



Vaccines Technology Transfer in 2010+

April 2010

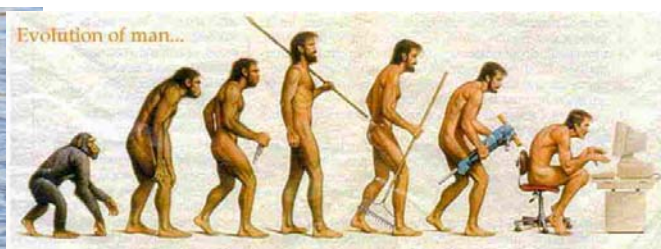
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What's so interesting?



Sounds very technical



In fact it mirrors the evolution of vaccines

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Why consider Technology Transfer?

Transfer of:

Knowledge

know-how

Tools

To:

1. Increase vaccine access and capacity
2. Lower Cost of Goods
3. Increase employment and wealth
4. Stimulate local industry and entrepreneurship
5. Decreases carbon footprint
6. Share Know-How
7. Share Intellectual Property

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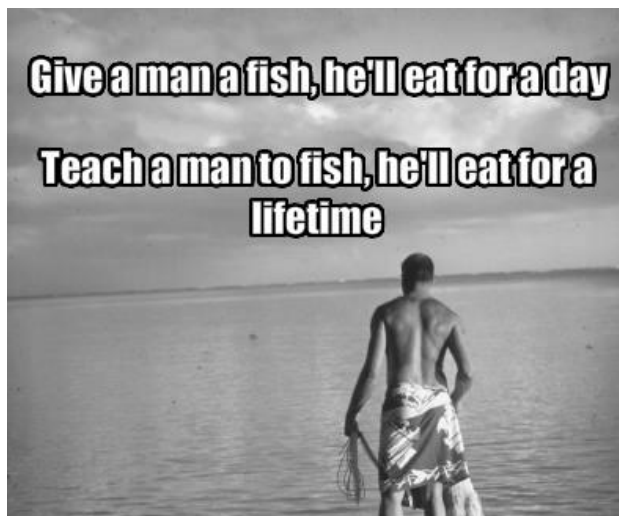
1. Adapted from http://en.wikipedia.org/wiki/Technology_transfer

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In essence

Give a man a fish, he'll eat for a day
Teach a man to fish, he'll eat for a lifetime



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History of Technology Transfer



FOUR ERAS OF VACCINATION WITH FOUR ERAS OF TECH. TRANSFER

1. Heroic era (8th century to 1930s)
 - Heroically led artisanal revolutions
2. National public health (1930s = >1990s)
 - National vaccine institutes
 - Growing complexity, sophistication and regulations
 - Divergence between Developed and Developing World
3. Global vaccination programs (1960s => 2000s)
 - Smallpox, Polio
 - UNICEF, EPI, CVI, GAVI
4. Era of privatization and biotechnology (~1990 =>)
 - Rapid reduction in number of national and commercial producers
 - Emerging/re-emerging developing world manufacturers
 - Having to balance:
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 - Sufficiently protected profit, IP and know-how to justify investment and innovation



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Technology Transfer in the Heroic Era 8th to 18th century South to North-Variolation

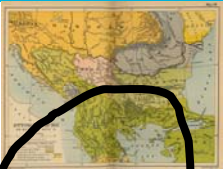
India
8th century, described by Madhav.





China
11th century Buddhist nun taught by a Tibetan monk.
Know-how:
Attenuated Virus
Not from *Variola major* but from a cotton plug inserted into the nose of an inoculated person with just a few scabs
Container closure
Wrap the scabs carefully in paper and put them into a small container bottle and cork it tightly
Cold chain
Don't expose to sunlight or fire. In winter *yang* potency will last thirty to forty days but in summer the *yang* potency will last only twenty days.



