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## **From Evidence to Policy**

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# Impact Evaluation of the Health Sector Reform in Costa Rica

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## Summary

Health Sector Reform was implemented gradually across Costa Rica in a sort of natural experiment that offers an opportunity to evaluate its impact. Assuming a quasi-experimental evaluation design, this is an analysis of mortality trends in the country's 420 districts (minor civil divisions) during the period between 1985 and 2001, applying multivariable regression models. The models estimated that reform adoption reduced childhood mortality by 8% and adult mortality by 2%. The effect was 14% on adult mortality due to communicable diseases, none due to those of social origin, and was similar to the total (2%) due to chronic diseases. These effects significantly increased with time since reform adoption, in a sort of dose-response effect. Translating these results into lives saved shows that approximately 120 children's lives and 350 adult lives were saved in 2001. The reform was applied first to the most dispersed and least socio-economically developed zones, which reduced the equity-in-services gap at the primary health care level. Health sector reform, which started to be implemented in 1995, is possibly the most important event for public health in Costa Rica during the last decade, since it allowed renewed progress on the path to development after a long stagnation. Life expectancy rose from 76.2 to 77.7 years between 1995 and 2000.

## Introduction

The purpose of this study is to evaluate the impact of Costa Rican Health Sector Reform on what is probably the most important result: mortality, as well as on equity-in-access.

Costa Rica has achieved excellent levels of health. Life expectancy at birth is 77.7 years, the second highest on the continent, exceeded only by Canada (Population Reference Bureau, 2001). It is even higher than that of the U.S. (76.9 years in 2000, according to CDC, 2001). Within the Latin American context, the country occupies first place with a life expectancy 2 years higher than Cuba, Puerto Rico, and Chile, those in next place. The country's health achievements have been amply studied (Rosero-Bixby 1991; Mesa-Lago 1985).

However, after exceptional progress for several decades, progress stagnated during the first half of the 90's, which even led to deterioration (Figure 1). It seemed as though the country had reached the end of the road. Between 1990 and 1995, life expectancy declined by almost a year, 76.9 to 76.2 years (Rosero-Bixby, 2002). This adverse trend finally proved itself temporary, since during the second half of the decade progress returned and the country climbed to a life expectancy of 77.7 years by 2000. The 1.5-year gain in five years, while not as spectacular as those of the 40's or 70's is very worthwhile, given the difficulty of achieving advances at the levels reached by Costa Rica. This renewed encounter with the path of progress after 1995 coincides with the implementation of the Health Sector Reform Program. Is this temporal coincidence merely a chance occurrence? Or, on the other hand, is there a causal link between reform and the renewed progress?

The fact that the whole country did not adopt the reform at the same time created a natural quasi-experiment, which has been exploited by this study in an attempt to respond to these questions.

The Costa Rican Health Sector Reform at the service level began in 1995 (planning and some administrative changes took place several years before) and has still not been completed in 2003. The declared objectives of the reform are ambitious and diverse (MIDEPLAN & MS, 1993; PAHO, 2002). In practice, however, the core objectives have been of an economic nature (nothing wrong with that): improvements in efficiency and rationalization in resource allocation (see for example, World Bank, 2001). This should not raise eyebrows, since the driving force for the process were loans from the World Bank, and as a consequence, enjoyed a very active participation of economists. The so-called "managerial commitments" are a key element in the reform and its search for greater efficiency. On the other hand, the so-called "EBAIS" (an abbreviation meaning "basic integrated health care team") are key elements in the reform of health care provision at the primary health care level and the achievement of "efficacy" objectives. This study provides elements to evaluate the reform's impact in the "efficacy" realm, in contrast to the studies that concentrate on "efficiency", i.e., achievements in the managerial, institutional, or legal fields (Sáenz, 2002: Proyecto Estado de la Nación, 2002).

Most of the changes in service provision brought about by the reform have taken place at the primary care level. Changes at the hospital level have been, so far, oriented to managerial aspects (with the understanding that this would improve quality of care). The transfer of the health centers and posts from the Ministry of Health to the Costa Rican Social Security Fund (CCSS) made a significant change in the service provision panorama at the primary level. Many health centers and posts considered redundant were closed or given other functions. At the same time, primary care facilities were opened and service provision was reorganized in existing facilities. In particular, EBAIS were created, which were originally staffed by teams of health personnel headed by a physician. These were assigned to a population of about 4,000 individuals and based in an existing health facility. These were a type of “software” that brought the reform to the “hardware” of the existing health facilities. In recent years, however, the EBAIS concept evolved, and they began to be considered as a complete package of software and hardware, so that the recently created EBAIS have been established with their own physical plant, thus becoming a new type of health facility.

