A forecasting model for drug utilization and expenditure integrating a Cellular Automata model with Budget Impact Analysis approach

Joppi R, Menti A, Pase D, Poggiani C.

Modelli di previsione e sostenibilità delle tecnologie sanitarie emergenti

Forecasting models: How to predict the impact of emerging technologies on the NHS

Verona, 25 Ottobre 2014

Summary

- Background
- Italian Horizon Scanning Project: How does it work?
- A forecasting model for drug utilization and expenditure

Summary

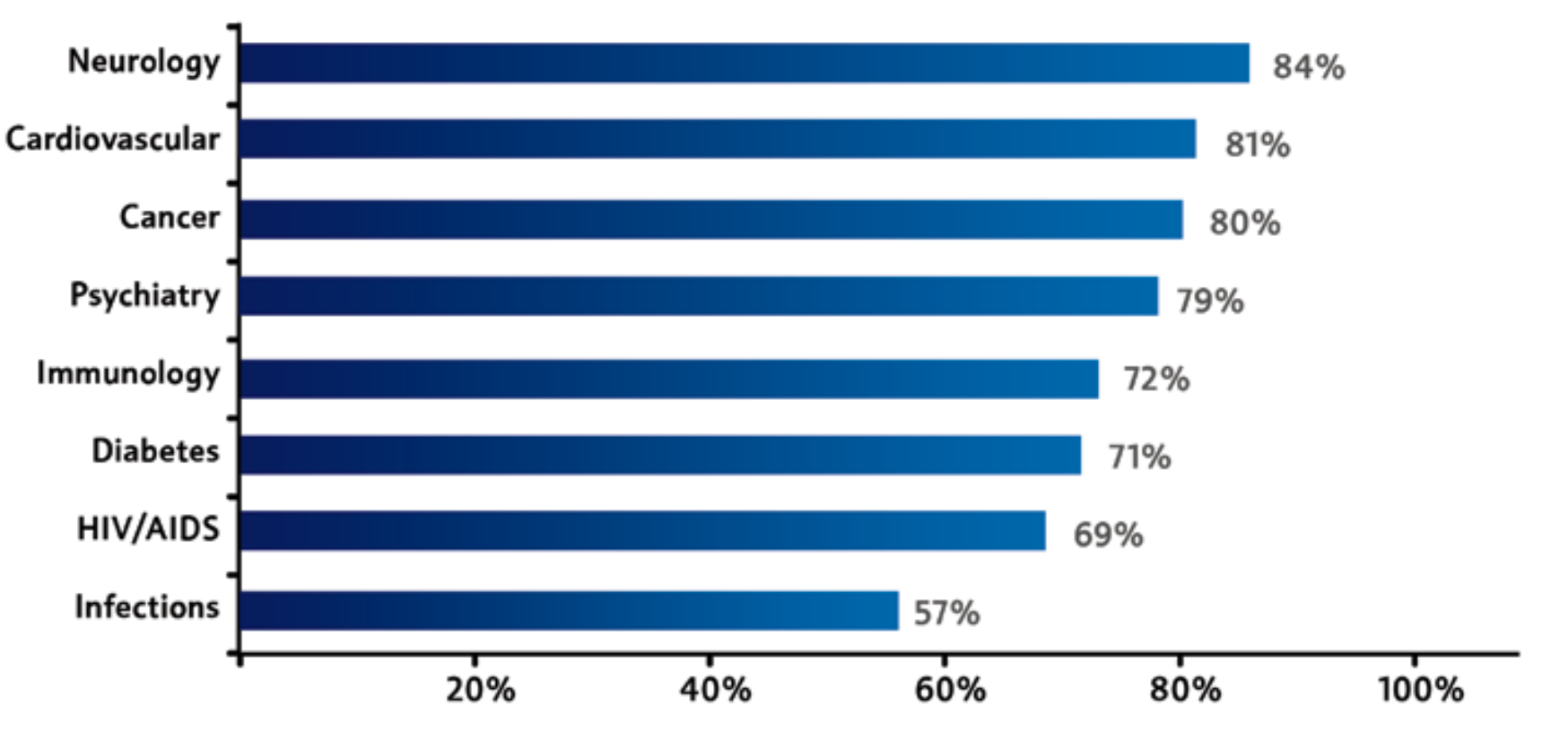
- **Background**
- Italian Horizon Scanning Project: How does it work?
- A forecasting model for drug utilization and expenditure

Background

Pharmaceutical expenditure has risen rapidly during the last decades. This has principally been driven by the introduction of new expensive drugs and has emphasized the need to develop new models to introduce medicines in healthcare to maintain an equitable and sustainable healthcare system.

