Original Article

# Mapping the Asthma Care Process: Implications for Research and Practice

**Alexandra Lelia Dima, PhD[a], Marijn de Bruin, PhD[a,b], and Eric Van Ganse, MD, PhD, FRCP[c,d]; on behalf of the ASTRO-LAB group** *Amsterdam, the Netherlands; Aberdeen, Scotland; and Lyon, France*

***What is already known about this topic?*** Asthma management is a complex process influenced by multiple interacting factors. There is limited integration of research on these influences, making it difficult to use research evidence in clinical practice.

***What does this article add to our knowledge?*** We propose a fully-integrated logic model of asthma care that emphasizes the role of patient behaviors (medication adherence, self-monitoring, trigger management, and management of severe asthma exacerbations) and health care professional behaviors (medical care and self-management support activities) in improving health outcomes.

***How does this study impact current management guidelines?*** The model can be used as an integrative framework for research and clinical practice in asthma, and optimized or adapted for different clinical contexts and respiratory conditions.

**BACKGROUND: Whether people with asthma gain and maintain control over their condition depends not only on the availability of effective drugs, but also on multiple patient and health care professional (HCP) behaviors. Research in asthma rarely considers how these behaviors interact with each other and drug effectiveness to determine health outcomes, which may limit real-life applicability of findings.**

**OBJECTIVE: The objective of this study was to develop a logic process model (Asthma Care Model; ACM) that explains how patient and HCP behaviors impact on the asthma care process.**

**METHODS: Within a European research project on asthma (ASTRO-LAB), we reviewed asthma care guidelines and empirical literature, and conducted qualitative interviews with patients and HCPs. Findings were discussed with the project team and respiratory care experts and integrated in a causal model.**

**RESULTS: The model outlines a causal sequence of treatment events, from diagnosis and assessment to treatment prescription, drug exposure, and health outcomes. The relationships between these components are moderated by patient behaviors (medication adherence, symptom monitoring, managing triggers, and exacerbations) and HCP behaviors (medical care and self-management support). Modifiable and nonmodifiable behavioral determinants influence the behaviors of patients and HCPs. The model is dynamic as it includes feedback loops of behavioral and clinical outcomes, which influence future patient and HCP decision making. Key evidence for each relationship is summarized to derive research priorities and clinical recommendations.**

**CONCLUSIONS: The ACM model is of interest to both researchers and practitioners, and intended as a first version (ACM-v1) of a common framework for generating and translating research evidence in asthma care.** **© 2016 The Authors. Published by Elsevier Inc. on behalf of the American Academy of Allergy, Asthma & Immunology. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).** **(J Allergy Clin Immunol Pract 2016;4:868-76)**

***Key words:*** *Asthma; Medication adherence; Management; Therapeutic education; Behavioral care; Evidence-based care*

[a]Amsterdam School of Communication Research ASCoR, University of Amsterdam, Amsterdam, the Netherlands

[b]Institute of Applied Health Sciences, University of Aberdeen, Foresterhill, Aberdeen, Scotland

[c]Lyon Pharmaco-Epidemiology Unit, Faculte d'Odontologie, Universite Claude Bernard Lyon 1, Lyon, France

[d]Respiratory Medicine, Croix-Rousse University Hospital, Lyon, France

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Corresponding author: Alexandra Lelia Dima, PhD, Amsterdam School of Communication Research ASCoR, University of Amsterdam, PO Box 15791, 1001NG Amsterdam, the Netherlands. E-mail: a.dima@uva.nl.

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*Abbreviations used*
*ACM- Asthma care model*
*HCP- Health care professional*
*HRQoL- Health-related quality of life*
*IM- Intervention mapping*
*SAE- Severe asthma exacerbation*

Managing asthma is a challenging task as it requires sustained performance of numerous behaviors from patients, their caregivers, and the health care professionals (HCPs) involved in their care. To support patients effectively in achieving and maintaining asthma control, HCPs need to monitor and intervene in a complex causal process, and to base their decisions on the latest research evidence regarding an ever-increasing number of treatment options, self-management strategies, technological advances, and health care policies. Advising patients on appropriate medication adherence strategies is part of this process. To be valuable for clinical practice, research needs to be conducted and disseminated in a standardized and easily interpretable manner and to provide accurate information on the whole domain of interest. However, recent reviews of adherence research highlighted study heterogeneity and substantial knowledge gaps.[1,2]