Primary health care service provision reform (the facility of the EBAIS) did not take place at the same time throughout the country. It was a gradual process begun in 1995, which has yet to be completed. Instauration of the reform in a specific geographic zone can be identified with the official inauguration of the “Health Area” to which the zone belongs. Inauguration of a “Health Area” means that the respective territory has been broken down into “Health Sectors” with a corresponding EBAIS to care for each one, i.e., the population is covered with the package of services included in the EBAIS. Map 1 represents the temporal sequence in the adoption of this aspect of the reform across the country. This evaluation of the impact is, essentially, a comparison of the mortality trends of the country’s communities classified by the time at which they adopted the intervention. If the data show that the communities that adopt the reform tend to reduce mortality more than during the preceding period and more than the communities that are not yet reformed, this would be evidence of impact. The evidence would be more convincing if the data show a type of dose-response in the effects, i.e., that the effect is stronger in the communities with more years of reform. If, in addition, these effects persist when communities with similar socio-economic and geographic characteristics are compared, the evidence for impact would be even stronger. The definitive proof only could come from a randomized experiment, which was not carried out, as almost never occurs in the world of public interventions of the magnitude we are analyzing here.

## **Data and Methods**

The evaluation follows a quasi-experimental design (Mohr, 1988), with before and after intervention (reform) measurement in areas with and without intervention.

The fact that a truly randomized experiment is not available opens the way to selection bias in any direction. On the one hand, there may be innovator bias: that the pioneer communities in the reform tend to be innovative in other areas, and therefore also present better health trends. In this case, accomplishments due to this propensity to innovate would be attributed erroneously to the reform. On the other hand, concentration of the intervention in areas with greater health needs or shortfalls would generate a bias in the opposite direction, since intervention could even be seen as related to poorer health performance.

These possible selection biases are neutralized in part by the analytical procedures adopted in this evaluation: (1) Multiple regression techniques to statistically control the effects of confounding variables (for example, markers for a propensity to innovate or to have a poor health performance), which is the equivalent of comparing only communities with similar confounding characteristics. (2) Inclusion of “before and after” intervention measurements to compare trends (instead of levels), which allows filtering the comparison of peculiarities from the community that have existed throughout the study period. This is known in the econometric literature as “fixed effects” models for panel type data.

Another potential bias arises from the possibility of spillover effects. To wit, the areas defined as those “without reform”, may have been contaminated by certain aspects of the reform. Undoubtedly, some of that has occurred. In many zones the EBAIS begin to be established prior to the official date for adopting the reform, i.e., prior to the inauguration of the Health Area. In addition, there are managerial and administrative improvements adopted at the central level that could also have benefited the regions that officially have not adopted the reform. Nevertheless, these spillover effects would cause a bias hiding part of the impact. That is to say, the real impact would be greater than that documented in the evaluation.

The database for the evaluation consists of time series of annual observations for the period 1985-2001 in the 420 districts of Costa Rica that existed in the 1984 Census. The district is the third level of the political-administrative division, below the provincial and municipal levels. In general it is a homogeneous geographic unit with five to ten thousand inhabitants.

In order to create the time series, it was necessary to correct changes in the territorial division during the period under study (the number of districts increased from

420 to 459 during the period). The correction consisted of rebuilding the district divisions at the beginning of the period. This was possible due to the large number of districts that were formed completely from within another previously existing district. In the few cases in which a district arose from several, the census segments segregated were identified to make the necessary corrections.

The database was also disaggregated by sex and 9 age groups (< 5 years, 5-14 years ... 65-74 years, 75+ years), which provided 18 observations for each year, for 17 years and for 420 districts, for a total of almost 130,000 observations in the database under analysis.

