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Title: The Cost-Effectiveness of NCDs and Their Risk Factors in the PAHO Region: A Systematic Review of Literature

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INTRODUCTION

Non-communicable diseases are the leading cause of death in the Americas, with cardiovascular disease responsible for 45 percent of those deaths.[1] In Latin America, it is estimated that from 1990 until 2020, death from CVD, including coronary heart disease (CHD) will increase by approximately 145% (for both men and women), compared with an increase of 28% for women and an increase of 50% for men in developed countries during the same period.[2]

The region has pioneered a strong and multi-sectoral response to NCD prevention and control, spearheaded by the leadership of the Caribbean countries in the 2011 United National High Level Meeting on NCDs, and continuing with the recent creation of the Healthy Latin America Coalition, which advocates for health promotion and NCD prevention. The Pan American Health Organization has promoted and facilitated member countries in surveillance, policy development, and guidelines for NCD prevention. Its Regional Strategy and Plan of Action for the Prevention and Control of Chronic Diseases was adopted by Ministers in 2012 with explicit attention to the development and economic importance of NCDs, and of the need for multi-sectoral involvement.[3]

In this environment, it is unsurprising that a large number of economic studies about NCDs have been produced in the PAHO region. This chapter reviews the cost-effectiveness literature from the Americas of interventions and policies to control and prevent NCDs. Many countries in the region use the World Health Organization threshold to define an intervention as cost-effective if the cost of a DALY or QALY is less than one times the country's gross domestic product per capita per life year. Most GDPs per capita in Latin America range between U$S 4,000 and 12,000.[4] The literature reflects several characteristics unique to the Americas:

- Relatively robust availability of health condition and risk factor data
- Strong political and advocacy environment for population policy implementation
- Active research network on economic and public health issues, particularly on cost-effectiveness methods

As a result, this review identified a large number of relevant articles, which enables interesting comparisons across time and geography.

SCOPE

This review examines cost-effectiveness literature in Latin American & the Caribbean region on cardiovascular, metabolic, and respiratory diseases and primary risk factors, including unhealthy diet, physical inactivity, tobacco consumption, and excessive alcohol consumption. We also reviewed cost-effectiveness studies of interventions for intermediate risk factors, such as high blood pressure and hypercholesterolemia. In addition, we reviewed cost-effectiveness studies on screening, prevention, and treatment of cancers. We excluded mental health disorders.

METHODS

Search strategy

We searched the literature from the year 2000 onward for cost-effectiveness studies around specific diseases and risk factors that focused on countries within the PAHO region. The search terms that we used largely matched those used for the economics reviews in the Disease Control Priorities in Developing Countries, Third Edition (DCP3). The original DCP3 reviews queried the Medline, EMBASE, NHS-EED, HEED and EconLit databases for economic evaluations around cardiovascular and metabolic diseases. In total, 3809 titles were screened but only 61 studies met the inclusion criteria, and 22 of these contained data relevant to the PAHO region. The DCP3 search was supplemented by a similar search of LILACS, Medline, the Cochrane Library, Embase, and Scielo databases for economic evaluations in the PAHO region that addressed either cardiovascular/metabolic diseases or cancers. In total, 428 additional titles were identified and screened but only 38 studies met the inclusion criteria. Hence we reviewed 60 studies in detail.

Data extraction

The full-text articles included in this review were subjected to detailed examination by one or more authors. We adapted a data extraction template from the DCP3 to capture 1) "demographics" of included articles (study year, country, and journal), 2) information on the intervention(s) considered and the target population(s), 3) incremental cost-effectiveness ratios (ICERs) including costs (in local currency units) and outcomes (typically in DALYs or QALYs), 4) conclusions and major assumptions of each article, and 5) quality assessment using the 10-point checklist developed by Drummond and colleagues.[5]

Data synthesis

To ensure all ICERs were comparable across studies, we deflated all costs to 2012 and converted them to US dollars. Studies that did not specify the currency year were assumed to report costs in currency units from the prior year. For example, a study reporting costs in Mexican pesos that did not report the currency year but was published in 2011 was assumed to be reporting 2010 Mexican pesos, and this was deflated and converted to 2012 US dollars. We used World Bank data on exchange rates, consumer price indices, and purchasing power parity dollars for our analysis.[6]

CARDIOVASCULAR DISEASE: PREVENTION AND SCREENING

Our searches returned 52 interventions in 12 studies dealing with the cost-effectiveness of cardiovascular disease prevention. Broadly, the studies tended to focus on one of two approaches: 1) reducing the burden of CVD risk factors (e.g., diet, lifestyle, and smoking) at the population level, or 2) screening and treating individuals with cardiovascular risk conditions (such as hypertension) or those at high risk of developing CVD – so-called "primary prevention." Table 1 summarizes the findings of these studies.

Author	Year	Condition	Country	Intervention	Comparator	ICER	Metric
Murray	2003	coronary heart disease	AmrB region	legislation to decrease salt content in processed foods and appropriate labelling	null	$2.60	per DALY
Murray	2003	coronary heart disease	AmrB region	legislation to decrease salt content in processed foods plus appropriate labelling plus mass media campaign on body-mass index and cholesterol	null	$2.80	per DALY
Murray	2003	coronary heart disease	AmrB region	mass media campaign on body-mass index and cholesterol	null	$2.80	per DALY
Murray	2003	coronary heart disease	AmrB region	voluntary reduction in salt content of processed foods plus appropriate labelling	null	$4.81	per DALY
Murray	2003	coronary heart disease	AmrB region	primary prevention "polypill" for individuals with >25% risk of CHD	null	$7.41	per DALY
Murray	2003	coronary heart disease	AmrB region	primary prevention "polypill" for individuals with >15% risk of CHD	null	$10.82	per DALY
Murray	2003	coronary heart disease	AmrB region	individual treatment of blood pressure above a threshold of 160 mmHg	null	$16.23	per DALY
Murray	2003	coronary heart disease	AmrB region	individual treatment of cholesterol above a threshold of 6.2 mmol/L	null	$17.43	per DALY
Murray	2003	coronary heart disease	AmrB region	primary prevention "polypill" for individuals with >5% risk of CHD	null	$18.63	per DALY
Murray	2003	coronary heart disease	AmrB region	individual treatment of cholesterol above a	null	$26.64	per DALY

