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Original article

Adherence to evidence-based recommendations for chronic noncommunicable diseases: a multicenter cross-sectional study of Bogotá physicians

Adherencia a recomendaciones basadas en evidencia para enfermedades crónicas no transmisibles: estudio de corte transversal multicéntrico en médicos de Bogotá

Adesão às recomendações baseadas em evidências para doenças crônicas não transmissíveis: estudo transversal multicêntrico em médicos de Bogotá

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ABSTRACT

Introduction. The management of patients with chronic noncommunicable diseases, when it follows evidence-based recommendations, improves clinical outcomes and health costs.

Author Contributions

JC:
Manuscript writing and data analysis.

JCV:
Initiated the study, was responsible for its overall design, and participated in drafting the manuscript.

SV:
Manuscript writing and data analysis.

AM:
Data collection and analysis.

FA:
Data collection. All authors critically reviewed the manuscript and approved the submitted version.

Despite its importance, little is known about adherence to guidelines and the processes for its monitoring in our environment. The objective of this study was to report the applicability and adherence to a selection of recommendations from clinical practice guidelines for noncommunicable chronic diseases by doctors in Bogotá. **Methods.** This was a cross-sectional study, the baseline of a cluster experiment that assessed the impact of disseminating recommendations on seven chronic diseases to patients, caregivers, and physicians. A total of 177 physicians from public and private health institutions were invited. Consecutive samples of their medical records were manually reviewed in predefined time ranges (up to 20 patients per physician, with up to two diseases of interest). The proportions of applicability and adherence were calculated according to 40 recommendations. **Results.** The 177 physicians who participated (out of 266 eligible) were from seven institutions, and 3,747 medical records (21,093 patients/recommendation) were analyzed. The general applicability was 31.9% (95% CI 31.3-32.6%), and it varied considerably by recommendation (range 0.3-100%) and disease (range 10.7-65%). Overall adherence was 42.0% (95% CI 40.8-43.2%), with higher adherence in acute coronary syndrome patients (58.4%) and lower adherence in diabetes mellitus patients (23.7%). **Discussion.** This is the most up-to-date, exhaustive, and representative measurement of adherence to guideline recommendations by doctors in Bogotá. **Conclusions.** Adherence to evidence-based recommendations for patients with chronic noncommunicable diseases in Bogotá is poor and highly variable.

Keywords:
Practice Guideline; Evidence-Based Medicine; Noncommunicable Diseases; Quality of Health Care; Implementation Science; Internal Medicine; Primary Health Care

RESUMEN

Introducción. El manejo de pacientes con enfermedades crónicas no transmisibles, cuando se realiza a partir de recomendaciones basadas en la evidencia, mejora los desenlaces clínicos y los costos en salud. Pese a su importancia, poco se conocen la adherencia a las recomendaciones de guías y los procesos para su monitoreo en nuestro medio. El objetivo de este estudio es reportar la aplicabilidad y la adherencia a una selección de recomendaciones de guías de práctica clínica, en enfermedades crónicas no transmisibles, por médicos de Bogotá. **Metodología.** Estudio de corte MSc.Participaron 177 médicos de instituciones de salud públicas y privadas. Se revisaron manualmente muestras consecutivas de sus historias clínicas en rangos de tiempo predefinidos (meta hasta 20 pacientes por médico, en hasta dos enfermedades de interés). Se calcularon las proporciones de aplicabilidad y adherencia en 40 recomendaciones. **Resultados.** Participaron 177 médicos (de 266 elegibles), de 7 instituciones, con 3,747 historias clínicas (21,093 pacientes/recomendación) analizadas. La aplicabilidad general fue 31.9% (IC95% 31.3%-32.6%), y varió considerablemente por recomendación (rango 0.3%-100%) y enfermedad (rango 10.7%-65%). La adherencia general fue 42.0% (IC95% 40.8%-43.2%), siendo mayor en síndrome coronario agudo (58.4%) y menor en diabetes mellitus (23.7%). **Discusión.** Esta es la medición más actualizada, exhaustiva y representativa de la adherencia a las recomendaciones de guías por parte de médicos de Bogotá. **Conclusiones.** La adherencia a recomendaciones basadas en evidencia, para pacientes con enfermedades crónicas no transmisibles de Bogotá, es deficiente y altamente variable.

Palabras clave:
Guía de Práctica Clínica; Medicina Basada en la Evidencia; Enfermedades no Transmisibles; Calidad de la Atención de Salud; Ciencia de la Implementación; Medicina Interna; Atención Primaria de Salud

RESUMO

Introdução. O manejo de pacientes com doenças crônicas não transmissíveis, quando realizado com base em recomendações baseadas em evidências, melhora os resultados clínicos e os custos de saúde. Apesar da sua importância, pouco se sabe sobre a adesão às recomendações das diretrizes e os processos para monitorá-la em nosso meio. O objetivo deste estudo é relatar a aplicabilidade e adesão a uma seleção de recomendações das diretrizes de prática clínica, em doenças crônicas não transmissíveis, por médicos em Bogotá. **Metodologia.** Estudo transversal (linha de base de um experimento cluster que avalia o impacto da divulgação de recomendações sobre sete doenças crônicas a pacientes, cuidadores e médicos). Participaram 177 médicos de instituições de saúde públicas e privadas. Foram revisadas manualmente amostras consecutivas de seus prontuários em intervalos de tempo pré-definidos (alvo de até 20 pacientes por médico, em até duas doenças de interesse). Foram calculadas proporções de aplicabilidade e adesão para 40 recomendações. **Resultados.** Participaram 177 médicos (de 266

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elegíveis), de 7 instituições, com 3,747 prontuários (21,093 pacientes/recomendação) analisados. A aplicabilidade geral foi de 31.9% (IC 95% 31.3%-32.6%) e variou consideravelmente por recomendação (intervalo 0.3%-100%) e doença (intervalo 10.7%-65%). A adesão geral foi de 42.0% (IC 95% 40.8%-43.2%), sendo maior na síndrome coronariana aguda (58.4%) e menor na diabetes mellitus (23.7%). **Discussão.** Esta é a medição mais atualizada, exaustiva e representativa da adesão às recomendações das diretrizes por médicos em Bogotá. **Conclusões.** A adesão às recomendações baseadas em evidências para pacientes com doenças crônicas não transmissíveis em Bogotá é fraca e altamente variável.

