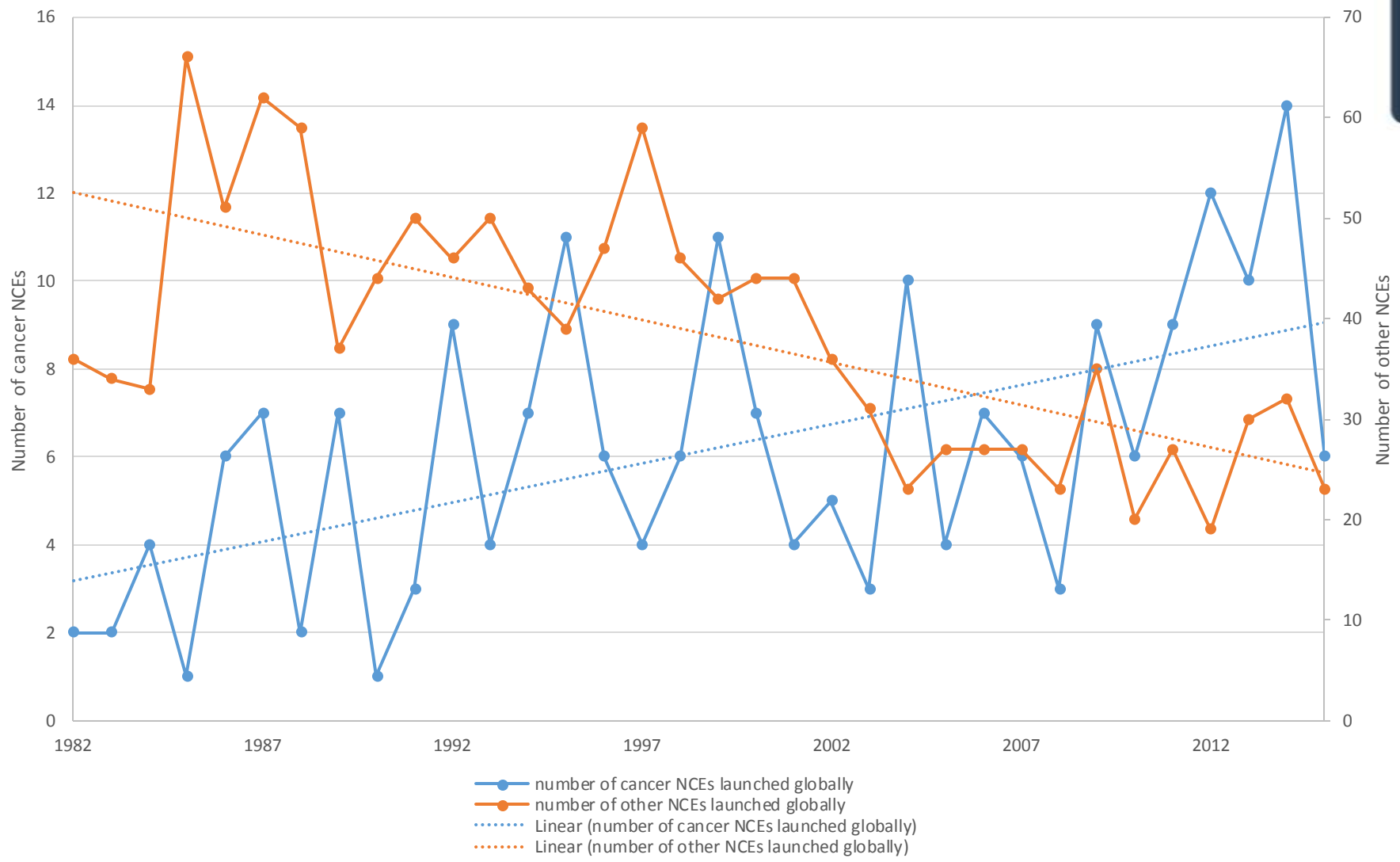
ROUGH ESTIMATE OF COST-EFFECTIVENESS



- Estimated expenditure in 2015 on new drugs by people below age 75 was \$US 2.34 billion, so **expenditure on new drugs per life-year below age 75 gained in 2015 from the drugs was \$US 834.**
- According to the standards of the WHO's *Choosing Interventions that are Cost-Effective* project, **new drugs launched in the 9 ME&A countries were very cost-effective overall, even if they hadn't reduced other medical costs or increased productivity.**
- Moreover, evidence from other countries suggests that new drug launches reduce other medical costs and increase productivity.