There were four types of variables for the analysis in the district and year database:

- **Result variables:** Number of deaths, classified by district, year, sex, and age. Models were estimated for mortality among children under 5 years of age, adults aged 15 or more years, and three large groups of causes of death: (1) communicable diseases (diarrheas, tuberculosis, respiratory infections, other infections and parasitism, AIDS, malnutrition, maternal, and cervical cancer); (2) social causes (alcoholism, accidents, homicide, and suicide); (3) a residual category (principally chronic and degenerative diseases). The information source was the vital statistics micro-data on deaths from the National Statistics and Census Institute (INEC), available on Internet in the Central American Population Center (CCP) at the University of Costa Rica (UCR): <http://censos.ccp.ucr.ac.cr>.
- **Exposition Variable:** Population in the district by year, sex, and corresponding age group. Estimates prepared by the CCP, available on Internet at the abovementioned site.
- **Intervention Variable:** If the reform has been adopted in the corresponding district and year (dichotomic variable, 1 = with reform) and an interval variable, which indicates the number of years since the adoption of the reform (0 = without reform, 1 = first year of reform, etc.). Variables created from the datum on the year of inauguration of the 84 Health Areas and the definition of the districts that make up each Area (source: Office of Modernization of the CCSS, personal communication from the Geographer Luis V\_lchez). For example, a district that belongs to a Health Area inaugurated in 1997 has zeros during the years 1985 through 1996 and ones from 1997 forward for the “reform” variable.
- **Confounding or Control Variables:** There are four indicators arising from the annual birth records (also available on the above Internet site), i.e., proportion

of Nicaraguans (estimated on the basis of the proportion of Nicaraguan mothers); general fertility rate (births per 100 women 15 to 44 years of age); proportion of adolescent mothers (under 20 years of age); and proportion of unwed mothers. Another four indicators were obtained by interpolating the 1984 and 2000 censuses: proportion of adults with secondary studies; proportion of persons in the total population covered with social health insurance; standardized income index (estimated on the basis of possession of 11 household appliances within the household, averaged for the district and standardized to the mean and standard deviation of the corresponding census, so that it measures the number of standard deviations with regards to the mean); proportion of persons that arrived to reside in the district (from another country or from other municipalities) during the last 5 years.

### ***The Regression Model***

Determination of the impact of the reform was carried out with Poisson multiple regression models (Cameron & Trivedi, 1998) with fixed effects (Rosenzweig & Wolpin, 1968), using the “xtpois” command under the STATA computing package (StataCorp, 2001). Only “fixed effect” models were estimated, which, as was mentioned above, remove selection biases that persist over time, by means of a comparison of annual variations instead of “levels”. The Poisson regression model was adopted considering that the dependent variable, number of deaths, is a tally with a Poisson distribution that takes whole, positive values with a generally small magnitude. Poisson regression is equivalent to a linear regression on logarithms of the mortality rates. The exponentiated regression coefficients estimate relative risks (RR) or rate ratios. Robust estimators were determined for the standard errors, with the district as the clustering variable.

### ***Access to Services***

In order to explore the mechanisms of the possible impact of the reform on mortality, the evaluation was complemented with an evaluation of the effect of the reform on an intermediate variable: population access to health services at the primary care level. The information for this analysis comes from a prior study of physical access to services, carried out with data from the 2000 Census, an inventory of health facilities and geographic information systems (Rosero-Bixby, 2003). This study proposes several measures of access. Here, one of the simplest and easiest to interpret is used: medical service access equity for a community, measured by the percentage of persons who do not have public medical care available (a facility offering medical consultation at least two week days) less than 4 km from their household.

## **Results**

A descriptive analysis of the temporal sequence of reform adoption suggests that the 3.8 million inhabitants of the 2000 Census are divided into three almost equal groups (Table 1): Pioneers (1995-96), Intermediates (1997-2000), and Latecomers (2001 or as yet un-reformed). However, with regards to the territory, a glance at Map 1 shows that the reform began preferentially in the peripheral areas with lower demographic density. The areas of greatest population concentration towards the center of the country (including the Greater Metropolitan Area) were incorporated later, or still have not done so. The pioneer areas are characterized by also being those of less relative development (Table 1), as can be seen by the fact that, according to the Census, only 34% of the adults have secondary education, as compared to 49% and 55% of the other two groups. Other indicators that are not shown here, such as poverty, also suggest that the reform went first to the geographic areas of least relative development. Similarly, infant mortality prior to the beginning of the reform is higher in the pioneer areas.

The data show, therefore, that the incorporation of the different areas of the country into the reform did not occur randomly, but rather there was a concentration of efforts on the dispersed areas and less privileged populations.