				threshold of 5.7 mmol/L			
Murray	2003	coronary heart disease	AmrB region	individual treatment of blood pressure and cholesterol above thresholds of 140 mmHg and 6.2 mmol/L, respectively	null	$36.66	per DALY
Murray	2003	coronary heart disease	AmrB region	individual treatment of blood pressure above a threshold of 140 mmHg	null	$37.26	per DALY
Rubinstein	2015	coronary heart disease	Argentina	policies to eliminate industrial trans fatty acids in foods	current practice	cost saving	per DALY
Rubinstein	2010	coronary heart disease	Argentina	population-based salt reduction in bread (1 gram per 100 grams bread)	current practice	cost saving	per DALY
Ferrante	2012	coronary heart disease	Argentina	population-based salt reduction (5%)	null	cost saving	per QALY
Ferrante	2012	coronary heart disease	Argentina	population-based salt reduction (25%)	null	cost saving	per QALY
Rubinstein	2010	coronary heart disease	Argentina	primary prevention "polypill" for individuals with >20% risk of CHD	null	cost saving	per DALY
Rubinstein	2009	coronary heart disease	Argentina	voluntary reduction in salt content in bread in Buenos Aires	null	$44.79	per DALY
Rubinstein	2009	coronary heart disease	Argentina	mass media campaign around salt intake in Buenos Aires	null	$199.90	per DALY
Rubinstein	2009	coronary heart disease	Argentina	primary prevention "polypill" for individuals with >20% risk of CHD in Buenos Aires	null	$1,069.55	per DALY

Rubinstein	2009	coronary heart disease	Argentina	primary prevention "polypill" for individuals with >10% risk of CHD in Buenos Aires	null	$1,215.55	per DALY
Rubinstein	2009	coronary heart disease	Argentina	primary prevention "polypill" for individuals with >5% risk of CHD in Buenos Aires	null	$1,339.91	per DALY
Rubinstein	2009	coronary heart disease	Argentina	individual treatment of blood pressure above a threshold of 140 mmHg in Buenos Aires	null	$2,311.70	per DALY
Rubinstein	2010	coronary heart disease	Argentina	Individual treatment of blood pressure (lifestyle change and medication)	null	$3,270.33	per DALY
Rubinstein	2010	coronary heart disease	Argentina	mass media campaign around tobacco cessation	null	$3,582.71	per DALY
Rubinstein	2010	coronary heart disease	Argentina	Individual treatment of cholesterol (lifestyle change and medication)	null	$16,224.79	per DALY
Rubinstein	2009	coronary heart disease	Argentina	individual treatment of cholesterol above a threshold of 6.2 mmol/L in Buenos Aires	null	$20,640.42	per DALY
Rubinstein	2010	coronary heart disease	Argentina	individual treatment of tobacco dependence with bupropion	null	$66,818.49	per DALY
Ribeiro	2015	coronary heart disease	Brazil	intermediate-dose statin (20% risk)	no statin	$1,339.77	per QALY
Ribeiro	2015	coronary heart disease	Brazil	intermediate-dose statin (15% risk)	no statin	$1,814.91	per QALY
Ribeiro	2015	coronary heart disease	Brazil	intermediate-dose statin (10% risk)	no statin	$2,288.11	per QALY

Gaziano	2006	coronary heart disease	Brazil	primary prevention "polypill" for individuals with >5% risk of CHD	null	$2,936.26	per QALY
Ribeiro	2015	coronary heart disease	Brazil	intermediate-dose statin (5% risk)	no statin	$6,208.92	per QALY
Ribeiro	2015	coronary heart disease	Brazil	high-dose statin (20% risk)	intermediate-dose statin	$17,168.53	per QALY
Ribeiro	2015	coronary heart disease	Brazil	high-dose statin (15% risk)	intermediate-dose statin	$21,731.22	per QALY
Ribeiro	2015	coronary heart disease	Brazil	high-dose statin (10% risk)	intermediate-dose statin	$30,664.75	per QALY
Ribeiro	2015	coronary heart disease	Brazil	high-dose statin (5% risk)	intermediate-dose statin	$61,350.10	per QALY
Bautista	2013	coronary heart disease	LAC region	primary prevention "polypill" for women with >10% risk of CHD	null	$284.00	per QALY
Bautista	2013	coronary heart disease	LAC region	primary prevention "polypill" for men aged 55+	null	$475.80	per QALY
Bautista	2013	coronary heart disease	LAC region	primary prevention "polypill" for men with >10% risk of CHD	null	$1,103.14	per QALY
Bautista	2013	coronary heart disease	LAC region	primary prevention "polypill" for women with abdominal obesity (WHO definition)	null	$2,935.34	per QALY
Bautista	2013	coronary heart disease	LAC region	primary prevention "polypill" for men with abdominal obesity (LASO definition)	null	$3,743.88	per QALY
Salomon	2012	harmful alcohol use	Mexico	aggressive alcohol taxation	null	$11.18	per DALY
Salomon	2012	harmful alcohol use	Mexico	bans on advertising	null	$49.69	per DALY

Valencia	2014	hypertension	Colombia	renal denervation surgery (resistant cases only)	best pharmacological care	$3.61	per QALY
Cecchini	2010	obesity	Brazil and Mexico	regulation of food advertising to children	null	$653.66 to $15,566.73	per DALY
Cecchini	2010	obesity	Brazil and Mexico	mandatory food labelling	null	$83.47 to $11,711.79	per DALY
Cecchini	2010	obesity	Middle-income countries	fiscal measures affecting the prices of fruit and vegetables and foods high in fat	null	cost saving	per DALY
Rubinstein	2009	tobacco use	Argentina	individual treatment of tobacco dependence with bupropion in Buenos Aires	null	$10,015.54	per DALY
Salomon	2012	tobacco use	Mexico	increased tobacco taxation	null	$21.74	per DALY
Salomon	2012	tobacco use	Mexico	bans on advertising	null	$434.78	per DALY
Lutz	2012	tobacco use	Nicaragua	varenicline	bupropion or nicotine replacement or unaided cessation	cost saving	per QALY