**PART II:
SPECIFIC ANALYSIS OF 20 CANCER SITES**

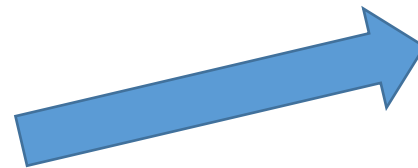
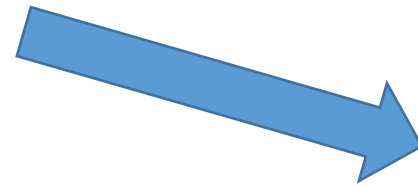
Annual number of cancer NCEs and other NCEs launched globally, 1982-2015



Source: author's calculations based on IMS Health New Product Focus database
 "Cancer NCEs" are NCEs in EphMRA/PBIRG Anatomical Classification L (ANTINEOPLASTIC AND IMMUNOMODULATING AGENTS)

New cancer
drugs launched
since 1993

Number of new
cancer cases
diagnosed in
2012



- Premature mortality from cancer in 2015
- Mean age at death from cancer in 2015

Note: all data classified by country and cancer site

20 CANCER SITES (TYPES)



1. C15 Esophageal Cancer
2. C16 Stomach (Gastric) Cancer
3. C18-C21 Colon and Rectal Cancer
4. C22 Liver Cancer
5. C25 Pancreatic Cancer
6. C33-C34 Lung Cancer
7. C43 Melanoma
8. C50 Breast Cancer
9. C53 Cervical Cancer
10. C56 Ovary Cancer
11. C61 Prostate Cancer
12. C62 Testicular Cancer
13. C64-C66 Kidney (Renal Cell) Cancer
14. C67 Bladder Cancer
15. C70-C72 Brain and nervous system cancers
16. C73 Thyroid Cancer
17. C81 Hodgkin Lymphoma
18. C82-C86, C96 Non-Hodgkin Lymphoma
19. C88, C90 Multiple Myeloma and Other Plasma Cell Neoplasms
20. C91-C95 Leukemia

SUMMARY CANCER MORTALITY AND INCIDENCE STATISTICS, 9 COUNTRIES COMBINED, 2005 AND 2015



Year	YPLL75	YPLL65	number of deaths	number of new cancer cases diagnosed 3 years before	mean age at death (yr)
2005	1,735,728	972,238	117,049	123,512	61.58
2015	2,184,852	1,184,267	153,356	212,792	62.35
% change	26%	22%	31%	72%	
change					0.78

Sources: Ferlay et al (2004), International Agency for Research on Cancer (2017), World Health Organization (2016).

Number of years of potential life lost before age 75 in 2015, by country and cancer site