Drugs in development…

According to the Pharmaceutical Research and Manufacturers of America (PhRMA) at the end of 2011 more than 2,900 medicines were in clinical development. Roughly 70% of them were potentially first-in-class.



http://www.phrma.org/sites/default/files/pdf/phrmapipelinereportfinal11713.pdf]

Comparative and **timeliness** evaluation of new treatments is **the most important information** to provide policy makers with

Summary

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- **Italian Horizon Scanning Project: How does it work?**
- A forecasting model for drug utilization and expenditure


Homepage | Horizon - Mozilla Firefox
File Modifica Visualizza Cronologia Segnalibri Strumenti ?
https://horizon.cineca.it/
Google
Horizon
New Drugs
Italian Horizon Scanning Project
Italian Horizon Scanning Project
New Drugs
Themes
project
authorized users
Host organization: Azienda ULSS 20 in Verona
CINECA
consorzio interuniversitario
Joppi R, Dematté L, Menti AM et al. (2009) The Italian Horizon Scanning Project. Eur J Clin Pharmacol 65:775–781
Completato
horizon.cineca.it

Aims

TO ORGANIZE and EVALUATE available information on emerging drugs BEFORE SUBMISSION of a MAA to Regulatory Agency and before any decision on COSTS and POSSIBLE CLASS OF REIMBURSEMENT

Specific aims:

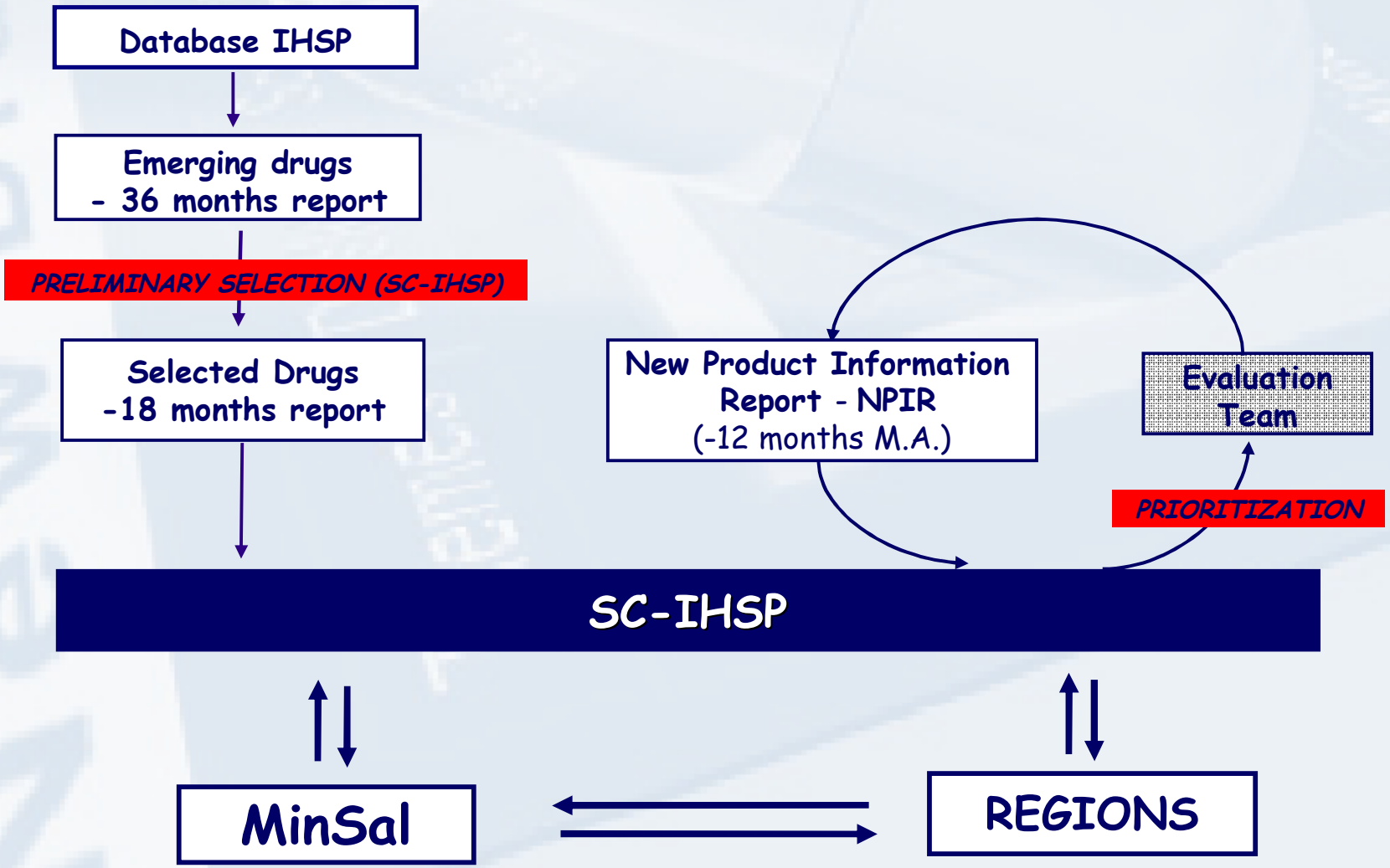
✓ to produce **periodical lists** of emerging drugs for which a MA will be expected within **12-36 months**

