Perspectives for Latin American Science after the pandemic. Role of regional integration and international cooperation.

Biotechnology Development in Cuba The fight against the COVID-19 pandemic COVID-19 Cuban Vaccine Candidates











"The future of our country must necessarily be a future of men of science, men of thought, because it is precisely what we are sowing more, opportunities to intelligence, since a considerable part of our people had no access to culture, nor to science..... Fidel Castro 1960

The Government of Cuba decided to promote biotechnology as one of the main industries of the future national development, 1980



- 1983 vol. 302, pag;745-748 ,28 April Abstract
- Cuba may be moving into the big league of scientific nations at just the right time.

Bob Ubell reports on a recent visit.







Harly O Halvorson Lynn Margulis



NACSEX was created in 1983 to develop interactions between Cuban and United States scientists.

NACSEX organized visits of scientists to Cuba to exchange ideas and information. About 80 individuals were part of this program.



NACSEX conducted several seminars and short courses in Cuba. Also, several Cuban scientist, engineers, physicians spent time in USA

Strategics Guides of Cuban Biotec and Pharmaceutical Industry July 1981 More than 1300 million USD were invested in this Projet

- **Cuban Government: a Huge Investment**
- Based on Cuban scientists and professionals
- National Health System as first priority
- Closed cycle" strategy: fully integrated institutions, from research to post-marketing follow-up
- National collaboration instead of individual competition; coordination between institutions doing R & D and institutions applying results
- **"Spin off" companies** derived from scientific or production institutions
- Gaining international competitiveness: quality, production volumes, cost, novelty, joint ventures
- Intensive building capacity: R & D, Production

EDITORIALS

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nature



today's tensions and conflicts are characterized lizations', than by larger groups feeling threatened and its end-users meant that h might otherwise have been the

Cuba's biotech boom

The United States would do well to end restrictions on collaborations with the island nation's scientists.

or a week after <u>Cuba marked the 50th anniversary of its</u> revolution on 1 January, a celebratory 'Caravan of Liberty' carried 50 people, including many university students and scientists, along the triumphal route that Fidel Castro had taken half a century earlier. These people represented the health-care and educational systems of which Cubans are proud, however much they with Randolph Lee Clark, the fo Cancer Center in Houston, Texa to a lab in Finland to learn how cells. The knowledge gleaned fr an industry that developed the 1985, and subsequently a vaccir B — the world's first human va

Castro's interest in the fledglin

Unfortunately, Cuba's biote limitations of the top-down the Soviet Union fell apart an

Cuba marked the 50th anniversary of its revolution on 1 January, a celebratory 'Caravan of Liberty' carried 50 people

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... And in no small

measure the scientists in the caravan symbolize the foundation of that health-care system in the developing world's most established biotechnology industry, which has grown rapidly even though it eschewed the venture-capital funding model that rich countries consider a prerequisite. THE WAY

Lessons from the International Polar Yes

AND SCALE PROTION

's old; the regime will not last much d America's cold-war perspective on g. In August, the state of Florida overd researchers at its universities from the island. And President-elect Barack ess to talk to his country's enemies. Tuld be wise to start that conversation January inauguration as possible. The h, of course, and the advantages could s the global centre of biotech, and with s contiguous with Cuba's, the United ith which cross-fertilization of ideas



CUBAN IMMUNIZATION PROGRAM IMPACT 1962 - 2018

Adopting some of Cuba's successful health-	DISEASES	Year of Intervention	Year of Impact	Impact Achieved
care policies may be the best first step toward normalizing relations.	Poliomyelitis	1962	1962	Eradicated
	Neonatal Tetanus	1962	1972	Eradicated
Congress could request an Institute of medicine study of the successes of the Cuban health system and how to best embark on a new era of cooperation between U.S and Cuban scientists.	Diphteria	1962	1979	Eradicated
	Measles	1971	1993	Eradicated
	Rubella	1982	1995	Eradicated
	Mumps	1986	1995	Eradicated
	Whooping cough	1962	1997	Eradicated
	Congenital Rubella Syndrome	1986	1989	Eradicated
30 APRIL 2010 VOL 328 SCIENCE	Post Parotiditis Meningitis	1986	1989	Eradicated
Paul K. Drain and Michele Barry*	Tetanus	1962	1992	Rate<0,1 x 10 ³ lnh.
	H. influenzae type B	1999	2001	Rate<0,1 x 10 ³ lnh.
	Hepatitis B<25 years old	1992	2001	Rate<0,1 x 10 ³ lnh.
	Meningococcus Meningitis	1988	2001	<98% Mortality <93% Incidence

Cuba, best conditions for motherhood among developing countries, according to Save the Children's State of the World's Mothers 2010 report

The report, made public Monday, examines 160 countries - 43 developed and 117 developing ones - and analyzes the best and worst places to be a mother based on 10 factors such as the educational status, health, economic circumstances of the mothers, as well as the basic well-being of children.