The lack of a unified and comprehensive overview of the asthma care process is not by itself a limitation of individual studies, but can be a barrier to effective care. Individual studies are, necessarily, constrained by the need to focus on specific concepts and relatively simple models that can be tested within the boundaries of 1 study. Expectedly, most observational asthma research uses cross-sectional designs and targets a limited number of concepts selected based on data availability rather than on theoretical considerations.[1] Experimental designs, although highly valued for their capacity to isolate the effect of a single causal element (eg, medical compound, behavioral intervention, care protocol), have been criticized for their low external validity when compared with routine care, which often involves a more complex causal network.[3] Aligning research hypotheses with questions relevant for real-life practice is a priority for asthma care, and medical care in general. Although individual studies can optimize their clinical impact to some extent,[4] building a unified picture of asthma care requires a separate process of reviewing evidence and clinical guidelines, studying current practice, and dialogue within the research and clinical community to reach and update consensus on essential causal relationships that require testing. This process would help generate not only a comprehensive model of asthma care, but also standardized methods for testing common research hypotheses.

This article proposes such a model, developed within the ASTRO-LAB project, a European Union-funded project investigating adherence to inhaled medication in asthma.[5] We describe model components and hypothesized causal relations, and derive an agenda for asthma care research that would maximize its value for clinical practice. The model is presented as a first version that would benefit from further input from clinicians, researchers, policy makers, and patients. We hope to stimulate collaboration and focus that would facilitate more rapid accumulation of evidence.

## METHODS

We conducted reviews of asthma treatment guidelines,[6-10] literature reviews, qualitative interviews, and behavior analysis of the asthma care process with input from the study team and respiratory care experts. Results from the guidelines review were complemented with focused scoping reviews on specific topics, such as HCP asthma care support, patient self-management (eg, medication adherence, trigger management, exacerbation management), and asthma outcomes (eg, control, exacerbations); and a systematic review on determinants of medication adherence in asthma.[1] Keyword searches were conducted in EMBASE, Medline, PsychInfo, and PsychArticles until July 2012 (the ASTRO-LAB set-up phase) using terms such as asthma, adherence, and determinant. Articles were selected if they reported empirical studies or narrative or systematic reviews on these topics. References of selected articles were examined for additional relevant works.

Qualitative interviews were conducted by telephone with patients, parents of children with asthma, and general practitioners and nurses involved in asthma care (13 interviews in France, 26 in the United Kingdom), as part of patient and public involvement in research. Participants were recruited via patient and professional organizations, and convenience sampling; no additional selection criteria were specified. The discussions were based on semistructured interview guides that included questions for HCPs on how they deliver medical and behavioral asthma care and their perceptions on patient behaviors and determinants, and barriers and facilitators to providing asthma care; patients and/or parents were invited to share their perceptions of the asthma care needed and received, and their asthma management behaviors and beliefs. Results were audio-recorded, summarized qualitatively, and used to interpret research evidence in light of patient, caregiver, and HCP experiences, and to analyze the asthma care process from a behavioral perspective based on health behavior theory and principles in line with the Intervention Mapping (IM) approach.[11] Links between components were formulated as causal relationships consistent with existing theory, evidence, and clinical observation. The model was developed iteratively via discussions with the ASTRO-LAB team and respiratory care experts, in which model versions were presented and feedback requested on its components, relationships, and general format. The research literature published during and after model development was integrated within the relevant model components and relationships.

## RESULTS

### The model

The asthma care logic model (ACM-v1; Figure 1) distinguishes between 3 categories of components: the asthma management process, the patient and/or caregiver's roles, and the HCP's contributions to this process. Each category is briefly described below, followed by a review of the available research evidence for the key model components, and the associated implications for research and clinical practice.

**The asthma management process.** The causal sequence of asthma management is well known to respiratory care practitioners and can be formulated in simple terms as the following sequence of events. The process of managing a person's asthma is prompted initially by an acute and spontaneous change in symptoms such as wheezing, breathlessness, chest tightness, and cough, indicating the onset of asthma at a given level of *asthma severity (a)*. These symptoms lead the patient to consult an HCP