Risk factor reduction in the general population

The earliest and most widely recognized studies on the cost-effectiveness of CVD risk factor reduction were published as part of the WHO CHOosing Interventions that are Cost-Effective (WHO-CHOICE) project. Murray and colleagues, conducting their analysis at the regional level, found that legislation and mass media campaigns around salt intake, body-mass index, and cholesterol were all very cost-effective (less than US$ 10 per DALY averted).[7] Similarly, Cecchini and colleagues, looking at a variety of interventions around obesity prevention in several middle-income countries (including Brazil and Mexico), found that fiscal measures to lower the price of healthy foods were cost-saving and that mandatory labels on food products and regulation of food advertising to children were cost-effective.[8] A WHO-CHOICE study specifically on NCDs in Mexico found that alcohol and tobacco taxation and advertising bans were very cost-effective, though bans on tobacco advertising would be less cost-effective than the other measures.[9]

Several of the cost-effectiveness studies looked specifically at Argentina, where the CVD burden as well as intervention costs and gross domestic product are higher than most other Latin American nations. In this context, salt reduction strategies through legislation and mass media campaigns as well as elimination of trans fatty acids were cost saving.[10-12] When assessing urban settings (e.g., Buenos Aires) specifically, salt reduction interventions were associated with incremental costs, though they were still very cost-effective.[13] Taken together, these studies illustrate that population-level efforts to reduce the CVD risk environment are either cost-saving or very cost-effective, though the overall economic impact may vary by country income and urbanicity in the case of local interventions.

Individual-level (clinical) prevention

<u>Treatment of individual CVD risk conditions</u>

The same WHO-CHOICE studies that assessed population-level risk factor reduction also assessed treatment of hypertension and high cholesterol to prevent CVD. According to Murray and colleagues (2003), ICERs for treating blood pressure and cholesterol at different thresholds were all very attractive (less than US$ 50 per DALY averted), though higher thresholds were more cost-effective due to selection of higher-risk individuals. By contrast, ICERs were much higher in the later studies by Rubinstein and colleagues looking at Buenos Aires specifically[13] and Argentina generally.[10] These differences are likely due to different data sources around the intervention costs as well as more modest assumptions around effectiveness. Blood pressure treatment ICERs ranged US$ 2300 – 3300 per DALY averted, while cholesterol treatment ICERs ranged US$ 16,200 – 20,600 per DALY averted. Similar results were seen in Brazil: Ribeiro and colleagues found that statin therapy for cholesterol treatment varied widely (US$ 1,400 – 61,400 per QALY gained) depending on dose of statin and risk threshold.[14]

Notably, only two studies assessed pharmacologic support for smoking cessation. Rubinstein and colleagues found that buproprion (compared to no medication) was not very cost-effective in Argentina on the whole,[10] though it was cost-effective in Buenos Aires[13] (US$ 66,800 vs. US$ 10,000 per DALY averted, respectively); again, these differences were due to lower overall costs as well as higher effectiveness in the country-wide analysis. By contrast, an abstract by Lutz and colleagues found that varenicline (compared to bupropion, nicotine replacement, or unaided cessation) was cost saving.[15] The latter analysis should be interpreted with caution, however, as it has not yet been published in a peer-reviewed journal. On the whole, the studies discussed above suggest that treating individual CVD risk

conditions can be cost-effective, provided that individuals are screened and targeted appropriately by clinicians according to absolute level of CVD risk. Pharmacologic approaches to smoking are less cost-effective than taxation and other population-based approaches, though more evidence is needed in this area.

Primary CVD prevention using multiple drugs: the "polypill"

Finally, several economic evaluations focused on combination drug therapy for primary prevention of CVD. The rationale for combining drugs such as blood pressure medications, aspirin, and statins is that each drug individually is effective at reducing the incidence of CVD (mediated by that drug's mechanism of action), so when combined, the risk reduction is much greater. The notion of a "polypill" containing a fixed-dose combination of these drugs has been around for about 15 years, however, the evidence for the effectiveness of a single combination pill is limited. Firstly, the TIPS trial, conducted in India,[16] showed significant reductions in biochemical and intermediate clinical endpoints (e.g., blood pressure and cholesterol) compared to placebo, and secondly the UMPIRE study, conducted in Europe and India,[17] showed that a such a single, fixed-dose pill significantly increased adherence as opposed to taking multiple pills. The only economic evaluation to include these primary data in a model for Latin American individuals was by Bautista and colleagues, who found that the pill was cost-effective in high-risk subpopulations, including older individuals and obese women (US$ 300 –3700 per QALY gained).[18]

Nevertheless, several other studies assessed a theoretical polypill based on effectiveness assumptions that preceded the TIPS trial and assumed good adherence (as demonstrated in the UMPIRE trial). Murray and colleagues[7] and Rubinstein and colleagues[10] found that a polypill targeting individuals at 15-25% ten-year risk of CVD was very cost-effective and under some scenarios, cost saving. When applied specifically in Buenos Aires, the intervention was somewhat less cost-effective (US$ 1100 – 1400 per DALY averted). Among these studies, the highest ICER (US$ 3000 per QALY gained) was for Brazilian individuals treated at a 5% ten-year CVD risk threshold.[19] As a group, then, these studies have similar conclusions to those around treating individual risk conditions. Hence, primary prevention of CVD on the whole can be cost-effective, though combined pharmacological therapy based on appropriate thresholds of absolute risk is probably more cost-effective than simply treating individual risk conditions themselves.

CARDIOVASCULAR, METABOLIC, AND RESPIRATORY DISEASES: TREATMENT

Our searches also returned 42 interventions in 22 articles on the cost-effectiveness of treatments for specific cardiovascular, metabolic, and respiratory conditions. A handful of studies focused on each of these diseases, though cardiovascular conditions were the most frequently studied. Table 2 summarizes the findings of these studies.