Palavras-chave:
Guia de Prática Clínica; Medicina Baseada em Evidências; Doenças não Transmissíveis; Qualidade da Assistência à Saúde; Ciência da Implementação; Medicina Interna; Atenção Primária à Saúde

Introduction

Chronic noncommunicable diseases (CNCDs) are the main cause of morbidity and mortality worldwide and are responsible for the greatest loss of quality-adjusted life years, disability, and health costs (1,2). According to data from the Pan American Health Organization, in 2019 CNCDs caused 5.8 million deaths (81% of the total) and 226 million disability-adjusted years lost in the Americas (3). Socioeconomic advances in developing countries, as well as improvements in prevention and treatment strategies for infectious diseases, have triggered demographic transitions with an aging population (4). Age is one of the main nonmodifiable risk factors for developing CNCD, which is why the burden of these conditions has been increasing in recent decades (5,6). On this background, the need to establish public policies that guide the prevention and management of people at risk of or suffering from CNCD has grown (7).

Clinical practice guidelines (CPGs) constitute a tool through which to apply the scientific evidence gathered about CNCDs (8–10). The objective of CPGs, as compiled from evidence-based recommendations, is to improve clinical outcomes, avoid unjustified variability in clinical practice, implement health resources more efficiently, and reduce inequity gaps (9,11). Consistently, greater adherence of users to CPG has improved clinical outcomes and reduced health costs in CNCD patients (12–16).

Each recommendation includes the characteristics that the patient must meet for the recommendation to be executed (applicability). Considering the wide diversity of patients, the CPG recommendations can be applied to a variable range of patients with the clinical condition in question, but their implementation is based on clinical expertise to incorporate the patient's values into the evidence (17).

Despite their importance and strength, especially in CNCDs, the implementation of CPGs is still limited by doctor and patient factors (16,18,19), which has a negative impact on clinical outcomes and healthcare costs. In fact, compliance with the guidelines is part of the quality of care standard to reduce the burden derived from CNCDs (20,21). The implementation of institutional CPGs has been part of the Colombian regulations for institutions that provide health services since 2014 (22).

Data on adherence to recommendations derived from the CPG of the CNCD in Colombia are scarce. In addition, there are not enough indicators to measure adherence and judge the sources of information (23). The objective of this study is to report the applicability and adherence to recommendations derived from the CPG of the CNCD by doctors from Bogotá.

Methodology

Design

A cross-sectional study corresponded to the baseline measurement in the subpopulation of physicians participating in the *Vector Salud Bogotá* project (24) . Briefly, the *Vector Salud Bogotá* project is a randomized, multicenter cluster experiment that seeks to evaluate the impact of disseminating to various users of health information (patients, caregivers, and physicians) a prioritized series of recommendations based on CPG evidence for CNCD. Specifically, arterial hypertension (HTN), type 2 diabetes mellitus (DM2), heart failure, acute coronary syndrome (ACS), stroke (cerebrovascular accident, CVA), asthma, and chronic obstructive pulmonary disease (COPD) were included.

This study describes the applicability and adherence ratios among participating physicians for a selection of 40 recommendations for these seven CNCDs. The recommendations (Annexes 1-7) were chosen by multidisciplinary panels (clinical experts, methodologists, patients, and caregivers) taking the corresponding CPG as input.

Scenarios and participants

The study included doctors who treated patients with CNCD in different locations of four care networks (three public) and five health institutions (three hospitals, one

private outpatient center and one public hospital) in Bogotá, whose institutional ethics committees approved their participation in the project. Between March and June 2022, the institutional directorates sent invitations to their doctors by email, WhatsApp messages, or phone calls to participate in face-to-face meetings. The aim was to recruit general practitioners or specialists who performed care tasks at least 20% of their working time, reported managing patients with any of the seven CNCDs of interest and agreed to participate through informed consent. Those who reported not managing adult patients or who did not manage any patients with the CNCDs of interest were excluded.

Variables and sources of data collection

Through a self-completed questionnaire, each doctor reported identification variables, sociodemographic information, academic training, work experience, characteristics of their work (time dedicated to care, administrative, teaching, or research tasks), and the number of patients treated for each of the 7 conditions of interest.

Study staff members assigned up to two CNCDs to each physician according to the highest reported frequency of care. To explore the practice patterns of each physician in relation to the selected recommendations, about 20 of each doctor's patients with a main diagnosis of each of these conditions were selected. For this purpose, the institutions were asked to deliver the list of patients treated in the last 12 months by each participating doctor whose ICD-10 codes for outpatient consultation or hospital discharge were related to the assigned health conditions.

Study personnel consecutively reviewed the medical records of eligible patients, starting from the date of inclusion and going backwards until their 20th birthday or until a window of 1 year of care was reached. The care of patients for whom CNCD was confirmed to be the main reason for consultation was included.

The research assistants collected (without knowledge about the evaluated physician other than his or her name and identification) the information recorded in the eligible medical records to determine the following: first, the applicability of the patient to the guideline recommendation (the clinical characteristics that allow its execution), and then adherence based on prescription records, requests for diagnostic aids, referrals, or interconsultations. This was done for each recommendation included by the panel in the histories of patients with CNCDs.

The percentage of patients who adhered to the evidence-based recommendations applied to the patients in each cluster was the primary outcome. To reduce possible information and classification biases, the study personnel underwent training to review medical records, specifying the information extraction sites. The study data manager verified the consistency of the information recorded in the study database. Additionally, an exploratory analysis was performed to evaluate the variation in adherence according to the characteristics of the participating physicians and the characteristics of the recommendations evaluated.

Sample size

Since the unit of analysis for this cross-sectional study was the patient/recommendation evaluated, in order to detect a prevalence of adherence of 40%, with a precision of 1.2% and a confidence of 95%, 6018 patients were needed.

In accordance with the objective of the base cluster experiment of this study, we set ourselves the goal of reviewing 3,000 patients from at least 150 physicians. The total number of evaluable patients/recommendations depended on the distribution of patients with respect to CNCDs since not all conditions included the same number of recommendations and not all were equally applicable. Therefore, this baseline analysis included the data available to us.

Statistical analysis

The discrete variables that were part of the participating medical characteristics are summarized as counts and proportions. Variables such as age and years of professional experience are categorized according to the percentile distribution.