### ***Mortality Trend***

As was already noted in the introduction, the country got back on the track of progress towards controlling mortality in 1995, after a decade of stagnation and even deterioration (Figure 1). The progress between 1995 and 2001 occurred in both sexes and in all age groups. The deterioration during the previous five-year period was concentrated among adults, especially males; mortality among children did not stagnate during those years, but progress was slower (Rosero-Bixby, 2002). Figure 2 shows the trends in childhood and adult mortality in the country's districts grouped by period when they were incorporated into the reform. The differences in the trends are not clear. It would seem as though during the five-year period from 1995 to 2000, the districts that did not adopt the reform saw a smaller reduction in their mortality than those that did adopt it. This is visible in both child and adult mortality. It is the only suggestion of impact in mortality observable in a descriptive analysis.

### ***Impact of Reform on Mortality***

The results of the Poisson multiple regression analysis can be seen in Table 2, which presents estimations from two models: one for mortality among children un-



der age 5 years and the other for mortality among adults age 15 years or more. The first line of the table shows the effect of adoption of the reform in the district, as measured by the relative risk or rate ratio from the multiple regression. The two models estimate a significant effect from the reform. The effect consists of reducing mortality among children by 8% and mortality among adults by 2%. The results of the second or dose-response type of analysis of the impact of the years of reform are synthesized in the last line of the table: 5 additional years of reform reduce child mortality by 13% and adult mortality by 4%.

The effects identified in the regression are controlled by the remaining variables in the models, which are also shown in Table 2. The well-known effects of sex and age are, for example, shown there. Being male increases the risk of dying by 25% in a child and 45% in an adult. Each extra year of age increases the risk of death by 8%. A district's socio-economic characteristics have few significant effects. Higher fertility in the district raises mortality significantly for both children and adults, especially the former. Education in the district presents a lowering effect on mortality only among the children, while among adults there is a perverse effect of increasing mortality that – although small – is significant. Nicaraguan and internal immigration do not appear to be associated with mortality variations, as neither are the indicators of adolescent pregnancy and out of wedlock fertility. The indicator for standardized income shows a mortality reducing effect, but it is significant only among adults: an increase by one standard deviation in the income level of the district reduces adult mortality by 5%. Social security coverage presents no effect in child mortality and shows a perverse effect by increasing adult mortality. It is not an objective of the present evaluation to analyze in detail or discuss the effects of these variables, but it is worth noting that prior studies in the country have already run into perverse effects of socio-economic development on mortality in adults (not so in children), similar to those found here with the education and social security variables (Rosero-Bixby, 1995).

To better understand the estimated effects of reform, the number of deaths per district, year, sex and age group were estimated with the regression coefficients, i.e., the values predicted by the regressions were obtained. Thereupon, this calculation was repeated, but simulating a situation without reform. Figure 3 shows the mortality rates for children and adults obtained with these simulations. Upon comparison of the observed rates with the rates estimated by the regression, it can be seen that the models do not capture the surge in mortality that took place during the years just prior to the reform. This was not the purpose of the study and there was no attempt to incorporate variables that would explain that increase. The models only capture a general trend during the 1985–2001 period, consisting of an increase in mortality

among adults and a decrease in that among children. What is really interesting for the purposes of this evaluation is the comparison of the two curves of the model with and without reform. The simulation of mortality without reform results in higher mortality rates after 1995 than those estimated under real conditions, i.e., with the reform. The difference between the two curves, translated into number of deaths suggests that the number of lives saved by the reform in 2001 amounts to 120 children under 5 years and 350 adults.

### ***Causes of Death***

Thru which mechanisms did the Health Sector Reform had an impact on mortality? A first approximation to this question is provided by an analysis of causes of death. Table 3 includes the results from the estimated regression model separated by the three large cause-of-death groups for adults (among children the number of observations is insufficient to differentiate causes of death). As can be seen, the impact of the Reform is substantially greater on traditional mortality due exclusively to communicable diseases and malnutrition. Reform adoption in a district reduces this mortality by 14% and the effect increases to 22% with a 5-year “dose” of Reform. There is no significant impact from the Reform on social origin mortality. In mortality of a chronic origin, which is the most important in modern Costa Rica, Reform has had a significant impact that is similar to the magnitude of its impact on overall adult mortality.