Author	Year	Condition	Country	Intervention	Comparator	ICER	Metric
Rodriguez-Martinez	2013	asthma	Colombia	fluticasone	beclomethasone	$55,851.77	per QALY
Reyes	2011	chronic obstructive pulmonary disease	Chile	pulmonary rehabilitation program	usual care	cost saving	per QALY
Ariza	2012	chronic obstructive pulmonary disease	Colombia	salmeterol/fluticasone	indacaterol	cost saving	per QALY
Ariza	2012	chronic obstructive pulmonary disease	Colombia	formoterol/budesonide	indacaterol	cost saving	per QALY
Ariza	2012	chronic obstructive pulmonary disease	Colombia	Indacaterol	tiotropium	$1.53	per QALY
Alivs-Guzman	2008	chronic obstructive pulmonary disease and acute lower respiratory infection	Colombia	natural gas cooking fuel in homes	current practice	$128.01	per DALY
Araujo	2008	coronary heart disease	Brazil	pre-hospital thrombolytic therapy for acute coronary syndrome	usual care	cost saving	per life-year
Gaziano	2006	coronary heart disease	Brazil	secondary prevention "polypill"	null	$934.59	per QALY
Ribeiro	2015	coronary heart disease	Brazil	low-dose statin, secondary prevention	no statin, secondary prevention	$1,820.06	per QALY

Ribeiro	2015	coronary heart disease	Brazil	intermediate-dose statin, secondary prevention	low-dose statin, secondary prevention	$2,270.08	per QALY
Vieira	2012	coronary heart disease	Brazil	medical management of stable multivessel disease	null	$4,895.38	"event-free costs"
Vieira	2012	coronary heart disease	Brazil	surgical (bypass graft) management of stable multivessel disease	null	$9,856.06	"event-free costs"
Vieira	2012	coronary heart disease	Brazil	catheter-based management of stable multivessel disease	null	$10,775.66	"event-free costs"
Ribeiro	2015	coronary heart disease	Brazil	high-dose statin, secondary prevention	intermediate-dose statin, secondary prevention	$26,021.58	per QALY
Polanczyk	2007	coronary heart disease	Brazil	drug-eluting stent (sirolimus) for symptomatic disease	bare metal stent	$293,644.00	per life-year
Poggio	2012	heart failure and sudden death	Argentina	cardiac resynchronization therapy plus usual care	usual care	$118.93	per QALY
Alcaraz	2011	heart failure and sudden death	Argentina	primary prevention implantable cardioverter-defibrillator (population risk similar to MADIT-I trial), public sector	usual care	$8,353.32	per QALY
Alcaraz	2011	heart failure and sudden death	Argentina	primary prevention implantable cardioverter-defibrillator (population risk similar to MADIT-I trial), private sector	usual care	$9,827.10	per QALY

Alcaraz	2011	heart failure and sudden death	Argentina	primary prevention implantable cardioverter-defibrillator (population risk similar to MADIT-II trial), public sector	usual care	$17,116.08	per QALY
Alcaraz	2011	heart failure and sudden death	Argentina	primary prevention implantable cardioverter-defibrillator (population risk similar to MADIT-II trial), private sector	usual care	$19,526.06	per QALY
Alcaraz	2011	heart failure and sudden death	Argentina	secondary prevention implantable cardioverter-defibrillator, public sector	usual care	$20,752.99	per QALY
Alcaraz	2011	heart failure and sudden death	Argentina	secondary prevention implantable cardioverter-defibrillator, private sector	usual care	$23,658.52	per QALY
Bertoldi	2011	heart failure and sudden death	Brazil	cardiac resynchroniziation therapy plus optimal medical therapy	optimal medical therapy	$11,460.76	per QALY
Ribeiro	2010	heart failure and sudden death	Brazil	primary prevention implantable cardioverter-defibrillator, high-risk patients	usual care	$15,903.35	per QALY

Bertoldi	2011	heart failure and sudden death	Brazil	cardiac resynchroniziation therapy plus implantable cardioverter-defibrillator plus optimal medical therapy	implantable cardioverter defibrillator plus optimal medial therapy	$21,121.86	per QALY
Bertoldi	2011	heart failure and sudden death	Brazil	implantable cardioverter-defibrillator plus optimal medial therapy	optimal medical therapy	$23,887.63	per QALY
Kuhr	2011	heart failure and sudden death	Brazil	cardiac rehabilitation plus usual care	usual care	$24,954.59	per QALY
Ribeiro	2010	heart failure and sudden death	Brazil	primary prevention implantable cardioverter-defibrillator	usual care	$45,767.93	per QALY
Bertoldi	2011	heart failure and sudden death	Brazil	cardiac resynchroniziation therapy plus implantable cardioverter-defibrillator plus optimal medial therapy	cardiac resynchroniziation therapy plus optimal medical therapy	$54,542.56	per QALY
Arias	2011	stroke	Argentina	percutaneous closure of patent foramen ovale plus aspirin (cryptogenic stroke only)	aspirin alone	$21,087.05	per QALY
Araujo	2010	stroke	Brazil	treatment of acute ischemic stroke in women with thrombolytics plus usual care	usual care	$24,546.05	per QALY
Araujo	2010	stroke	Brazil	treatment of acute ischemic stroke in men with thrombolytics plus usual care	usual care	$27,158.09	per QALY

Cruz-Cruz	2014	stroke	Mexico	treatment of acute ischemic stroke with dapsone plus usual care	usual care	$3,773.88	per QALY
Nita	2012	type 2 diabetes	Brazil	saxagliptin plus metformin	rosiglitazone or pioglitazone plus metformin	cost saving	per QALY
Obreli-Neto	2015	type 2 diabetes	Brazil	pharmaceutical care support program	usual care	$24.26	per QALY
Elgart	2012	type 2 diabetes	Colombia	saxagliptin plus metformin	sulfonylurea drug plus metformin	$1.26	per QALY
Chicaiza-Becerra	2010	type 2 diabetes	Colombia	magnetic resonance imaging plus plain radiographs for diagnosis of diabetic foot infection	plain radiographs alone	$1,101.97	per DALY
Home	2015	type 2 diabetes	Mexico	insulin detemir plus oral hypoglycemic drugs (failed oral drugs alone)	oral hypoglycemic drugs	cost saving	per QALY
de Leon-Castaneda	2012	type 2 diabetes	Mexico	glibenclamide	metformin	$132.13	per QALY
de Leon-Castaneda	2012	type 2 diabetes	Mexico	glibenclamide	acarbose	$168.97	per QALY
de Leon-Castaneda	2012	type 2 diabetes	Mexico	glibenclamide	no treatment	$313.70	per QALY
de Leon-Castaneda	2012	type 2 diabetes	Mexico	metformin	no treatment	$341.14	per QALY
de Leon-Castaneda	2012	type 2 diabetes	Mexico	acarbose	no treatment	$471.60	per QALY

Acute care for coronary heart disease and stroke

Acute coronary syndromes ("heart attacks") and strokes are typically treated in hospitals and require advanced medical, diagnostic, and sometimes surgical capabilities. Unfortunately, there is limited evidence on the cost-effectiveness of various treatment approaches in Latin American countries. For acute coronary syndromes, Araujo and colleagues found that pre-hospital (paramedic) administration of thrombolytic medications in Brazil was cost saving.[20] On the other hand, Polanczyk and colleagues found that using sirolimus-eluting stents as compared to bare metal stents were not cost-effective in Brazil, likely because of their greatly increased cost relative to their effectiveness.[21] Another study by Araujo and colleagues found that thrombolytic medications for acute ischemic stroke were relatively cost-effective (US$ 24,500 per DALY averted in women and US$ 27,200 in men).[22] A final study by Cruz-Cruz and colleagues in Mexico concluded that dapsone as an adjunct treatment (neuro-protective agent) for acute ischemic stroke was cost-effective;[23] however, this medication should be considered experimental as it has not yet been included in stroke treatment guidelines.