✓ to evaluate **potential clinical impact and cost effectiveness** in terms of healthcare and cost for National Health Service

✓ to give **well-timed information** to improve regulatory decisions about emerging drugs

✓ to identify **further research fields** needed to be investigated

IHSP Workflow



Methods and tools of the IHSP

Organization Structure

- Scientific Committee (SC)
- Database Team (DT)
- Evaluation Team (ET)

Data Management

- Information sources
- Evidence considered
- Data presentation
- Trial Quality Assessment

IHSP Database

- Data Collection
- Check
- Archive
- Discussion Forum

IHSP Reports

- Priority-setting criteria
- Output

Information Sources

- Regulatory Agencies
- Medical-scientific literature
- Scientific databases
- Medical websites/Press-releases
- Pharmaceutical Bulletins

Evidence considered

Clinical Trial (Phase I-III):

- ✓ Completed and published
- ✓ Completed not published
- ✓ Ongoing

Data presentation

- Narrative
- Tables of all Phase II-III studies

Trial Quality assessment

Item evaluated (Jadad modified + 3-level Likert scale):

- ✓ Design
- ✓ Allocation
- ✓ Blinding
- ✓ Lost to follow-up
- ✓ Protocol violation(s)
- ✓ Sample size
- ✓ Pre-specified secondary/sub-group analysis

The IHSP Database

ATC code (I level)	ATC decsription	US+EU n	EU n	EU phase I n (%)	EU phase II n (%)	EU phase III n (%)	EU phase I/II+II/III n (%)
L	Antineoplastic and immunomodulating agents	918	470	30 (6)	157 (33)	255 (54)	28 (6)
N	Nervous system	244	115	16 (14)	31 (27)	65 (57)	3 (3)
A	Alimentary tract and metabolism	149	81	11 (14)	26 (32)	41 (51)	3 (4)
J	Antiinfectives for systemic use	143	78	8 (10)	26 (33)	41 (53)	3 (4)
C	Cardiovascular system	100	60	0	16 (27)	43 (72)	1 (2)
B	Blood and blood forming organs	78	53	3 (6)	16 (30)	32 (60)	2 (4)
M	Musculo-skeletal system	74	31	4 (13)	7 (23)	18 (58)	2 (6)
R	Respiratory system	58	35	6 (17)	10 (29)	19 (54)	0
G	Genito-urinary system and sex hormones	34	16	2 (13)	5 (31)	9 (56)	0
S	Sensory organs	28	14	1 (7)	4 (29)	9 (64)	0
D	Dermatologicals	27	16	1 (6)	5 (31)	10 (63)	0
V	Various	16	7	0	1 (14)	5 (71)	1 (14)
H	Systemic hormonal preparations, excluded sex hormones and insulins	13	8	0	3 (38)	4 (50)	1 (13)
P	Antiparasitic products, inseticides and repellents	3	1	0	0	1 (100)	0
	Total drugs in development	**1885**	**985**	**82 (8)**	**307 (31)**	**552 (56)**	**44 (4)**
	Registered/launched drugs	464	260				
	Discontinued/Suspended drugs	267	144				
	Total number of items registered in the database	**2616**	**1389**				