Cancer site	Egypt	Jordan	Kuwait	Lebanon	Morocco	Saudi Arabia	South Africa	Tunisia	UAE	TOTAL
C15 Esophageal Cancer	15,790	308	123	338	3,737	2,620	44,466	588	910	68,877
C16 Stomach (Gastric) Cancer	27,353	3,108	388	2,068	16,636	6,435	21,942	4,745	1,668	84,340
C18-C21 Colon and Rectal Cancer	44,735	7,510	1,350	3,823	24,978	19,188	43,293	8,383	2,845	156,103
C22 Liver Cancer	219,005	1,968	770	1,225	2,420	8,823	33,915	1,200	1,325	270,650
C25 Pancreatic Cancer	31,885	2,175	548	1,535	6,215	5,285	23,223	2,435	1,075	74,375
C33-C34 Lung Cancer	68,627	6,447	953	8,605	54,173	11,717	89,453	20,478	3,178	263,628
C43 Melanoma	538	83	0	130	485	170	7,915	158	0	9,478
C50 Breast Cancer	116,723	7,300	2,228	9,923	62,505	19,800	75,123	11,950	3,960	309,510
C53 Cervical Cancer	5,100	305	165	533	16,843	1,388	91,466	1,333	618	117,749
C56 Ovary Cancer	24,481	1,097	263	1,420	8,536	3,758	17,605	2,247	1,075	60,480
C61 Prostate Cancer	3,223	385	78	745	4,710	1,150	18,225	623	180	29,318
C62 Testicular Cancer	1,536	774	0	308	2,078	1,252	1,370	143	75	7,534
C64-C66 Kidney (Renal Cell) Cancer	27,190	1,714	165	1,149	10,450	8,316	7,962	2,590	579	60,113
C67 Bladder Cancer	37,381	1,017	173	1,750	7,060	2,465	6,970	2,370	240	59,425
C70-C72 Brain and nervous system cancers	67,364	4,290	882	2,672	20,315	9,833	17,722	3,885	1,297	128,258
C73 Thyroid Cancer	3,638	328	90	170	4,000	2,295	1,925	283	250	12,978
C81 Hodgkin Lymphoma	12,622	2,077	0	1,340	8,213	5,701	4,287	2,020	418	36,675
C82-C86, C96 Non-Hodgkin Lymphoma	60,056	3,286	563	4,477	18,323	15,272	67,782	5,424	2,235	177,416
C88, C90 Multiple Myeloma and Other Plasma Cell Neoplasms	5,638	790	90	590	4,053	1,753	9,880	968	498	24,258
C91-C95 Leukemia	121,893	8,212	2,051	5,261	22,984	28,198	33,581	7,296	4,217	233,692
TOTAL	894,772	53,170	10,875	48,058	298,710	155,414	618,102	79,113	26,640	2,184,852

Source: Author's calculations based on data contained in WHO Global Health Estimates 2015.

Number of post-1992 NCEs that had been launched by 1 November 2015, by country and cancer site

Cancer site	Egypt	Jordan	Kuwait	Lebanon	Morocco	Saudi Arabia	South Africa	Tunisia	UAE	AVERAGE
C15 Esophageal Cancer	4	2	4	2	0	4	4	2	4	2.9
C16 Stomach (Gastric) Cancer	6	4	6	4	0	6	8	6	6	5.1
C18-C21 Colon and Rectal Cancer	14	8	14	16	2	8	16	10	14	11.3
C22 Liver Cancer	2	0	4	4	0	2	4	2	2	2.2
C25 Pancreatic Cancer	10	6	12	12	0	10	14	10	12	9.6
C33-C34 Lung Cancer	22	16	24	28	0	18	22	14	22	18.4
C43 Melanoma	6	4	8	6	2	6	12	4	2	5.6
C50 Breast Cancer	34	26	32	36	10	28	36	24	28	28.2
C53 Cervical Cancer	8	4	8	8	4	6	8	0	6	5.8
C56 Ovary Cancer	16	10	14	14	2	10	16	6	12	11.1
C61 Prostate Cancer	18	10	16	14	8	14	16	8	16	13.3
C62 Testicular Cancer	6	6	6	8	6	6	4	4	2	5.3
C64-C66 Kidney (Renal Cell) Cancer	8	4	10	8	0	8	12	4	8	6.9
C67 Bladder Cancer	4	2	2	2	2	2	4	0	2	2.2
C70-C72 Brain and nervous system cancers	8	6	6	8	0	2	8	6	6	5.6
C73 Thyroid Cancer	2	0	2	2	0	2	2	2	0	1.3
C81 Hodgkin Lymphoma	8	2	6	10	4	4	10	8	0	5.8
C82-C86, C96 Non-Hodgkin Lymphoma	12	6	14	16	6	10	22	12	6	11.6
C88, C90 Multiple Myeloma and Other Plasma Cell Neoplasms	8	2	6	12	2	4	14	12	6	7.3
C91-C95 Leukemia	20	6	22	26	6	18	26	12	14	16.7
AVERAGE	10.8	6.2	10.8	11.8	2.7	8.4	12.9	7.3	8.4	

Source: Author's calculations based on U.S. National Cancer Institute's *Drugs Approved for Different Types of Cancer* database, and IMS Health *New Product Focus* database

Estimates of the number of new cases of cancer diagnosed in 2012, by cancer site and country