The applicability of and adherence to each recommendation were estimated as percentages with their 95% confidence intervals (CIs), and the patient/recommendation was taken as the unit of analysis. Among the patients evaluated within each CNCD, patients who met specific criteria for the execution of each recommendation were included in the study. Compliance was successful if the physician followed the recommended care for the patients to whom the recommendation applied.

To explore the variation in adherence to the recommendations according to the characteristics of the participating physicians, hypothesis tests were performed with t tests for independent groups and the chi-squared test to compare the means of continuous variables and of frequencies of categorical variables, respectively, at an alpha level of 5%. All statistical computations were done in R, version 4.0.5.

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Results

The 266 physicians who responded to the call to their institutions for eligibility were screened. Of this set, 82 reported not seeing patients with CNCDs of interest, seven did not agree to participate, and 177 physicians agreed to participate and measure the baseline for this report. However, with data on physician characteristics from only 176 (Table 1). Half of the physicians were under 35 years of age, most had at least 5 years of professional experience (73.3%), and most were general practitioners (53%). Some 56.3% exercised care work predominantly over other areas of performance.

Table 1. Characteristics of the physicians

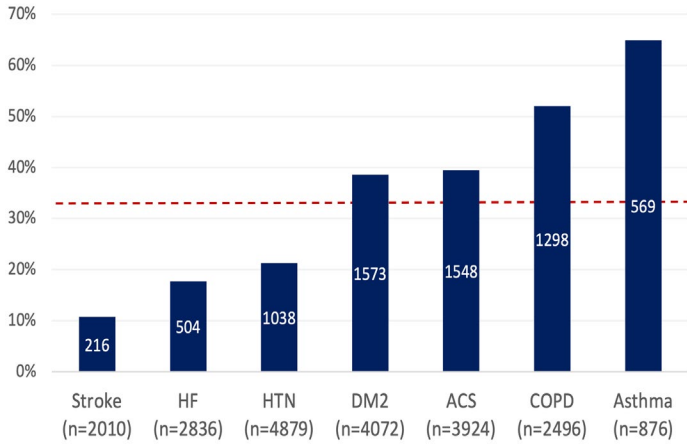
Characteristics of the physicians (n = 176)		
	N	**%**
Age		
≤29 years	51	29.0%
30 to 34 years	37	21.0%
35 to 41 years	48	27.3%
≥42	40	22.7%
Female sex	75	42.6%
Years of experience		
≤4 years	47	26.7%
5 to 9 years	43	24.4%
10 to 15 years	44	25.0%
≥16	42	23.9%
Academic training		
Undergraduate	90	53%
Postgraduate	80	47%
Percentage of care work		
1-60%	77	43.8%
61-100%	99	56.3%
Percentage of administrative work		
0-60%	171	97.16%
61-100%	5	2.84%
Percentage of teaching work		
0-60%	165	93.75%
61-100%	11	6.25%
Percentage of investigative work		
0-40%	156	88.6%
41-100%	20	11.4%

There were no data on the characteristics of one of the doctors included.
Source: elaborated by the authors.

The applicability of and adherence to the seven CNCDs were evaluated according to 40 recommendations selected by multidisciplinary panels (Annexes 1-7). Of these, 19 came from national CPGs, and 65% were published before 2020. Most of the recommendations addressed aspects of treatment (75%), had high certainty of evidence (57.5%), and were rated as strongly in favor (75%). The medical records of 3,747 patients were reviewed, which, according to the recommendations selected for each CNCD, resulted in 21,093 patient/recommendation pairs for analysis.

Applicability

The general applicability of the recommendations was 31.9% (95% CI 31.3%-32.6%). Applicability was highest in patients with asthma (65%) and the lowest in patients with stroke (10.7%) (Figure 1). The applicability was greater for the international CPG recommendations than for the national recommendations (43.7% vs. 24.6%, $p < 0.001$), for those published between 2019 and 2021 (43.7%), for those focused on education (97.3%), for those weakly in favor (41.5%), and for those with very low certainty of evidence (58.5%) (Table 2).



*The numbers below the bars correspond to the number of patients/recommendations evaluated for each disease, and the numbers within the bars correspond to the number of patients/recommendations that apply to each disease. Stroke; DM2: type 2 diabetes mellitus; COPD: chronic obstructive pulmonary disease; HF: heart failure; HTN: arterial hypertension; ACS: acute coronary syndrome.

Figure 1. General applicability of the recommendations and applicability by condition. The red line represents the general applicability (32.0%).
Source: elaborated by the authors.

Table 2. Patient/recomendation's characteristics, aplicability and adherence.

	Evaluated	% Evaluated	Apply	% Applies	Complies	% Compliant
Condition						
ACS	3,924	18.6%	1,548	39.4%	904	58.4%
Asthma	876	42%	569	65.0%	332	58.3%
HF	2,836	13.4%	504	17.8%	286	56.7%
Stroke	2,010	9.5%	216	10.7%	107	49.5%
COPD	2,496	11.8%	1,298	52.0%	532	41.0%
HTN	4,879	23.1%	1,038	21.3%	302	29.1%
DM2	4,072	19.3%	1,573	38.6%	373	23.7%
Origin of the guideline						
International	8,162	38.7%	3,566	43.7%	1,590	44.6%
National	12,931	61.3%	3,180	24.6%	1,246	39.2%
Publication year						
2013-2015	7,393	35.0%	2,151	29.1%	719	33.4%
2016-2018	5,538	26.3%	1,029	18.6%	527	51.2%
2019-2021	8,162	38.7%	3,566	43.7%	1,590	44.6%
Scope of application						
Education	438	2.1%	426	97.3%	219	51.4%
Treatment	16,328	77.4%	4,510	27.6%	2,258	50.1%
Follow-up	1,915	9.1%	450	23.5%	206	45.8%
Screening	2,412	11.4%	1,360	56.4%	153	11.3%
Strength of recommendation						
Strong	16,802	79.7%	4,966	29.6%	2,320	46.7%
Weak	4,291	20.3%	1,780	41.5%	516	29.0%
Certainty of the evidence						
High	11,942	56.6%	4,162	34.9%	1,951	46.9%
Moderate	6,696	31.7%	1,460	21.8%	450	30.8%
Low	709	3.4%	102	14.4%	40	39.2%
Very low	1,746	8.3%	1,022	58.5%	395	38.6%
Total	**2,1093**	**100%**	**6,746**	**32.0%**	**2,836**	**42.04%**

Stroke; DM2: type 2 diabetes mellitus; COPD: chronic obstructive pulmonary disease; HF: heart failure; HTN: arterial hypertension; ACS: acute coronary syndrome.
Source: elaborated by the authors.