The Italian Horizon Scanning Project, October 2014

Priority-setting criteria used by SC-IHSP

AREA to INVESTIGATE	PARAMETERS	EVALUATION	
Burden of disease			
	Epidemiology	Rare	Not rare
	Severity	Severe	Not severe
	Duration	Acute	Chronic
	Treatment	Available	Absent
Patient impact			
	Efficacy vs. current treatments *(mortality, morbidity, quality of life, etc.)*	Higher	Equal or Lower
	Safety vs. current treatments	Higher	Equal or Lower
	Compliance vs. current treatments	Higher	Equal or Lower
NHS Pressures			
	Social impact (Media, patients associations, lobbies ...)	YES	NO
	Service reorganization and/or staff training required	YES	NO
	Economic impact on the NHS	High	Low
Others			
	Possible launch date	≤ 18 months	> 18 months
	Drug in development for other indications of interest	YES	NO
	Other drugs in development for the same indication	YES	NO

Outputs

-36 MONTHS REPORT

Produced annually

- general information
  - *Drug/brand name/ active substance*
  - *Company*
  - *ATC Group*
- licensee
- stage of development
- possible submission date of the MAA
- main proposed indication(s)
- ongoing studies

NPIR

(-12 months to M.A.)

"Drug Name"
"Drug Indication"

- general information
  - *Active substance*
  - *Brand name*
  - *Company*
  - *ATC Group*
  - *Dosage*
  - *Route of administration*
  - *Development state*
  - *.....*
- clinical need and burden of disease
- summary of efficacy/safety data from available clinical trials
- clinical critical assessment
- social / economic impact
- ongoing trial(s) for the same or other indication(s)

-18 MONTHS REPORT

Produced every 6 months

- general information
  - *Drug/brand name /active substance*
  - *Company*
  - *ATC Group*
  - *Route of administration*
- possible submission date of the MAA
- proposed indication(s)
- summary of the available data on clinical efficacy and safety
- overview of all ongoing trials and completed studies not published
- possible price and economic impact (if available)
- alternative(s) already on the market
- possible competitors in development

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- Italian Horizon Scanning Project: How does it work?
- **A forecasting model for drug utilization and expenditure**

Obiettivo generale del progetto

Sviluppare e validare un **modello per la previsione di consumi e spesa di farmaci**, **integrando** il modello basato su un **mercato dinamico potenziale degli Automi cellulari (AC)** con la **Budget Impact Analysis (BIA)**.
Attraverso tale modello si intende stimare l'impatto sul SSN/SSR dei **farmaci emergenti** identificati, prioritizzati e valutati criticamente in termini di efficacia e sicurezza da **IHSP**.

Obiettivi specifici

► Prevedere il processo di diffusione di farmaci emergenti

Farmaco emergente → Studio *dinamiche sequenziali dei competitori* già sul mercato (classe omogenea di farmaci) → Determinazione delle *dinamiche di diffusione* all'interno della classe omogenea

► Integrare le previsioni di consumo con quelle di spesa

attraverso modelli finalizzati a definire le potenzialità cliniche (*valutazioni IHSP*) e l'impatto economico dei farmaci emergenti su SSN/SSR;

► Monitorare i farmaci emergenti per 1-3 anni dopo la loro commercializzazione al fine di valutare la validità del modello messo a punto.

Una volta introdotto un nuovo prodotto, sarà possibile valutare il suo comportamento, analizzando i dati di utilizzo, monitorare e prevedere gli orientamenti futuri del mercato.