### ***Equity of Access to Services***

A geographic analysis of the location of health services supply and demand shows that the Reform had a clear impact on access to services at the primary care level (Table 4). From 1994 to 2000, the percentage of the population defined as having deficient or inequitable access to services was reduced from 22% to 13%, i.e., a 9 point reduction. This improvement was concentrated much more in the pioneer areas of the Reform (inaugurated in 1995-96), which reduced the percentage of access inequity by 15 points compared with an improvement of only three points in the areas that still had not been incorporated into the Reform in mid-2000 (Table 4).

## **Discussion**

Health Sector Reform is possibly the most important event for the Costa Rican public health during the last decade. The reversion of the stagnation and deteriora-

tion from 1985 through 1995 and the county's re-encounter with the path of progress during the second half of the decade of the 90's seem to be associated with the Reform process undertaken in 1995.

The fact that the whole country did not adopt the Reform at the same time created a natural quasi-experiment, which allowed us to evaluate its impact, with the help of multiple regression models. These models estimate that adopting the Reform in a given area reduces mortality among children by 8% and among adults by 2%. The lowering effect is 14% among adults due to communicable diseases, none due to social origin mortality, and is similar to the overall reduction in mortality due to chronic diseases. On translating these results into lives saved, a simulation of the hypothetical situation of the absence of the Reform provides information that the Reform saved approximately 120 children and 350 adults during 2001 alone.

The impact from the Reform possibly occurred thanks to its concentration in less-developed areas, which reduced the equity gap in health services access.

The results from this evaluation are not fully conclusive, since they are not an outcome from a fully randomized experimental design. Nevertheless, the results obtained can be considered very robust and highly valid since they come from what could be called the second-best evaluative design, to wit, a quasi-experimental design with pre and post measurements of trial and control groups. Furthermore, the design allowed the effects of possible confounding variables to be controlled, which could have produced selection biases in any direction. The presence of a "dose-response" type of effect is an element that reinforces the validity of the results obtained.

The evaluation did not control for possible biases due to spillover (Reform effects in the areas defined as without Reform). Certainly these biases exist, but instead of invalidating the results obtained, they point to the fact that the impact may well have been greater than what was found in this study.

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**Table 1: Characteristics of the population by adoption year of the reform.**

Indicators	Total	Reform 1995-96	Reform 1997-2000	No-reform
Population (millions)	3.81	1.27	1.31	1.23
Adults with high school	46%	34%	49%	55%
Nicaraguan immigrants*	13%	12%	15%	14%
Infant mortality rate (per 1,000 births) 1993-95	13.4	14.5	12.5	13.2
Number of EBAIS by 2001	665	343	264	58

\* Nicaraguan mothers in the birth vital statistics of 1999-2001

**Table 2: Death rate ratios estimated with regression models.**

**Costa Rica 1985-2001**

(Fixed effects Poisson regression on the mortality in the district)

\* Effect of 10 percent points

\*\* Effect in models with the variable "years of reform" instead of the dummy variable yes/no reform

Explanatory variable	Children (<5 years)	Adults (15+ years)
	RR (95% CI)	RR (95% CI)
Reform	0.92 (0.88 - 0.97)	0.98 (0.96 - 0.99)
Male	1.25 (1.22 - 1.29)	1.45 (1.44 - 1.47)
Age (1 year)	... ..	1.08 (1.08 - 1.08)
Pct. health insurance*	1.00 (0.96 - 1.04)	1.03 (1.01 - 1.05)
Pct. with high school*	0.77 (0.72 - 0.82)	1.03 (1.00 - 1.06)
Income index (normalized)	0.97 (0.89 - 1.06)	0.98 (0.95 - 1.01)
Pct. Nicaraguans*	0.99 (0.95 - 1.03)	1.00 (0.98 - 1.01)
Pct 5-year Immigrants*	0.95 (0.89 - 1.02)	0.98 (0.95 - 1.01)
General fertility rate	1.56 (1.47 - 1.66)	1.12 (1.10 - 1.15)
Pct. adolescent mothers*	1.02 (0.97 - 1.07)	1.01 (1.00 - 1.03)
Pct. single mothers*	0.99 (0.96 - 1.03)	1.00 (0.98 - 1.01)
Five-year reform dose**	0.87 (0.82 - 0.92)	0.96 (0.94 - 0.98)