Adherence

Overall adherence was 42.0% (95% CI 40.8-43.2%), with ACS accounting for the greatest percentage (58.4%), followed by asthma (58.3%), HR (56.7%) and CVA (49.5%) (Figure 2). The physicians evaluated had the highest adherence to the international CPG recommendations (44.% 6 vs. 39.2%, $p < 0.001$), while those aimed at screening had the lowest proportion (11.3%). As expected, those with strong recommendations and high certainty of evidence had greater adherence (46.7% and 46.8%, respectively) (Figure 3).

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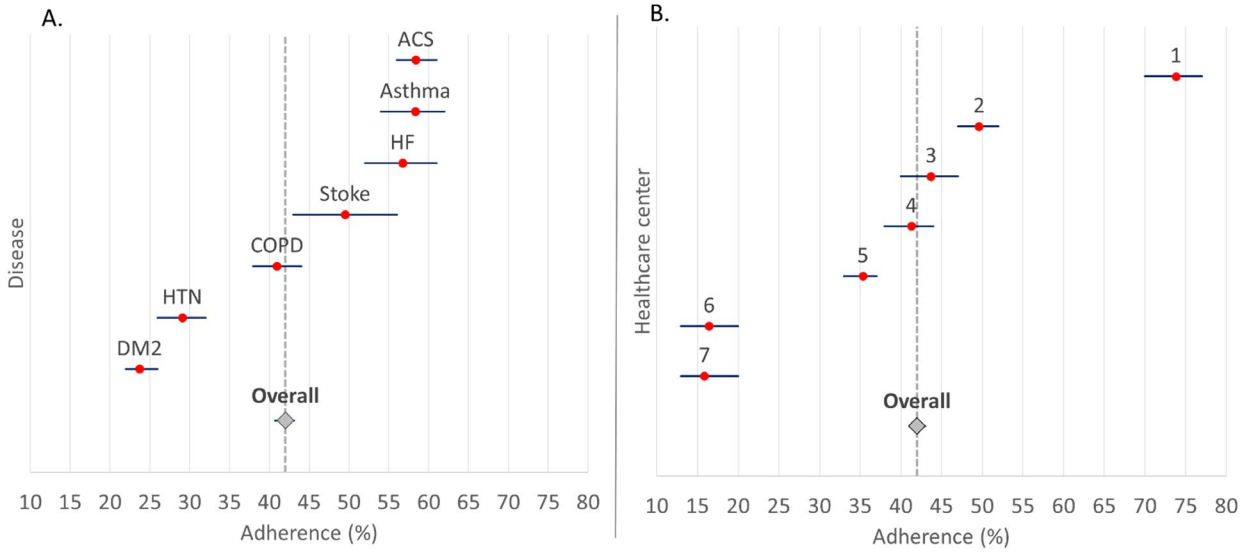
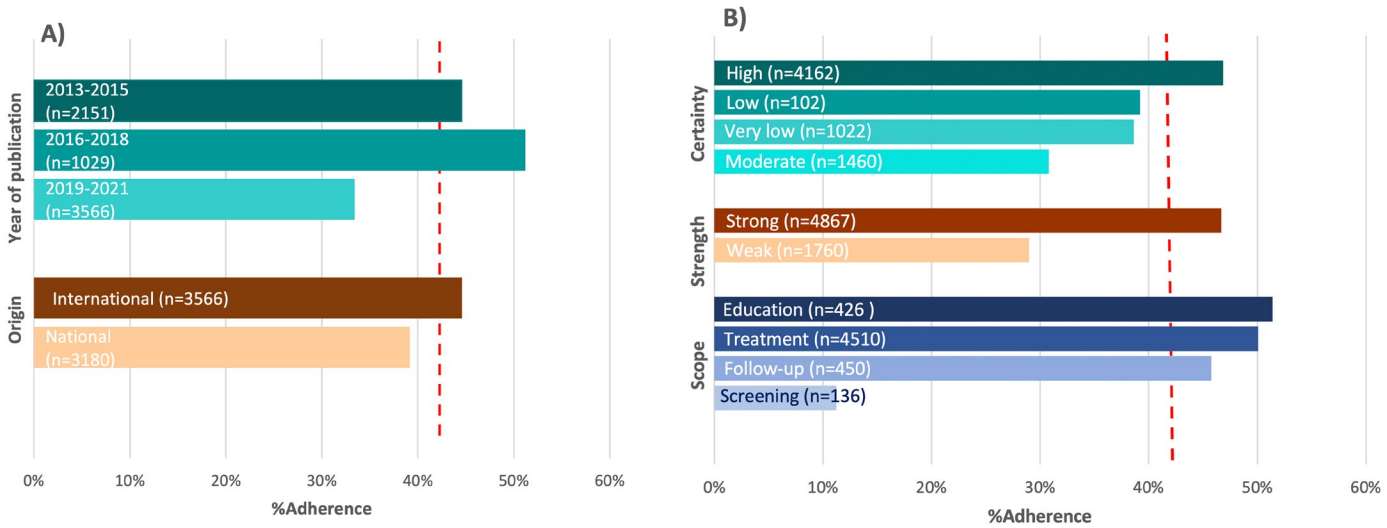


*The points (●) correspond to the average adherence, and the bars (——) correspond to the 95% confidence intervals. Stroke; DM2: type 2 diabetes mellitus; COPD: chronic obstructive pulmonary disease; HF: heart failure; HTN: arterial hypertension; ACS: acute coronary syndrome.

Figure 2. Overall adherence (42.0%), (a) adherence by disease, and (b) adherence by healthcare center to recommendations of clinical practice guidelines for chronic noncommunicable diseases.

Source: elaborated by the authors.



*The dotted red line corresponds to the overall adherence (42.0%); the numbers within the bars correspond to the number of patients/ recommendations that applied for each category.

Figure 3. Variation in adherence to recommendations by (a) the characteristics of the original guideline and (b) by characteristics of the recommendation.

Source: elaborated by the authors.