Metodi

- Italian Horizon Scanning Project → **Identificazione e valutazione critica dei farmaci emergenti**

- Modello Automi Cellulari → **Stima della penetrazione nel mercato dei farmaci emergenti, valutando le modalità di diffusione dell'informazione sui nuovi medicinali tra gli attori del sistema**

- Budget Impact Analysis → **Stima dell'impatto economico dei farmaci emergenti prima della loro commercializzazione**

Italian Horizon Scanning Project

↓

FARMACO EMERGENTE
→Valutazione critica
→ Place in therapy

↓

Comparatori sul mercato
(Traccianti)

↓

Dati di consumo dei traccianti
- database ARNO (CINECA) -

↓

Comportamento dei traccianti
nel tempo

↓

Budget Impact Analysis (Ex-Ante) **+** **Cellular Automata** (Ex-Ante)

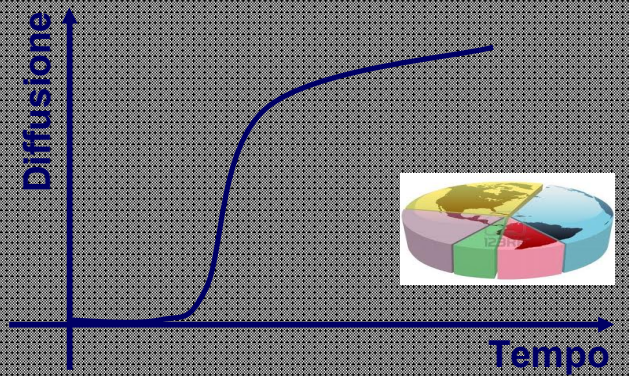
→

RISULTATI ATTESI

Modello di impatto relativo a farmaci emergenti

Antidiabetici

[Classi di farmaci **omogenee**, in cui il comportamento dei traccianti è definito e opportunamente governato, facilitando la costruzione dei primi modelli]



FORECASTING

New Product Information Report

DAPAGLIFLOZIN

Type-2 Diabetes Mellitus

PG: 17/12/2010

Update: May 2011

M.A. EMA: 12/11/2012

Summary

Clinical and Patients impact

Mechanism of action

Dapagliflozin is a first-in-class glucosuric agent acting through the potent and selective inhibition of the human renal sodium-dependent glucose cotransporter 2 (SGLT2).

Efficacy

Efficacy

Add-on (second-line). Baseline level of A1C ranged from 7.9% to 8.5% across 3 phase III trials. **(i)** When added to metformin (NCT00528879, n=546), mean change from baseline to week 24 in %A1C was -0.30% for placebo (P) vs -0.67% (p=0.0002), -0.70% (p<0.0001) and -0.84% (p<0.0001) for dapagliflozin (D) 2.5, 5 and 10 mg, respectively. **(ii)** When added to glimepiride (NCT00680745, n=597), mean change from baseline to week 24 in %A1C was -0.13% for P vs -0.58%, -0.63% and -0.82% for D 2.5, 5 and 10 mg, respectively (p<0.0001 for each). **(iii)** When added to insulin (NCT00673231, n=808, still ongoing), mean change from baseline to week 24 in %A1C was -0.30% for P vs -0.75%, -0.82% and -0.90% for D 2.5, 5 and 10 mg, respectively (p≤0.0001 for each).

In a phase III, 52-week trial still ongoing (NCT00660907, n=816) oral dapagliflozin (2.5, 5 or 10 mg daily) was non-inferior to glipizide (both add-on to metformin) in patients not well-controlled on metformin alone in reducing %A1C at week 52 (primary endpoint) [-0.52%, with both treatments, difference 0.00 (95% CI: -0.11;0.11), pre-fixed non-inferiority margin 0.35%].

Monotherapy (first-line). In a phase III, 24-week, trial (NCT00528372, N=485), change from baseline to week 24 in %A1C was -0.23% with P vs -0.58%, -0.77% (p<0.001) and -0.89% (p<0.0001) with D 2.5, 5 and 10 mg, respectively. Dapagliflozin did not significantly reduce body weight with respect to P.

Safety

Safety

Across all placebo-controlled trials, main adverse events with D rather than with P were events suggestive of urinary tract infections (4-12.5% with D vs 4-8% with P) and events suggestive of genital infections (6.2-12.9% with D vs 0.7-5% with P). In the 52-week trial, events suggestive of genital infection were 12.3% with dapagliflozin (21.1% among females; 5.3% among males) vs. 2.7% with glipizide (5.4% among females; 0.4% among males). Events suggestive of urinary tract infection were 10.8% for dapagliflozin vs.6.4% for glipizide.

In NCT00528879, at week 24 blood urea nitrogen increased of 0.6-0.7 mmoL across all D arms vs. 0.2 mmoL increase in P arm; LDL cholesterol increased of 5.0%, 3.1% and 9.5% with D 2.5, 5 and 10 mg, respectively vs. 3.5% with P.