Secondary prevention and chronic care for cardiovascular diseases

Evidence for the cost-effectiveness of secondary prevention and chronic care for CVD in Latin America is similarly limited. Secondary prevention refers to using drug therapy to treat individuals with existing CVD in order to reduce mortality and non-fatal events such as repeat heart attacks and strokes. In Brazil, Gaziano and colleagues found that a "polypill" approach to secondary prevention was very cost-effective,[19] and Ribeiro and colleagues found that low-to-intermediate dose statins alone were cost-effective[14] (US$ 900, 1800, and 2200 per QALY gained, respectively). Ribeiro and colleagues also found that high-dose statins as compared to intermediate-dose statins were less cost-effective (US$ 26,000 per QALY gained). For chronic CVD, a Brazilian study of medical therapy, coronary artery bypass graft surgery, and catheter-based angioplasty/stenting found that medical therapy costs until a subsequent CVD event were lower than surgical and catheter-based approaches.[24] Unfortunately this study did not assess the incremental costs of these approaches using utility-based measures, so application of their findings is limited. Finally, Arias and colleagues in Argentina looked at catheter-based closure of patent foramen ovale following "cryptogenic strokes" (i.e., strokes without known cause, many of which are presumed due to this congenital defect). They found that closure was cost-effective relative to aspirin therapy alone; however, it should be noted that aspirin therapy is cost-effective in itself and is likely the higher priority treatment.[25] Taken together, this limited evidence suggests that certain medication regimens and technologies can be cost-effective for secondary CVD prevention and chronic care.

Management of heart failure and sudden cardiac death

Heart failure refers to a clinical syndrome that is predominately the end result of severe coronary heart disease. Viral infection, Chagas disease, rheumatic valve disease, and nutrition-related conditions are other important causes of non-ischemic heart failure in developing countries. The standard medication regimen for heart failure employs several blood pressure medications, diuretics, and sometimes drugs to improve cardiac contractions, however, none of the studies in this review assessed the cost-effectiveness of such regimens. One study by Kuhr and colleagues found that cardiac rehabilitation (exercise therapy) for heart failure in Brazil was modestly cost-effective (US$ 25,000 per QALY gained).[26]

The natural history of heart failure also includes both poor cardiac function due to lack of synchronized heart beats between ventricles as well as lethal arrhythmias that lead to sudden death; these can both

be treated by intracardiac devices, and these were the subject of three studies. Poggio and colleagues found that cardiac resynchronization pacing therapy (CRT) was very cost-effective in Argentina (US$ 100 per QALY gained).[27] Alcaraz and colleagues, studying implantable cardioverter-defibrillators (ICDs) in Argentina, found that ICERs for "primary prevention" ICDs (i.e., for individuals who had not experienced sudden death) ranged US$ 8400 – US$ 19,500 per QALY gained, depending on the risk level of the individual and whether the payer was the public or private sector. Interestingly, they also found that "secondary prevention" ICDs (i.e., for individuals who had experienced sudden death but then successfully revived) were slightly less cost-effective (US$ 20,800 – 23,700 per QALY gained).[28]

In Brazil, Ribeiro and colleauges found that the cost-effectiveness of ICDs depended quite a bit on the risk level of the individual, with higher- vs. lower-risk individuals having an ICER of US$ 15,900 vs. US$ 45,800 per QALY gained, respectively.[29] Bertoldi and colleagues assessed combinations of CRT and ICD implantation as compared to optimal medical therapy. They found that the most economically attractive approach was to start with CRT (vs. medical therapy alone) or to add CRT for individuals who had already received an ICD (US$ 11,500 and US$ 21,200 per QALY gained, respectively). Providing ICD therapy first, or adding ICD capability for individuals who had already received CRT were less cost-effective (US$ 23,900 and US$ 54,500 per QALY gained, respectively).[30] The weight of evidence from all these studies suggests that, in some contexts, CRT and ICD devices are cost-effective provided the individual's risk is high enough. CRT is probably more cost-effective than an ICD as a single intervention, though the clinical indications for using these devices often overlap substantially, and they both require a similarly specialized cardiac electrophysiology and surgery platform.

Management of type 2 diabetes

A few studies assessed the cost-effectiveness of medical therapy for type 2 diabetes. In Mexico, de Leon-Castaneda and colleagues found that a variety of oral medication for diabetes were quite cost-effective (US$ 100 – 500 per QALY gained).[31] For Mexican individuals who have failed oral medications, the addition of long-acting insulin detemir appears to be cost saving.[32] For individuals who have failed metformin alone, adding saxagliptin is a cost-effective alternative to sulfonylurea drugs in Colombia[33] and is a cost-saving alternative to rosiglitazone or pioglitazone in Brazil.[34]

In addition to the studies of specific medications, two analyses focused on other aspects of diabetes care. A study by Obreli-Neto and colleagues in Brazil found that a pharmaceutical care support intervention – aiding in diabetes and hypertension medication dosing and adherence – was very cost-effective (US$ 25 per QALY gained).[35] Another important issue is the use of magnetic resonance imaging (MRI) to diagnose diabetic foot infection. MRI is superior to plain radiographs for this purpose, yet it is a very costly technology; however, a study Chicaiza-Becerra and colleagues found that in Colombia MRI is cost-effective relative to radiographs (US$ 1100 per QALY gained).[36] In summary, although the number of studies is limited, the evidence suggests that using modern drugs and diagnostics for managing type 2 diabetes is quite cost-effective.