When evaluating adherence to the recommendations according to the characteristics of the physicians, an important variation was found (Table 3). Doctors classified as male had 12.6% higher adherence than those classified as female (46.9% vs. 34.3%, $p < 0.001$). There was no significant difference in adherence according to the age of the physician (< 35 years 40.9% vs. ≥ 35 years 42.7%, $p = 0.077$) or years of professional experience (< 10 years 42.7% vs. ≥ 10 years 41.38%, $p = 0.12$). There was greater adherence by physicians with first (48.4%) and second

specialties (51.4%) than by those with general specialties (34.6%, $p < 0.001$ in both cases). When evaluating medical specialties, internists had greater adherence (51.3%) than emergency medicine specialists (35.6%) and family doctors (17.7%) ($p < 0.001$ for both).

Table 3. Variation in adherence to recommendations according to physician and patient characteristics

Physician characteristics	Adherence	Patient characteristics	Adherence
Sex		**Diagnosis time**	
Male (n=4,096)	46.9%	<6 months (n=1,554)	58.4%
Female (n=2,662)	34.4%	6-12 months (n=503)	42.9%
Age		1-5 years (n=1,095)	43.4%
<35 years (n=2,709)	40.9%	5 years (n=1,387)	48.2%
≥35 years (n=4,049)	42.7%	**Patient sex**	
Experience		Male (n=3,307)	45.3%
<10 years (n=2,908)	42.8%	Female (n=3,451)	38.8%
≥10 years (n=3,850)	41.4%		
Educational level			
Undergraduate (n=3,383)	34.6%		
1ra specialty (n=2,238)	48.4%		
2da specialty (n=1,137)	51.4%		
First specialty			
Internist (n=1,446)	53.2%		
Emergency medicine (n = 292)	35.6%		
Family physician (n = 62)	17.7%		
Other (n=1,575)	49.7%		
Care dedication time			
1-40% (n=1,358)	45.1%		
21-40% (n=1,604)	35.8%		
41-80% (n=1,163)	36.7%		
81-100% (n=2,633)	46.5%		
With administrative activities	58.5%		
Yes (n=2,811)	44.3%		
No (n=3,947)	40.3%		
With research activities			
Yes (n=3,016)	49.2%		
No (n=3,742)	36.2%		
With teaching activities			
Yes (n=3,659)	46.7%		
No (n=3,099)	36.4%		
Performance area			
Outpatient consultation (n=2,172)	36.5%		
Mixed (n=661)	45.5%		
Hospitalization (n=2,373)	47.7%		

Source: elaborated by the authors.

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Adherence varied depending on the distribution of work activities, being greater for physicians who dedicated 81-100% of their time to care work (46.5%) and lower for those who spent 41-60% of their time in this area (35.8%). Doing other types of activities was associated with greater adherence, particularly for those who carried out some degree of research work (49.2 vs. 36.2%, $p < 0.001$), teaching (46.7 vs. 36.4%, $p < 0.001$), and, to a lesser extent, administrative tasks (44.3% vs. 40.3%, $p < 0.001$). Adherence varied considerably depending on the health center to which the physician belonged, the highest being 73.8% and the lowest being 15.9% (Figure 2b).

Finally, the adherence of physicians to the recommendations was greater when the patient was male (45 vs. 39%, $p < 0.001$) and when the diagnosis was more recent (< 5 years: 58.4%; 6-12 months: 42.9%; 1-5 years 43.4% and > 5 years: 48.2%; $p < 0.001$).

Discussion

Adherence of Bogotá physicians to CPG evidence-based recommendations for the management of CNCD is suboptimal and highly variable. This report is the most up-to-date, exhaustive, and representative measurement of the practice patterns of Bogotá doctors in reference to what is recommended by the CPGs. Despite the demonstrated importance of CPG implementation in terms of clinical outcomes (16,19,21,25), adherence to the recommendations is poor (42% in general but as low as 23.7% for DM2 and 29.1% for HTN). These findings are worrying, as they come from a selection of priority practices to adequately manage highly prevalent conditions that cause high demand in health services (26).

Evaluating adherence in terms of patient/recommendation pairs, we found considerable variation depending on the characteristics of the doctors, patients, or the type of recommendation. For the population evaluated, the strong recommendations in favor, with certainty of high evidence, those focused on treatment or education, and those from international CPGs had greater adherence. Additionally, the degree of academic training seemed to be associated with greater adherence, and internists had higher adherence than other specialists, while screening recommendations had less adherence. This emphasizes the importance of the participation of specialist physicians in the management of CNCD, as well as the strengthening of primary care and evidence-based medicine in medical curricula.

Results in context

Our findings are in line with earlier ones. A study of more than 5 million patients with CNCD in the United States showed that in less than 50% of the patients there was good adherence to the CPG, which is defined as having prescribed at least two medications recommended by the guidelines and a follow-up to the guidelines for 6 months (27). Pepió et al (28) evaluated adherence to recommendations in a cohort of 438 patients with cardiovascular disease (coronary disease, cerebrovascular disease, or peripheral arterial disease) in eight centers in Spain. In their study, 38.5% of patients adhered to therapeutic recommendations. On the other hand, a systematic review of adherence to CPG for COPD revealed that 73% of patients did not have an adequate classification of their disease, only 49% had received vaccination for the influenza virus, 27.5% were referred to a program of pulmonary rehabilitation, and only 38% of the pharmacological prescriptions followed the CPG (29). In Colombia, 24 physicians (271 medical records) from an institution in Pereira reported adhering to the HTN guidelines. In this study, overall adherence was intermediate (score 3-3.9 out of 5) when weighing the knowledge and practices of physicians, with lower adherence for the diagnostic and screening components (30).

To improve adherence to the CPGs, factors related to lower compliance were evaluated (31,32). A Colombian study that surveyed 240 health service providers reported that 89% identified barriers to using CPGs, which arose more frequently among clinical staff than among administrative staff (33). Another study in Bogotá that audited 63 medical records found that only 21% of patients had optimal results when evaluating adherence to the CPG for cervical cancer prevention. When surveying the participating physicians, they reported that the main factors for which they thought there was poor adherence to the guidelines were the limited time for professionals to stay up to date and the lack of inclusion in the socialization of CPGs (34) .

Strengths and limitations

The present study included a substantial number of physicians who treat patients in a variety of institutions and who exist in a variety of administrative, work, and clinical contexts in health institutions in Bogotá. Trained personnel who were blinded to the characteristics of the evaluated physicians analyzed their medical records, compiling information from more than 3000 medical records in seven CNCDs of interest. These records covered more than 55% of the deaths in Bogotá in the studied period (26).