Among developed countries, Norway is in first place in the rankings, followed by Australia, Iceland and Sweden. USA appeared in position 28th. Cuba is in first place on the list of best developing countries









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> 32 Enterprises

- > 64 manufacturing facilities
- > 21 785 Workers AN INDUSTRY WORKING SINCE MORE THAN 30 YEARS











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Lab. Roberto Escudero

The products are marketed in 49 countries (893 marketing approvals abroad)



The fight against the COVID-19 pandemic

• Since the beginning of the pandemic, in March 2020, in Cuba there was the intention of contributing to the confrontation of the disease, unknown throughout the world. Therapeutic procedures were developed, some of a preventive nature in immunological terms. Procedures aimed at improving the immune status of people were used, with products such as Biomodulin T, interferon - recombinant alpha-2B, HeberFeron and transfer factor (Hebertrans), all in reprofiling mode (reassigning a drug existing, with a known safety profile and originally used for another disease, in the treatment of a new disease, in this case, COVID-19). They were used on the logic of their mechanism of action, to avoid complications, prevent, resolve a certain clinical picture.

They were used on the logic of their mechanism of action, to avoid complications, prevent, resolve a certain clinical picture.

Then **Jusvinza**, an immunomodulatory peptide, and a monoclonal antibody, **Itolizumab**, were used in the so-called cytokine cascade or storm. This has sought to combat, support patients, avoid the worst manifestations of the disease.

As stated in the Lancet article (www.thelancet.com/infection Vol 21 April 2021: "After keeping SARS-CoV-2 at bay for most of 2020, Cuba has experienced a surge of infections in 2021. As of March 8, the country had reported 55 693 cases of COVID-19 and 348 deaths. 23 093 new cases occurred in February alone, almost twice as many as occurred in the whole of 2020. Cuba is still doing far better than the majority of other countries in the region, but a vaccine is urgently needed. "

Behind Cuba's successful pandemic response, Thalha Burki, The Lancet Volume 21, ISSUE 4, P465-466, April 01, 2021

COVID-19 Cuban Vaccine Candidates

- Soberana 01 Vaccine based on the RBD antigen of the new coronavirus, produced from mammalian CHO cells (derived from Chinese hamster ovary). The formulation also contains meningococcal serotype B membrane antigens, plus aluminum hydroxide as an adjuvant.
- Soberana 02 Protein subunit vaccine composed of RBD protein produced by biotechnology in CHO cells, covalently conjugated to tetanus toxoid and absorbed in aluminum hydroxide gel. Sovereign Plus Protein subunit vaccine composed of the SARS-CoV-2 RBD protein produced by biotechnology in CHO cells, expressed in dimeric form and absorbed in aluminum hydroxide gel.
- Soberana Plus Protein subunit vaccine composed of the SARS-CoV-2 RBD protein produced by biotechnology in CHO cells, expressed in dimeric form and absorbed in aluminum hydroxide gel.
- Mambisa Vaccine based on a formula that has the same RBD protein, produced recombinantly in Pichia pastoris yeast cells, plus the hepatitis B nucleocapsid antigen, for intranasal administration.
- Abdala Vaccine formulated from RBD protein, produced recombinantly in Pichia pastoris yeast cells, with aluminum hydroxide as adjuvant.

At this time

Phase III of Sovereign 02 has three groups: one with placebo, another with two doses, which has already ended, and a group that should receive the third dose, which is about to end.

Phase III of Abdala, the stage of administration of the three doses has ended and the evaluation phase is now passing. The results take a process and will be given in the coming weeks, between the end of May or perhaps later, in June and July

Production: The two vaccines have their own production systems. It was designed like this so they wouldn't compete, so that many vaccines could be manufactured in a short period of time."

By August Cuba will have completed the number of doses need to immunize its whole population

- Can Cuba beat COVID with its homegrown vaccines? Nature NEWS Q&A 29 April 2021
- Coronavirus Vaccine Tracker, New York TimesBy Carl Zimmer, Jonathan Corum and Sui-Lee Wee
- Aljaeera By Elizabeth Melimopoulos, 29 Apr 2021
- How Cuba is developing five homegrown Covid-19 vaccines, The Indian Express, April 30, 2021 5:57:08 pm

Cuban biotechnology in 2021

OUR OPPORTUNITIES AND STRENGTHS

- 1. The Levers of Socialism
- 2. Human Capital created by the educational work of the Revolution
- 3. Early start of biotechnology: 30 years of experience today
- 4. Infrastructure of Institutions and productive facilities Our Health System
- 5. Start of the Latin American Integration process

OUR PROBLEMS AND CHALLENGES

- 1. The aftermath of the Special Period
- 2. The continuity of the Economic Blockade
- 3. Financial constraints
- 4. The increasingly restrictive and exclusive regulatory environment FDA / EMA
- 5. The size of our population and the speed of our demographic transition
- 6. The competitive environment and global dominance of multinational companies