RR = Rate Ratio of dying; CI = Confidence interval

N = 420 districts X 17 years

**Table 3: Cause-specific death rate ratios estimated with regression models.  
Costa Rica 1985-2001**  
(Fixed effects Poisson regression on the mortality in the district)

Explanatory variable RR	Communicable	Social	Chronic
	(95% CI) RR	(95% CI) RR	(95% CI)
Reform	0.89 (0.84 - 0.95)	1.02 (0.98 - 1.07)	0.98 (0.96 - 1.00)
Male	0.98 (0.94 - 1.02)	2.08 (2.02 - 2.14)	1.43 (1.42 - 1.45)
Age (1 year)	1.07 (1.07 - 1.07)	1.04 (1.04 - 1.04)	1.09 (1.09 - 1.09)
Pct. health insurance*	0.97 (0.90 - 1.04)	1.06 (1.01 - 1.11)	1.03 (1.01 - 1.05)
Pct. with high school*	1.11 (1.00 - 1.24)	1.04 (0.96 - 1.12)	1.02 (0.99 - 1.06)
Income index (normalized)	1.00 (0.87 - 1.14)	1.03 (0.94 - 1.13)	0.97 (0.94 - 1.01)
Pct. Nicaraguans*	0.99 (0.93 - 1.04)	0.99 (0.96 - 1.03)	1.00 (0.98 - 1.01)
Pct 5-year Immigrants*	0.95 (0.85 - 1.06)	1.00 (0.92 - 1.08)	0.98 (0.95 - 1.01)
General fertility rate	1.17 (1.07 - 1.29)	1.16 (1.09 - 1.24)	1.11 (1.08 - 1.14)
Pct. adolescent mothers*	1.02 (0.96 - 1.09)	0.99 (0.94 - 1.03)	1.02 (1.00 - 1.04)
Pct. single mothers*	1.01 (0.96 - 1.06)	1.00 (0.97 - 1.03)	0.99 (0.98 - 1.01)
Five-year Reform dose**	0.83 (0.77 - 0.90)	1.01 (0.95 - 1.06)	0.96 (0.94 - 0.98)

\* Effect of 10 percent points

\*\* Effect in models with the variable “years of reform” instead of the dummy variable yes/no reform

RR = Rate Ratio of dying; CI = Confidence interval

N = 420 districts X 17 years

**Table 4: Population with deficient access to medical care by reform adoption.  
Costa Rica 1994, 2000**

Year	Total	Reform	Reform	No-reform
		1995-96	1997-2000	June 2000
1994	22%	36%	14%	14%
2000	13%	21%	6%	11%
Change	-9%	-15%	-7%	-3%

Figure 1: Life expectancy (LE) and infant mortality rate (IMR).  
Costa Rica 1970-2001