Establishing the patient/recommendation as the unit of analysis led to more than 20,000 independent observations, reducing the halo effect in the recording of information and increasing the efficiency of field work in the extraction of information. In addition, it allowed high statistical precision in the description of adherence by various categories (health conditions, institutions, rating of the recommendation, and characteristics of doctors and patients), facilitating the identification of contrasts between levels and generating hypotheses for future research.

The information generated here has several limitations. It refers only to the decisions recorded by the physicians treating patients with CNCDs. It should be understood that, in the continuum of the care process, for a recommendation to achieve the desired result, adherence by patients must also be ensured, which involves several additional challenges. Although seven CNCDs were addressed and despite the large volume of information collected for this analysis, due to logistical constraints, our evaluation is limited to a fraction of the recommendations included in each CPG.

The process of prioritizing recommendations was systematic and involved the consultation of panels of clinical, methodological, and patient experts. Although it may not be reproducible, it is a valid strategy that has been implemented in multiple scenarios for quality management (35). In any case, as these are more important recommendations, the adherence results presented here might be considered overestimated if they were extended to all CPGs or to physicians evaluated in other contexts due to the voluntarism bias in the process of inclusion of this convenience sample.

In this study, only one in three patients' histories evaluated met the necessary characteristics for the recommendation in question to be implemented (particularly for CVA, only one-tenth were applicable). This low applicability to the selected recommendations reduced the statistical power of the study, reducing the efficiency of the field work. This may be due to the differences between the context of their development and application (e.g., those coming from international CPGs) and the criteria of the panel members. The applicability could also be limited by the retrospective and external nature of the measurement and because it was limited to the information available in the evaluated records, which may be incomplete, potentially underestimating this indicator. Our experience reiterates two challenges for CPG development groups, who must formulate recommendations for patients with a condition with a wide range of questions and possible clinical scenarios: prioritizing those recommendations with the greatest impact, balancing the elements that provide strength with their applicability, and formulating them in such a way that the measurement of adherence is operative.

Implications

Given that adherence to CNCD CPGs is still deficient, it is necessary to implement and evaluate strategies to improve their implementation (36,37). A first step would be to standardize a process of continuous and systematized monitoring of adherence to the CPGs (38). This would allow us to identify specific points to improve and to perceive, in a systematic and continuous way, changes in adherence after specific knowledge-transfer interventions (39). It has been suggested that such implementation strategies, if effective (40), need to be maintained over time to guarantee clinical results (41).

On the other hand, the variability in adherence reported here allows us to identify areas of interest for future interventions. Considering the increasing proportion of female doctors(42,43), to confirm the finding of less adherence to the CPG by doctors, the impact of this factor and the associated conditioning factors should be studied in depth. This difference in adherence could be related to factors such as the greater social and family burden that falls on women in today's society, which has been shown to impact the performance of physicians, as there are discrepancies in the measures of well-being for this population (44,45). On the other hand, the lower adherence to the CPGs when the patient is female, which has also been reported in other studies (46,47), supports the hypothesis of an association between the features of inequity and discrimination in care.

In the case of the complementary activities of doctors, participating in research, academic, or administrative tasks could allow the doctor to be more updated and thus know the structure of the CPGs or recommendations, which would increase awareness of the importance of their implementation. Therefore, it would be desirable for physicians to integrate other complementary activities into their work profile that could improve adherence to CPGs. Finally, the variation in adherence by health institution can be another reducible source of inequity for patient care. This should motivate efforts and the design of health policies to unify practices and establish quality standards in care.

Conclusions

The adherence of Bogotá physicians to evidence-based recommendations for patients with CNCDs is poor and highly variable, depending on the characteristics of the physicians, patients, and recommendations. Since these conditions are responsible for a significant burden of morbidity and mortality, low adherence to CPGs can have a negative impact on the clinical outcomes of patients and on healthcare costs. Greater monitoring of adherence and identification of factors associated with its variability would allow the implementation of improvement strategies.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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Ethical considerations

Protection of persons: This study is considered a low-risk investigation due to its nature. This study was approved by the Institutional Ethics Committee.

Confidentiality of data: The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent: The authors obtained informed consent from the subjects referred to in the article. This document is in the possession of the corresponding author referred to in the article.

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Annex. Description of the selected recommendations

Annex 1. Acute coronary syndrome (physicians = 47, patients = 654)

Number Source guide	Recommendation text	Scope of application	Rating	
			Fortress	Certainty
1 ESC SCA 2020	In patients with acute coronary syndrome (ACS) and left ventricular systolic dysfunction or heart failure with reduced ejection fraction (LVEF <40%), beta-blockers are recommended.	Treatment	Strong	High
2 Colombian CPG 2013-17	In patients with acute coronary syndrome (ACS) with ST elevation and less than 12 hours of evolution, reperfusion therapy is recommended as soon as possible, with primary percutaneous coronary intervention with angioplasty and a stent, ideally in the first 90 minutes of the first medical contact, or the administration of fibrinolytic therapy, ideally in the first 30 minutes of the first medical contact, according to the availability of the health center.	Treatment	Strong	Moderate
3 ESC SCA 2020	In patients with acute coronary syndrome, parenteral anticoagulation * is recommended, in addition to antiplatelet treatment **, at the time of diagnosis and according to both ischemic and hemorrhagic risks.	Treatment	Strong	High
4 ESC SCA 2020	In patients with heart failure with reduced ejection fraction (<40%), diabetes or chronic kidney disease, and acute coronary syndrome, angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor antagonists, in cases of intolerance to ACE inhibitors, to reduce cardiovascular and all-cause mortality and cardiovascular morbidity unless contraindicated.	Treatment	Strong	High
5 Colombian CPG 2013-17	In patients with acute coronary syndrome with ST elevation, the use of clopidogrel, in addition to aspirin, is recommended in the emergency department, regardless of the reperfusion strategy (fibrinolysis or primary angioplasty). Note: the high-quality REBE is for Clopidogrel, but not exclusive of other P2Y12 antiplatelet agents.	Treatment	Strong	High
6 ESC SCA 2020	In patients with acute coronary syndrome, multidisciplinary exercise-based cardiac rehabilitation is recommended as an effective means for patients to achieve a healthy lifestyle and control risk factors in order to reduce the causes of cardiovascular morbidity and mortality and improve their health-related quality of life.	Treatment	Strong	High

Source: elaborated by the authors.