Management of chronic lung disease

Lastly, a few studies have assessed strategies to deal with chronic lung diseases. Compared to beclomethasone, fluticasone was found not cost-effective in Colombia, however, other medications for asthma were not assessed in this study, and no other studies in this review assessed asthma treatments.[37] By contrast, Ariza and colleagues found that several different inhalers were all very cost-

effective or cost saving for chronic obstructive pulmonary disease in Colombia.[38] Reyes and colleagues evaluated a pulmonary rehabilitation (exercise therapy) program for chronic obstructive pulmonary disease in Chile and found it to be cost saving when added to standard care.[39] Finally, with regards to prevention, Alivs-Guzman and colleagues found that an intervention to replace biofuels with natural gas in Colombian homes reduced the burden of acute lower respiratory tract infections and chronic lung disease (US$ 100 per QALY gained).[40] Hence, similar to the case of type 2 diabetes, strategies to address chronic lung diseases seem to be very cost-effective in general.

CANCER PREVENTION AND TREATMENT

Our search returned 35 interventions in 11 articles devoted solely to cervical cancer prevention and screening and 33 interventions in 11 articles devoted to other cancers, primarily breast cancer. The results are summarized in Table 3 (cervical cancer) and table 4 (breast and other cancers).

Author	Year	Condition	Country	Intervention	Comparator	ICER	Metric
Aponte-González	2013	cervical cancer	Colombia	HPV vaccination (quadrivalent)	usual care	$14.39	per DALY
Aponte-González	2013	cervical cancer	Colombia	HPV vaccination (bivalent)	HPV vaccination (quadrivalent)	$17.08	per DALY
Colantonio	2009	cervical cancer	Argentina	HPV vaccination plus usual care	usual care	$1,429.31	per QALY
Colantonio	2009	cervical cancer	Brazil	HPV vaccination plus usual care	usual care	$7,068.57	per QALY
Colantonio	2009	cervical cancer	Chile	HPV vaccination plus usual care	usual care	$50.75	per QALY
Colantonio	2009	cervical cancer	Mexico	HPV vaccination plus usual care	usual care	$993.04	per QALY
Colantonio	2009	cervical cancer	Peru	HPV vaccination plus usual care	usual care	$2,091.74	per QALY
Dutilh Novaes	2015	cervical cancer	Brazil	HPV vaccination plus usual care	usual care	$4,627.08	per DALY
Fonseca	2013	cervical cancer	Brazil	HPV vaccination and 3 Papanicolaou smear screenings (lifetime)	HPV vaccination	$422.41	per QALY
Fonseca	2013	cervical cancer	Brazil	HPV vaccination and 10 Papanicolaou smear screenings (lifetime)	HPV vaccination	$652.82	per QALY
Gutiérrez-Delgado	2008	cervical cancer	Mexico	Papanicolaou smear screening	no screening	$1,634.30	per DALY
Gutiérrez-Delgado	2008	cervical cancer	Mexico	hybrid capture screening	Papanicolaou smear screening	$2,147.38	per DALY
Gutiérrez-Delgado	2008	cervical cancer	Mexico	HPV vaccination	hybrid capture screening	$8,335.25	per DALY
Insinga	2007	cervical cancer	Mexico	HPV vaccination (girls only) plus usual care	usual care	$3,036.79	per QALY

Insinga	2007	cervical cancer	Mexico	HPV vaccination (girls only) plus booster vaccination (girls only) plus usual care	HPV vaccination (girls only) plus usual care	$3,404.90	per QALY
Insinga	2007	cervical cancer	Mexico	HPV vaccination (girls and boys) plus booster vaccination (girls only) plus usual care	HPV vaccination (girls only) plus booster vaccination (girls only) plus usual care	$18,613.44	per QALY
Insinga	2007	cervical cancer	Mexico	HPV vaccination (girls and boys) plus booster vaccination (girls and boys) plus usual care	HPV vaccination (girls and boys) plus booster vaccination (girls only) plus usual care	$18,656.09	per QALY
Kawai	2012	cervical cancer	Brazil	HPV vaccination	usual care	$188.89	per QALY
Kawai	2012	cervical cancer	Brazil	HPV vaccination plus booster vaccination	HPV vaccination	$388.57	per QALY
Kim	2007	cervical cancer	Brazil	HPV vaccination (50% coverage)	null	$80.70	per life-year
Kim	2007	cervical cancer	Brazil	HPV vaccination (75% coverage)	null	$349.71	per life-year
Kim	2007	cervical cancer	Brazil	HPV vaccination (90% coverage)	null	$807.02	per life-year
Reynales-Shigematsu	2009	cervical cancer	Mexico	HPV vaccination plus usual care	usual care	$7.18	per life-year
Reynales-Shigematsu	2009	cervical cancer	Mexico	HPV vaccination plus Papanicolaou smear screenings every 5 years plus usual care	HPV vaccination plus usual care	$1,682.70	per life-year
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 5 per dose (90% coverage)	usual care	$12.68	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 12 per dose (50% coverage)	usual care	$71.64	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 12 per dose (70% coverage)	usual care	$161.68	per QALY

Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 12 per dose (90% coverage)	usual care	$224.44	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 27 per dose (50% coverage)	usual care	$367.73	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 27 per dose (70% coverage)	usual care	$604.85	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 27 per dose (90% coverage)	usual care	$720.25	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 120 per dose (50% coverage)	usual care	$2,189.90	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 120 per dose (70% coverage)	usual care	$3,333.68	per QALY
Vanni	2012	cervical cancer	Brazil	HPV Vaccine US$ 120 per dose (90% coverage)	usual care	$3,772.42	per QALY
Walwyn	2015	cervical cancer	Belize	HPV vaccination plus usual care	usual care	$214.50	per DALY

Cervical cancer

Nearly all of the studies on cervical cancer prevention focused on vaccination against human papillomavirus (HPV) as the primary method of prevention. Most studies focused on Brazil and Mexico. Generally, HPV vaccination was very cost-effective when added onto "usual care," which in many settings includes cervical cancer screening with Papanicolaou smear every two or three years.[41-45] Only one study specifically investigated the tradeoffs between screening and treatment.[46] This study, conducted in Mexico, found that (compared to doing nothing) Papanicolaou smear was the most cost-effective intervention, followed by hybrid capture screening and then HPV vaccination (ICERs of US$ 1600, US$ 2100, and US$ 8300 per DALY averted, respectively).