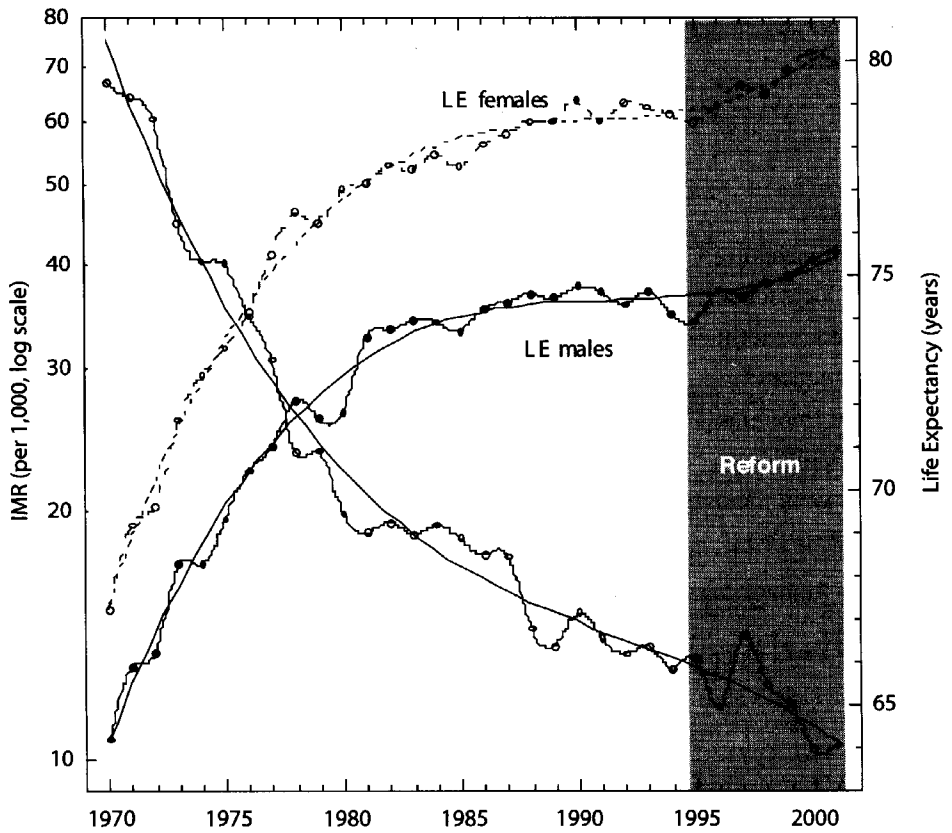


Figure 2: Mortality trends by reform's adoption\*. 1985-2001

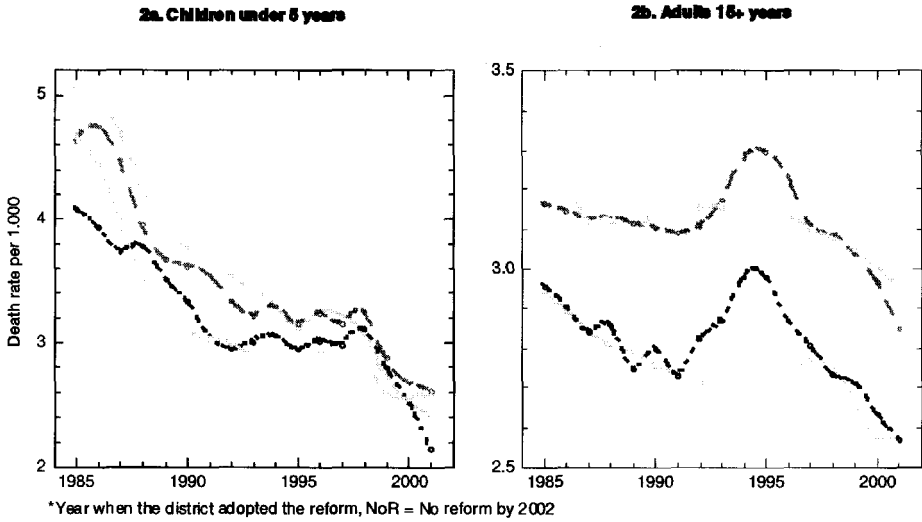
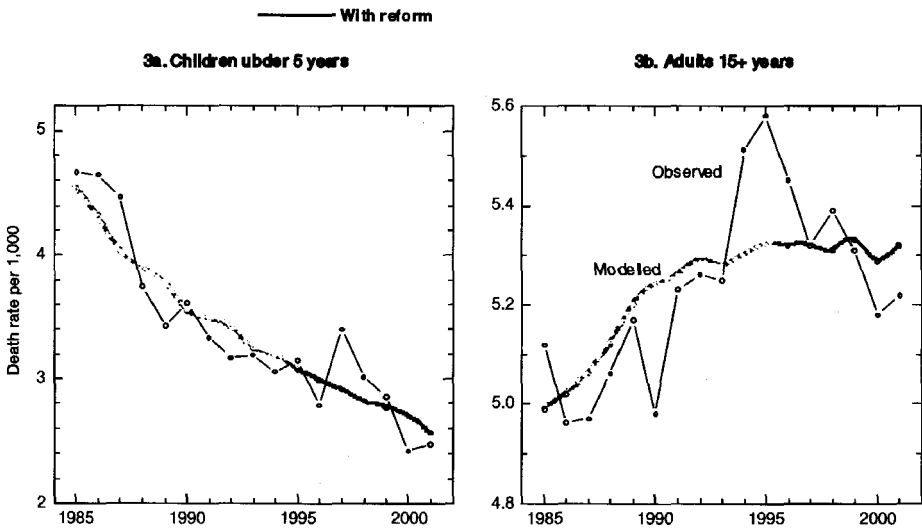


Figure 3: Mortality trends, observed and simulated with and without reform





**Map 1: Adoption year of health reform in Costa Rica**