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Annex 2. Heart failure (doctors = 54, patients = 709)

Number Source guide	Recommendation	Scope	Strength	Certainty
1 Colombian CPG 2016	The use of angiotensin-converting enzyme inhibitors or angiotensin receptor blockers is recommended in patients with AHA stage B * heart failure to slow the progression of heart failure.	Treatment	Strong	Moderate–high
2 Colombian CPG 2016	The use of beta-blockers is recommended in patients with stage B, C, or D * heart failure who have ejection fraction <40%, to reduce cardiovascular mortality, hospitalizations and avoid functional deterioration.	Treatment	Strong	High
3 Colombian CPG 2016	Patients with heart failure with reduced ejection fraction (≤ 40%), who remain symptomatic (NYHA ≥ II *), despite treatment with adequate doses of optimal medical therapy **, and who have systolic blood pressure > 90 mmHg and creatinine <1.5 mg/dL, should be referred to a heart failure program and should be evaluated for the use of a neprilysin inhibitor to reduce cardiovascular death, hospitalizations for heart failure, and disease progression.	Follow-up	Strong	Low
4 Colombian CPG 2016	The primary-care physician should diagnose and refer patients with heart failure of ischemic origin stage AHA B, who are on optimal pharmacological therapy, who have ejection fraction <35%, are 40 days after an infarction or 3 months after a myocardial revascularization procedure, who have a life expectancy greater than 1 year, and who have good functional status, for the implantation of an implantable cardioverter defibrillator to reduce mortality.	Treatment	Strong	Discharge for sudden death, discharge for other outcomes

Source: elaborated by the authors.

Annex 3. Stroke (physicians = 32, patients = 335)

Number Source guide	Recommendation	Scope	Strength	Certainty
1 Stroke Prevention AHA/ASA 2021	In patients with carotid artery stenosis and a transient ischemic attack (TIA) or cerebrovascular attack (CVA), optimal medical management, with antiplatelet therapy, lipid-lowering therapy, and treatment of hypertension, is recommended to reduce the risk of ACV	Treatment	Strong	High
2 Stroke Prevention AHA/ASA 2021	In patients with ischemic cerebrovascular attack or transient ischemic attack and atherosclerotic disease (intracranial, carotid, aortic or coronary), lipid-lowering treatment with a high intensity statin (Atorvastatin 80 mg/ day or Rosuvastatin 40 mg) is recommended./day) * up to an LDL target <70 mg/dl, to reduce the risk of major cardiovascular events.	Treatment	Strong	High
3 AHA/ASA 2021 ESO TIA 2021	In patients with high-risk noncardioembolic acute transient ischemic attack (ABCD2 score ≥ 4) or minor cerebrovascular attack *, dual antiplatelet therapy with aspirin and clopidogrel is recommended for 21 days, followed by monotherapy.	Treatment	Strong	High
4 ESO Stroke 2021	For patients with acute ischemic cerebrovascular attack <4.5 hours from symptom onset, intravenous thrombolysis with alteplase is recommended to be performed in a center with the capacity to care for stroke or under telemedicine guidance.	Treatment	Strong	High
5 Stroke Prevention AHA/ASA 2021	In patients with a cerebrovascular attack or transient ischemic attack who smoke cigarettes, interdisciplinary counseling with or without drug therapy (including nicotine replacement, bupropion, or varenicline) is recommended to help with smoking cessation.	Treatment	Strong	High
6 Stroke Prevention AHA/ASA 2021	In patients with a transient ischemic attack or ischemic cerebrovascular attack without severe disability in the last 6 months and severe stenosis (70-99%) of the ipsilateral carotid artery, carotid endarterectomy is recommended to reduce the risk of future stroke, provided that perioperative morbidity and mortality is estimated to be <6%.	Treatment	Strong	High

Source: elaborated by the authors.

Annex 4. Hypertension (physicians = 37, patients = 697)

Number Source guide	Recommendation	Scope	Strength	Certainty
1 Colombian CPG 2013	In patients with newly diagnosed hypertension (HTN) and systolic blood pressure ≥ 160 mmHg or diastolic blood pressure ≥ 100 mmHg, it is recommended to start treatment with a combination of antihypertensive families instead of monotherapy, except the combination of ACE inhibitors and ARA II.	Treatment	Strong	Moderate
2 Colombian CPG 2013	In patients with arterial HTN who have not achieved the blood pressure goals (<140/90) in the first 6 months of follow-up with monotherapy at standard doses, treatment with a combination of antihypertensive families is recommended instead of increasing the dose of a single agent. Except the combination of ACEI and ARA II.	Treatment	Strong	Moderate
3 Colombian CPG 2013-2017	In patients with arterial HTN who are older than 65 years or who have a concomitant diagnosis of diabetes, the use of antihypertensive therapy is recommended with goals of systolic blood pressure <140 mmHg if auscultatory method is used or systolic blood pressure <130 mmHg if they are used. automated methods in the first 6 months of follow-up.	Treatment	Strong	Moderate
4 Colombian CPG 2013	In patients with HTN and left ventricular hypertrophy confirmed by transthoracic echocardiography, it is recommended to repeat this study between 6 and 12 months to evaluate the response to treatment.	Follow-up	Strong	High
5 Colombian CPG 2013-2017	In patients with HTN who are estimated to be at high risk of cardiovascular events using the Framingham scale, it is recommended to set more intensive goals (BP <130/80 mmHg) to be achieved in the first 6 months of treatment. * The patient should be evaluated and adjusted routinely during the 6 months after the start of intensive treatment. ** Patients with refractory HTN are excluded from this recommendation. *** High risk is considered if the Framingham (2008) estimate is greater than 20% at 10 years.	Treatment	Strong	Moderate
6 Colombian CPG 2013	In patients with a higher risk of left ventricular hypertrophy defined as those with a history of HT of at least 5 years, HT stage II *, refractory HTN ** or chronic kidney disease stage III *** or higher, it is recommended to request transthoracic echocardiogram to identify LVH and assess ventricular function * HT stage II corresponds to blood pressure> 160/100 mmHg. ** Refractory HT is considered a blood pressure that remains> 140/90 mmHg despite the concurrent use of three antihypertensive agents of different classes and one of the three agents is a diuretic, all agents should be prescribed at the maximum recommended doses or maximum tolerated. *** Stage III chronic kidney disease is defined as a glomerular filtration rate on the Cockcroft-Gault scale ≤ 60 mL/min/1.73 m2.	Screening	Strong	High
7* Colombian CPG 2013	In patients with arterial HTN, it is recommended to rule out glomerular injury in a casual urine sample by measuring the proteinuria/creatinuria ratio * during the first three months after diagnosis. In patients with arterial HTN and a positive proteinuria/creatinuria * ratio, it is recommended to measure albuminuria in 24 hours for the diagnosis of hypertensive nephropathy. * A positive proteinuria/creatinuria ratio is considered> 150 mg/g, if this measurement is not available. an albuminuria/creatinuria ratio> 30 mg/g is considered positive.	Screening	Strong	High

* HTA recommendation 7 combines two recommendations related to the screening and diagnosis of glomerular injury.