Most studies focused on the benefit of HPV vaccination added to current screening practices. For instances, a study by Vanni and colleagues in Brazil highlighted that the ICER for vaccination could range from less than US$ 100 per QALY gained to nearly US$ 3800 per QALY gained, depending on the price per dose and the coverage level.[47] A similar gradient across coverage was reported by Kim and colleagues.[48] Another study demonstrated HPV vaccination was very cost-effective in Belize.[49] Finally, two studies looked at the cost-effectiveness of a repeat dose of the HPV vaccine ("booster" shot) in older adolescents. Kawai and colleagues found that a repeat dose would involve an additional US$ 200 per QALY gained.[50] An earlier study by Insinga and colleagues had similar results but also found that vaccinating both girls and boys involved much higher costs (US$ 18,600 – 18,700 per QALY gained depending on whether a repeat dose was given).[51] All things considered, the evidence suggests that HPV vaccination is a cost-effective addition to current practices, though coverage targets, vaccine prices, and the option of a booster shot all change the relative cost-effectiveness of vaccination.

Author	Year	Condition	Country	Intervention	Comparator	ICER	Metric
Pichon Riviere	2015	breast cancer	Argentina	trastuzumab plus usual care	usual care	$17,024.05	per QALY
Pichon Riviere	2015	breast cancer	Bolivia	trastuzumab plus usual care	usual care	$10,159.48	per QALY
De Souza Bandeira	2015	breast cancer	Brazil	trastuzumab plus docetaxel	docetaxel	$709.80	per QALY
Souza	2013	breast cancer	Brazil	biennial screen-film mammography	usual care	$868.41	per QALY
De Souza Bandeira	2015	breast cancer	Brazil	trastuzumab plus paclitaxel	trastuzumab plus docetaxel	$5,700.93	per QALY
Ribeiro	2013	breast cancer	Brazil	organized breast screening program implemented in Porto Alegre	usual care	$6,874.31	per QALY
Souza	2013	breast cancer	Brazil	annual screen-film mammography	biennial screen-film mammography	$7,556.73	per QALY
Souza	2013	breast cancer	Brazil	annual full-field digital mammography (<50 years) and annual screen-film mammography (50–69 years)	annual screen-film mammography	$17,563.88	per QALY
Sasse	2009	breast cancer	Brazil	adjuvant anastrazole (public sector)	adjuvant tamoxifen (public sector)	$20,544.14	per QALY
Sasse	2009	breast cancer	Brazil	adjuvant anastrazole (private sector)	adjuvant tamoxifen (private sector)	$35,042.28	per QALY
Pichon Riviere	2015	breast cancer	Brazil	trastuzumab plus usual care	usual care	$56,468.06	per QALY
Machado	2012	breast cancer	Brazil	lapatinib plus capecitabine as second-line treatment	capecitabine alone as second-line treatment	$163,935.66	per QALY
Pichon Riviere	2015	breast cancer	Chile	trastuzumab plus usual care	usual care	$114.97	per QALY
Buendía	2013	breast cancer	Colombia	trastuzumab plus usual care	usual care	$42.45	per QALY

Pichon Riviere	2015	breast cancer	Colombia	trastuzumab plus usual care	usual care	$43.93	per QALY
Niens	2014	breast cancer	Costa Rica	current coverage (80%)	null	$10.91	per DALY
Niens	2014	breast cancer	Costa Rica	biennial clinical breast examination screening (40–70 years) plus treatment of stage I to IV (95% coverage)	biennial mammography screening (40–70 years) plus treatment of stage I to IV plus trastuzumab (95% coverage)	$13.73	per DALY
Niens	2014	breast cancer	Costa Rica	biennial mammography screening (40–70 years) plus treatment of stage I to IV (95% coverage)	current coverage (80%)	$30.92	per DALY
Niens	2014	breast cancer	Costa Rica	biennial mammography screening (40–70 years) plus treatment of stage I to IV plus trastuzumab (95% coverage)	biennial mammography screening (40–70 years) plus treatment of stage I to IV (95% coverage)	$69.90	per DALY
Niens	2014	breast cancer	Mexico	basic awareness outreach program plus mass media awareness raising plus treatment of stage I to IV (95% coverage)	biennial mammography screening (40–70 years) plus treatment of stage I to IV plus trastuzumab (95% coverage)	$427.52	per DALY
Niens	2014	breast cancer	Mexico	biennial mammography screening (50–70 years) plus treatment of stage I to IV (95% coverage)	current coverage (70%)	$1,082.90	per DALY

Niens	2014	breast cancer	Mexico	biennial mammography screening (50–70 years) plus treatment of stage I to IV plus trastuzumab (95% coverage)	biennial mammography screening (50–70 years) plus treatment of stage I to IV (95% coverage)	$1,191.55	per DALY
Niens	2014	breast cancer	Mexico	biennial mammography screening (40–70 years) plus treatment of stage I to IV plus trastuzumab (95% coverage)	biennial mammography screening (50–70 years) plus treatment of stage I to IV plus trastuzumab (95% coverage)	$1,457.29	per DALY
Zelle	2013	breast cancer	Peru	triennial fixed plus mobile mammography screening (45-69 years) plus stage I to IV treatment (95% coverage)	null	$1,563.93	per DALY
Zelle	2013	breast cancer	Peru	triennial fixed plus mobile mammography screening (40-69 years) plus stage I to IV treatment (95% coverage)	null	$2,145.52	per DALY
Zelle	2013	breast cancer	Peru	biennial fixed plus mobile mammography screening (40-69 years) plus stage I to IV treatment (95% coverage)	null	$10,417.48	per DALY
Pichon Riviere	2015	breast cancer	Peru	trastuzumab plus usual care	usual care	$21,163.67	per QALY
Zelle	2013	breast cancer	Peru	annual fixed plus mobile mammography screening (40-69 years) plus stage I to IV treatment (95% coverage) plus extended palliative care plus	null	$33,076.83	per DALY

				adjuvant trastuzumab			
Pichon Riviere	2015	breast cancer	Uruguay	trastuzumab plus usual care	usual care	$2,073.01	per QALY
Valencia	2012	chronic myeloid leukemia	Colombia	dasatinib as first-line treatment	imatinb as first-line treatment	$338,324.47	per QALY
Valencia	2012	chronic myeloid leukemia	Venezuela	dasatinib as first-line treatment	imatinb as first-line treatment	$112,508.95	per QALY
Muciño Ortega	2012	pancreatic neuroendocrine tumors (non-resectable)	Mexico	sunitinib plus usual care	usual care	$2,356.47	per QALY