Innovation

Innovation and/or advantages

Dapagliflozin is an antidiabetic drug with a new mechanism of action. Strict monitoring over the time will be necessary due to safety concerns.

NHS and Financial Impact

Possible price

Possible price:

Price of dapagliflozin is not yet available. One month therapy with metformin costs €3.62-14.60; one month therapy with a sulfonylurea costs €2.34-16.92.

Italian possible setting: Community

Place in therapy

Possible place in therapy

Based on clinical trials, dapagliflozin is proposed as add-on therapy to metformin, glimepiride or insulin in patients not adequately controlled to previous monotherapy with metformin, glimepiride or insulin, respectively. Dapagliflozin is also proposed as first-line treatment of patients not adequately controlled with diet and exercise.

Modello Automi Cellulari

Stat Meth Appl (2008) 17:291–308
DOI 10.1007/s10260-007-0059-3

ORIGINAL ARTICLE

Cellular automata and Riccati equation models for diffusion of innovations

Renato Guseo · Mariangela Guidolin

Technological Forecasting & Social Change 76 (2009) 806–820

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

Modelling a dynamic market potential: A class of automata networks for diffusion of innovations

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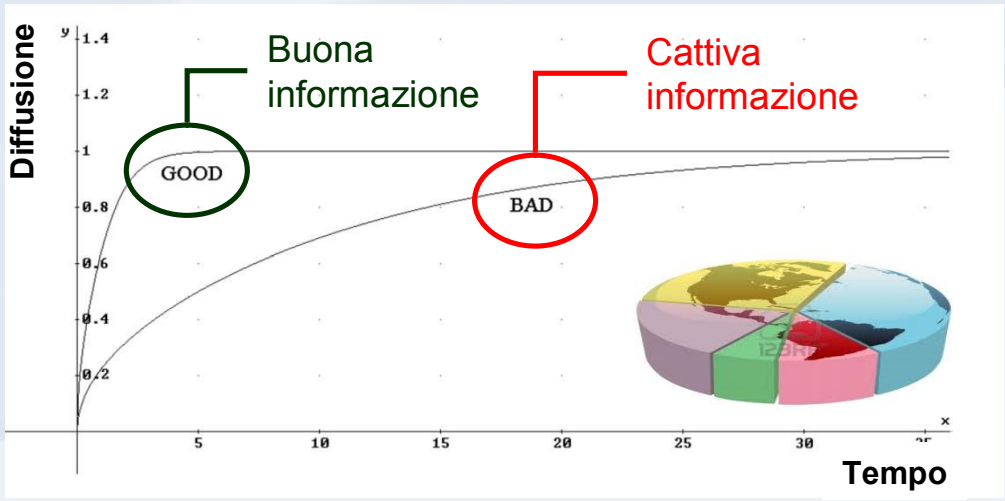
INNOVAZIONE

Scambio INFORMAZIONE tra ATTORI del sistama



DIFFUSIONE sul mercato basata sull'INFORMAZIONE

Budget Impact Analysis

Volume 10 • Number 5 • 2007
VALUE IN HEALTH

Principles of Good Practice for Budget Impact Analysis: Report of the ISPOR Task Force on Good Research Practices—Budget Impact Analysis

Josephine A. Mauskopf, PhD,[1] Sean D. Sullivan, PhD,[2] Lieven Annemans, PhD, MSc,[3] Jaime Caro, MD,[4] C. Daniel Mullins, PhD,[5] Mark Nuijten, PhD, MBA, MD,[6] Ewa Orlewska, MD, PhD,[7] John Watkins, RPh, MPH,[8] Paul Trueman, MA, BA[9]

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Journal of Medical Marketing: Device, Diagnostic and Pharmaceutical Marketing **May 2012** vol. 12 no. 2 **93-103**

Market access management by pharmaceutical companies in a complex environment: The Italian case study

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NUOVO FARMACO

Accesso al MERCATO

STIMA IMPATTO ECONOMICO

Costi introdotti

Il nuovo farmaco generalmente è più costoso dei vecchi

Costi evitati

- ottimizzazione pratica assistenziale
- dismissione tecnologie obsolete
- riduzione eventi (morti, ospedalizzazioni, altro)

...

GRAZIE PER L'ATTENZIONE

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