Turkey and UK
After 1716 Lady Mary Montagu imported the technique from Turkey.
Spread amongst the royal families of Europe then amongst the people

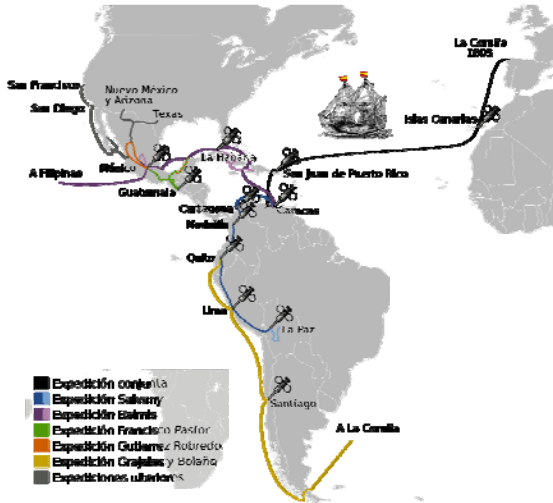


USA
In 1721 in Boston Zabdiel Boylston inoculated two slaves and his own son after hearing of inoculation from his Sudanese slave



Technology Transfer in the Heroic Era 19th century North to South - Vaccination



Balmis Expedition

- Three year mission
- 22 orphan boys (8 to 10 years old) as successive carriers of the vaccine.
- Vaccination delivered to: Canary Islands, Colombia, Venezuela, Ecuador, Peru, Mexico, Philippines, St Helena, and China.
- Also delivered scientific instruments and Historical and Practical Treatise on the Vaccine by Moreau de Sarthe
- Local vaccine commissions founded.

"I don't imagine the annals of history furnish an example of philanthropy so noble, so extensive as this."

Edward Jenner



VACCINE TECHNOLOGY TRANSFER – Heroic Era

Heroic era (8th century to 1930s)

- Low-tech/artisanal thus low cost
- Low or no regulatory hurdles
- No or Low Quality standards
- Tech. transfer by single person study/communication



Making yellow fever vaccine.....probably



Smallpox (Vaccinia) vaccine



VACCINE TECHNOLOGY TRANSFER: SUMMARY CHART

	TECHNOLOGY	ECONOMICS	POLITICS	REGULATION	LEGAL AND INTELLECTUAL PROPERTY	TECHNOLOGY TRANSFER
HEROIC	Low	Low cost	Colonial policy plus altruism	Nearly absent	Absent	Word of mouth
MID-CENTURY National Public Health						
ERADICATION PROGRAMS						
CURRENT						
FUTURE?						



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Growth and establishment of National Vaccine Institutes and Manufacturers – E.g. Network of Pasteur Institutes



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BUT RAPID DIVERGENCE BETWEEN DEVELOPED COUNTRIES.....

■ New vaccines

- Polio (Salk & Sabin)
- Measles
- Mumps
- Hepatitis B
- Meningococcus
- Haemophilus influenza
- Combinations

■ New technologies

- Culture on chick embryos (Goodpasture, Walter Reed, 1931)
- Tissue culture (Enders, 1949)
- Recombinant vaccines (1980s)
- Conjugate vaccines (1980s)
- Plus improved production and assay techniques

■ New regulations

- "Jim" and Biologicals Act – 1902
- Cutter incident – 1955 – led to creation of Division of Biologics Standards in NIH, now in FDA
- GMP and management of input materials 1963 and 1976
- Management of air pressure – 1978/87
- WHO developed a prequalification system – 1989
- Documentation and Team Biologics --1990s
- Many more regulatory and quality standards

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.....and LESS DEVELOPED COUNTRIES

- ◆ Many small scale producers e.g. 74 rabies vaccine producers in 1984
- ◆ Frequent GMP problems
- ◆ Did not make new vaccines
 - OPV, not IPV, partly because of WHO pressure
 - Whole-cell pertussis, not acellular
- ◆ Independence and conversion of colonial public health systems into national ones with limited resources.
- ◆ Lack of major scientific research programs until 1980s
- ◆ Diverging Vaccination coverage:
 - Industrialized countries 60 %
 - Latin America 38 %
 - South Asia 5 %
 - East Asia 5 %
 - MidEast 25 %
 - Sub-Sahara Africa 5 %



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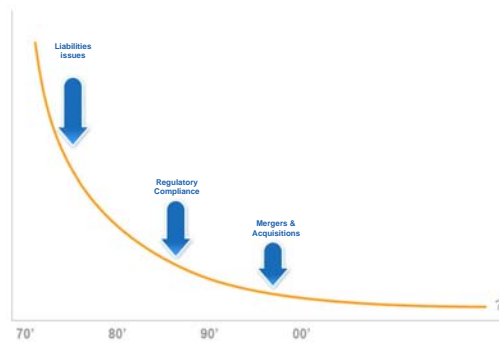
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INCREASED DEMAND, INCREASED COST, INCREASED REGULATIONS AND PRICE PRESSURE

- Global programs required increased supply at minimum cost/profit
- Increasing costs of R&D, quality and production
- EPI/UNICEF faced severe shortages and high prices as suppliers merged and reached capacity limits during 1990s.
- 10 of 14 developed-world manufacturers partially or totally stopped production of traditional vaccines during 1998-2001 (UNICEF).