Breast cancer

Comprehensive cancer prevention and control

A handful of studies focused solely on approaches to screening for breast cancer. In Brazil, standard mammography performed every other year is more cost-effective than yearly mammography and full-field digital mammography added to yearly mammography, with ICERs of US$ 900, 7600, and 17,600 per QALY gained, respectively.[52] An important aspect of implementing screening is stimulating demand; to this end, Ribeiro and colleagues assessed a program to increase breast cancer screening in Porto Alegre, Brazil, and found it to be cost-effective (US$ 6900 per QALY gained).[53]

On the other hand, two studies, following the WHO-CHOICE approach, looked at the expansion pathway for screening and treatment of breast cancer. First, Zelle and colleagues assessed breast cancer prevention and control in Peru. They found that, assuming 95% access to breast cancer treatment at all stages, standard mammography is most cost effective when performed every third year among women aged 45-69 years as compared to screening every third year among women aged 40-69 years or screening every second year among women aged 40-69 years (ICERs of US$ 1600, US$ 2100, and US$ 10,400 per DALY averted, respectively). The least cost-effective strategy, and the one most closely resembling high-income country standards, was annual screening of women aged 40-69 plus addition of trastuzumab (see below) and extended palliative care for eligible individuals (ICER US$ 33,100 per DALY averted).[54]

Second, Niens and colleagues assessed screening and treatment of breast cancer in Mexico and Costa Rica. They also assumed scale-up of breast cancer treatment to 95% in all but the base case scenario (current coverage 70& in Mexico and 80% in Costa Rica). In Mexico, all the strategies that were assessed were very cost-effective, with the most cost-effective being outreach and mass media campaigns around screening and the least cost-effective being standard mammography every second year plus trastuzumab for eligible women (US$ 400 and US$ 1500 per DALY averted, respectively). In Costa Rica, rankings of interventions were similar, though the ICERs were all lower (US$ 10 – 70 per DALY averted). On the whole, these studies suggest that combining screening (and outreach) efforts with treatment provides the best value for the money, particularly at the population level.[55]

Specific chemotherapeutic agents

Several studies evaluated novel chemotherapeutic agents from a health technology assessment perspective. The most frequent drug assessed was trastuzumab, which is used in an adjuvant setting for women with cancers that express the HER2-neu gene. In Latin America, it is estimated that 23.4-29.4% of cases of breast cancer are HER2-neu positive and would thus be eligible for trastuzumab.[56] Pichon Riviere and colleauges evaluated the inclusion of trastuzumab to standard cancer care in six Latin American countries and found that ICERs ranged from US$ 42,000 per QALY gained in Uruguay to over 110,000 per QALY gained in Brazil.[56] Their ICER for Colombia was very similar to one reported in an earlier study by Buendia and colleagues.[57] Additionally, de Souza Bandeira and colleagues found that addition of trastuzumab to a taxane-based regimen was cost-effective (US$ 700 per QALY gained for docetaxel and US$ 5700 per QALY gained for paclitaxel as compared to docetaxel).[58] Another study found that, for second-line treatment, lapatinib (a biosimilar to trastuzumab) added to capeitabine in Brazil was $164,000 for each additional QALY compared to capeitabine alone.[59]

Finally, a study by Sasse and colleagues in Brazil assessed anastrazole, which is used in an adjuvant setting for women with cancers that express estrogen/progesterone receptors. The study by Sassa and colleagues found that, compared to tamoxifen (an older drug for hormone receptor positive cancers), the ICER for anastrazole ranges US$ 20,500 – 30,000 per QALY gained depending on public vs. private sector care.[60] Taken together these studies provide suitable evidence that targeted agents for breast cancer can be cost-effective in a variety of Latin American settings, though some regimens are much less cost-effective than others.

Other cancers

Only two studies looked at interventions for cancers other than breast and cervical cancer, and both focused on targeted chemotherapeutic agents. First, Valencia and Orozoco compared agents for chronic myeloid leukemia, dasatinib (a newer, more effective and expensive drug) to imatinib (an older generic drug). They found dasatinib not to be cost-effective in Venezuela or Colombia.[61] Second, Muciño Ortega and colleagues compared sunitinib plus usual care to usual care only for non-resectable pancreatic neuroendocrine tumors and found this drug to be cost-effective (US$ 2400 per QALY gained).[62] It should be noted that pancreatic neuroendocrine tumors are rare cancers, so the usefulness of this study to policy makers is limited.

Despite the evidence presented above, there are massive gaps in knowledge around cancer prevention and control in Latin America. For instance, our search found no economic evaluations around lung, stomach, colorectal, or prostate cancer, which are the other most common neoplasms in the PAHO region besides breast and cervical cancer.[63] Treatments for these cancers include a wide variety of non-specific and targeted chemotherapy regimens as well as surgical and radiotherapy modalities. Hence most cancer prevention and treatment strategies lack any evidence for or against their cost-effectiveness evidence.

CONCLUSIONS

Cardiovascular disease and cancers comprise a majority of the burden of disease in the Latin American region, and given recent epidemiological changes, they will continue to grow in importance. Notably, most resources in PAHO countries are still devoted to infectious diseases and maternal and child health programs. Despite these discrepancies in allocation of resources, the studies presented here provide an important evidence base for implementing cost-effective prevention and treatment programs around NCDs in the region.

Each cost-effectiveness study should, however, be considered in the local context. Most Latin American countries have pluralistic health care systems, and decision-making around interventions, programs, and policies can be fragmented due to the different actors – especially when considering public vs. private sector programs. Hence drastically different cost-effectiveness ratios – and decisions around interventions – may be seen across different payers. This was demonstrated explicitly in studies of the cost-effectiveness cardiac stents[21] and defibrillators[29] in Brazil, however, similar nuances exist in other settings.

Hence, as the number and role of stakeholders – especially private actors as pharmaceutical and device companies – grows in the region, it will be increasingly important to conduct transparent and up-to-date

analyses of new health technologies in each country. Until recently, there was very little use of economic evaluations to guide the decision-making process in the health care systems of most Latin American countries. Nevertheless, a considerable awareness was perceived of the need to understand, conduct and apply these tools to improve allocation of resources.[64] In this regard, this last decade witnessed a large increase in the use of economic evaluations to inform coverage policies in different countries in the region.[65]

Considering its growing burden and costs, this systematic review highlights the regional evidence on cost-effectiveness of different interventions, programs and policies that may be useful to inform resource-allocation decisions regarding NCD's in Latin America.

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