Source: elaborated by the authors.

Annex 5. Type 2 diabetes mellitus (doctors = 32, patients = 509)

Number Source guide	Recommendation	Scope	Strength	Certainty
1 Colombian CPG 2015	In patients with DM2 and persistent microalbuminuria *, regardless of the diagnosis of arterial hypertension, it is suggested to give treatment with an angiotensin-converting enzyme (ACE) inhibitor or an angiotensin-2 receptor antagonist (ARA2). * Albuminuria/creatinuria (> 30 mg/g) confirmed by a second sample in a period between three or six months, or confirmed with quantification of proteinuria in 24 hours (> 30 mg).	Treatment	Weak	Moderate
2 ADA 2019	In patients with DM2 who at the time of diagnosis have HbA1c levels> 10, it is suggested to consider the combination of metformin and basal insulin regimen.	Treatment	Weak	Very low
3 ADA 2019	In all patients with DM2, treatment should be evaluated every 3 to 6 months and intensified when the goal of HbA1c (7%) has not been achieved and consider adjusting it in cases of hypoglycemia or HbA1C <6.5%.	Follow-up	Weak	Very low
4 Colombian CPG 2015	In patients with DM2 without established cardiovascular disease * who at the time of diagnosis require combination therapy (HbA1c> 8), or who have not reached the therapeutic goal (HbA1c> 7%) with metformin, the combination of metformin with a dipeptidyl peptidase-4 inhibitor is recommended. * Coronary disease, cerebrovascular disease and peripheral arterial disease of presumed atherosclerotic origin.	Treatment	Weak	Moderate
5 Colombian CPG 2015	In patients with DM2 with established cardiovascular disease * who at the time of diagnosis require combination therapy (HbA1c> 8), or who have not reached the therapeutic goal (HbA1c> 7%) with metformin, the combination of metformin with an iSGLT2 is recommended. ** Coronary disease, cerebrovascular disease and peripheral arterial disease of presumed atherosclerotic origin ** Do not use in patients with a glomerular filtration rate < 45 ml/min. Consider the risk of genital infection.	Treatment	Weak	Moderate
6 ADA 2019	In all patients with DM2 at the time of diagnosis and at least once a year it is recommended to screen distal symmetric polyneuropathy evaluating pain sensitivity, temperature sensitivity, vibration using a 128 Hz tuning fork and a 10 gr monofilament test, to identify risk of ulceration and amputation.	Screening	Weak	Very low
7 Colombian CPG 2015	In patients with DM2 and obesity (BMI ≥ 30), who have not reached the therapeutic goal (HbA1c <7%) with two oral medications, the use of GLP-1 agonists is recommended as a third medication. It is suggested that the two oral medications to be used are metformin and iSGLT2.	Treatment	Weak	Moderate
8 ADA 2019	In all patients with DM2, at the time of diagnosis and at least once a year, it is recommended to measure albuminuria and creatinuria and estimate the glomerular filtration rate from serum creatinine.	Screening	Weak	Very low–moderate

Source: elaborated by the authors.

Annex 6. Chronic Obstructive Pulmonary Disease (physicians = 40, patients = 624)

Number Source guide	Recommendation	Scope	Strength	Certainty
1 Colombian CPG 2014	To improve survival, patients with COPD and PaO2 < 55-mmHg, or 55-60 mmHg with a hematocrit greater than 55% and signs of pulmonary hypertension (signs symptoms of cor pulmonale and/or pulmonary hypertension confirmed by echocardiography), should use home oxygen for at least 15 hours/day.	Treatment	Strong	High
2 ALAT 2019	Dual bronchodilator therapy (long-acting β-agonist + long-acting muscarinic antagonist) is recommended in patients with moderate to very severe COPD who persist symptoms despite other bronchodilator therapies.	Treatment	Strong	High
3 Colombian CPG 2014	Physical exercise is recommended (30 min/day × 5 days a week), ideally in structured pulmonary rehabilitation programs in all patients with stable COPD (not exacerbated in the last 6-8 weeks), in order to improve exercise capacity and quality of life. It is very important to continue exercising at home, preferably with the supervision of caregivers, and undergo periodic monitoring by health personnel.	Treatment	Strong	High
4 Colombian CPG 2014	Annual vaccination against influenza viruses is recommended in all patients with stable COPD to reduce the frequency of exacerbations or hospitalizations and reduce mortality.	Treatment	Strong	High

Source: elaborated by the authors.

Annex 7. Asthma (physicians=22, patients=219)

Number Source guide	Recommendation	Scope	Strength	Certainty
1 GEMA 5.0 2020	In moderate asthma, the treatment of choice is the daily administration of a combination of glucocorticoid by inhaled route (IGC) at a low dose (beclomethasone 200-500 µg or its equivalent *) or medium (beclomethasone ≥ 500-1,000 µg or its equivalent *) with an inhaled long-acting β-agonist bronchodilator.	Treatment	Strong	High
2 GEMA 5.0 2020	In the patient with mild asthma, the maintenance treatment of choice is IGC daily at a low dose (beclomethasone ≤ 500 mcg/day or its equivalent - see equivalence table)	Treatment	Strong	High
3 GEMA 5.0 2020	It is recommended to train patients with a diagnosis of asthma and their caregivers in the technique of using inhalation devices (inhalers, inhalation chambers, nebulizers, etc.) and to carry out their periodic supervision by health personnel or caregivers.	Education	Weak	Very low
4 GEMA 5.0 2020	It is recommended that patients diagnosed with asthma and their caregivers be included and actively participate in a structured program of education about their disease that has an interdisciplinary team.	Education	Strong	High

Source: elaborated by the authors.