Number of
Developed-World
Vaccine Manufacturers



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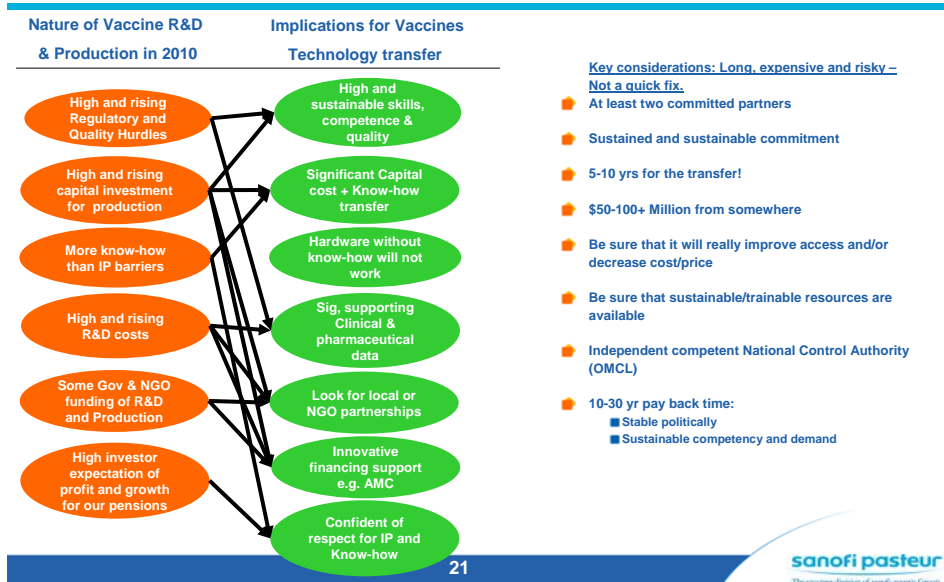


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To understand the feasibility of Tech Transfer one must understand the Tech to be transferred.



So off we go!



Technology transfer in 2010 – Vaccines are now more like 3-star food



🏠 The Place

🍽️ The Product

👤 The people



The Inspector

Transfer and sustain it

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Technology Transfer is not the only factor that impacts vaccination

- 🏠 Underlying general situation
 - Poverty
 - Political stability (wars and conflicts)
 - Political willingness (& corruption)
 - Cultural barriers
- 🍽️ Programmatic factors:
 - Lack of health infrastructure (health care system and logistics)
 - Lack of precise policy plans & long-term forecasting
 - Financial (pricing & reimbursement, distribution costs)
 - Capacity building
 - Regulatory issues (requirements, review timelines)
- 👤 R&D
 - Developing vaccines for neglected diseases
 - New health technologies
 - Public-Private-Partnership in R&D
- 🍽️ Vaccine supply / procurement
 - Assistance: donation and at-cost sales + training, equipment and manpower*
 - Differential pricing
 - Global financing mechanisms: GAVI, IFFIm, AMC...
- 🏠 Other partnership programmes: training, supply-chain management **...

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FUTURE?						



Conclusions

Vaccine Technology Transfer has mirrored Vaccine industry evolution

- ◆ Pre 1930 – artisanal technology, easily transferred
- ◆ 1930-1995 – Multiplication of local producers restricted by capital rather than contemporary technology
- ◆ 1995+ – globalization and integration, controlled by market structure, regulation, cost and time of entry and economies of scale in research and production

Vaccine technology transfer is alive and well but huge time, cost and resource commitments require careful consideration of:

- Feasibility
- Time
- Cost
- Resources
- True benefit/impact

Step wise progression of technology transfer preferred:

- Packing and distribution
- Bulk transfer, fill and finish
- Bulk production



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FUTURE?	High ? Role of disposable tech.	High cost/low margin, economies of scale Private & Public	Global immunization Sustainability Healthy competition	Continuing to increase	More "generics" More IP protection	Careful consideration of high cost, high risk option for access.

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The Evolution of Technology transfer

HEROIC Catch and grill it

National Public Health Many fish and many recipes

ERADICATION PROGRAMS Global, homogeneous low-cost

CURRENT Global, homogeneous haute cuisine



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