Cancer site	Egypt	Jordan	Kuwait	Lebanon	Morocco	Saudi Arabia	South Africa	Tunisia	UAE	TOTAL
C15 Esophageal Cancer	1,449	33	11	34	335	225	3,868	58	40	6,053
C16 Stomach (Gastric) Cancer	1,773	237	40	257	1,174	531	2,029	470	103	6,614
C18-C21 Colon and Rectal Cancer	4,060	967	192	745	2,484	2,047	4,697	1,203	260	16,655
C22 Liver Cancer	17,511	151	50	113	330	710	1,960	107	66	20,998
C25 Pancreatic Cancer	2,347	157	42	136	551	380	1,830	214	53	5,710
C33-C34 Lung Cancer	4,970	582	105	896	3,928	823	7,239	1,729	181	20,453
C43 Melanoma	118	20	1	53	97	58	1,856	58	14	2,275
C50 Breast Cancer	18,660	1,237	314	1,933	6,650	2,791	9,815	1,826	568	43,794
C53 Cervical Cancer	866	50	30	113	2,258	241	7,733	265	93	11,649
C56 Ovary Cancer	2,377	108	30	182	724	295	1,336	233	70	5,355
C61 Prostate Cancer	2,358	285	112	807	2,332	703	9,957	618	89	17,261
C62 Testicular Cancer	199	51	12	56	125	93	149	28	30	743
C64-C66 Kidney (Renal Cell) Cancer	1,535	115	29	133	346	386	423	220	57	3,244
C67 Bladder Cancer	8,898	267	75	777	1,606	594	1,689	917	75	14,898
C70-C72 Brain and nervous system cancers	4,875	156	23	158	734	339	632	204	87	7,208
C73 Thyroid Cancer	2,048	229	81	207	1,100	1,050	549	228	133	5,625
C81 Hodgkin Lymphoma	993	114	37	158	518	376	383	193	67	2,839
C82-C86, C96 Non-Hodgkin Lymphoma	5,365	242	101	575	1,696	1,151	2,254	539	164	12,087
C88, C90 Multiple Myeloma and Other Plasma Cell Neoplasms	541	97	24	98	479	174	796	143	41	2,393
C91-C95 Leukemia	3,439	228	80	248	709	565	1,258	348	127	7,002
TOTAL	84,382	5,326	1,389	7,679	28,176	13,532	60,453	9,601	2,318	212,856

Source: GLOBOCAN 2012 (International Agency for Research on Cancer (2017)).

RESULTS



- The estimates indicate that, on average, the launch of one additional NCE for a cancer site:
 - Reduced the number of years of potential life lost before age 75 due to cancer at that site by 4.4% 4 years later
 - Reduced the number of years of potential life lost before age 65 due to cancer at that site by 6.7% 4 years later
 - Increased the **mean age** at which people died from cancer at that site by **0.72 years** (or 8.6 months) 4 years later.
- The estimates also indicate that NCEs launched during the period 2002-2011:
 - Reduced the number of years of potential life **before age 75** lost in 2015 due to cancer by **280,312**
 - Reduced the number of years of potential life before age 65 lost in 2015 by 243,384

COST-EFFECTIVENESS OF CANCER DRUGS



- The estimate NCEs launched during the period 2006-2015 reduced the number of years of potential life before age 75 lost in 2015 due to cancer by 280,312.
- **So a (very conservative) upper bound estimate of the cost per life-year gained before age 75 is US \$1,170 (= 328 million / 280,312).**
- This is conservative, because (1) expenditure on all 71 drugs, not just drugs launched during the period 2006-2015, are included, and (2) because 15% of patients in these countries are diagnosed (and presumably treated) after age 75.

SUMMARY AND CONCLUSIONS



- Introduction of new innovative medicines (e.g. NCE) in the nine MEA countries significantly reduced the number of years of life lost due to 18 diseases, including cancer
- Although the nine MEA countries are not among the top 20 countries worldwide in cumulative NCE launches since 1992, there is a marked increase in the number of NCEs launched since the year 2000
- From an economic standpoint, launch of NCEs in the MEA countries appears to be very cost-effective based on WHO standards

IMPLICATIONS



- **Timely access to innovative medicine is key driver in realizing the benefits of reduction in YPLL**
- **Direct impact on productivity, in addition to longevity**
- **Direct impact on medical cost offset (e.g. hospitalization)**
- **Value assessment (e.g. Cost effectiveness)**