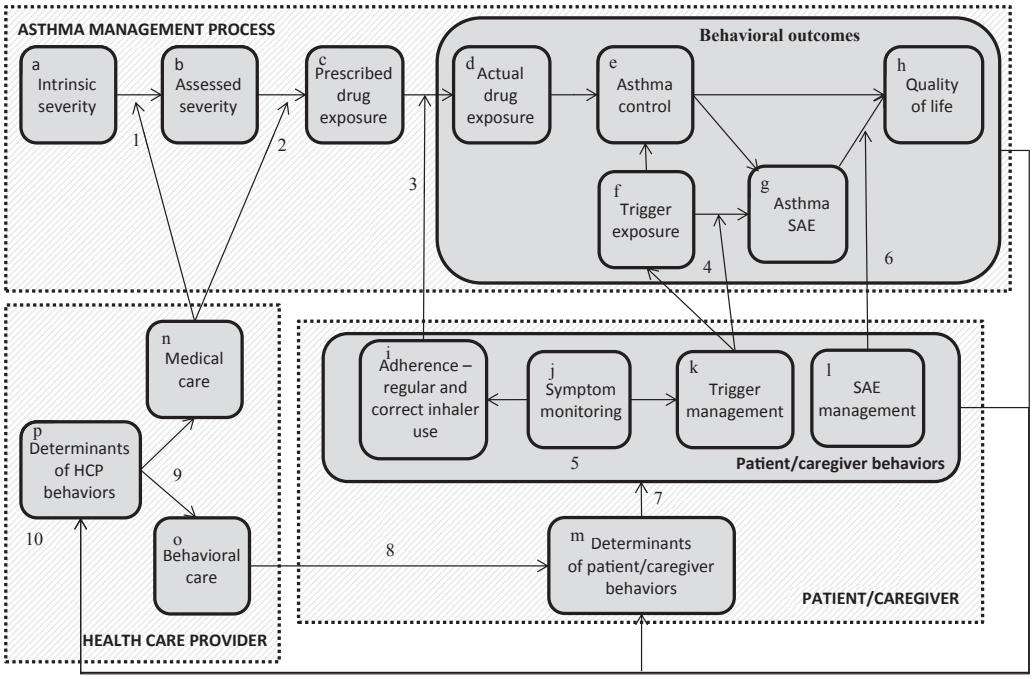


**FIGURE 1.** The logic model of asthma care (ACM-v1)—graphical representation.

for a clinical assessment, which results in *diagnosing asthma* with a specific *level of severity (b)*. This guides the HCP to recommend a corresponding regimen of *prescribed drug exposure (c)*, which should determine the patient's *actual drug exposure (d)* and together with reducing *trigger exposure (f)*, should increase *asthma control (e)*. Patients with controlled asthma and a limited exposure to triggers have a reduced *risk of severe asthma exacerbations (SAEs) (g)*. Both controlled asthma and reduced SAE contribute to increased *health-related quality of life (HRQoL) (h)*. This causal sequence is the implicit standard for asthma management, yet in real life it is subject to various influences that may weaken the strength of these causal links. These influences are conceptualized here as moderators, and described in terms of *patients and/or caregivers' behaviors* and *HCPs' behaviors*. Interventions to optimize asthma management in clinical practice are, in essence, efforts to modify these parameters to achieve maximum strength of association in this causal sequence. Understanding their role is therefore essential for asthma care.

**The patients and caregivers.** The model includes 4 groups of patient behaviors necessary for managing asthma: *adherence* to regular and correct use of controller *inhalers (i), symptom monitoring (j), trigger management (k), and SAE management (l)*. These behaviors can be the sole responsibility of patients, or can be shared between patients and caregivers (eg, parents of children with asthma). *Inhaler adherence* moderates the relationship between prescribed and actual drug exposure: patients need to inhale the drug in the quantity and at the intervals recommended, and perform the inhalations correctly. Not initiating treatment, modifying the dosage or timing of administration, interrupting or discontinuing treatment, and suboptimal inhalation technique can weaken or even sever the causal link between prescription and exposure. Trigger and SAE management behaviors act on the subsequent components of the asthma management process. *Trigger management* can directly reduce trigger exposure by avoidance behaviors (eg, removing allergens from the immediate environment) or can moderate the relationship between trigger exposure and SAE occurrence by remedial behaviors (eg, reliever inhaler use). *SAE management* behaviors (eg, using reliever inhalers, administering nebulized medication, requesting emergency services) can reduce the severity and duration of an SAE, and thus influence the impact of an SAE on the patient's HRQoL. Self-monitoring of asthma symptoms (*symptom monitoring*) offers patients feedback on the effects of prior behaviors, and thus influences asthma outcomes indirectly via medication adherence and trigger management. These 4 types of behaviors are in turn influenced by a set of *behavioral determinants (m)*. These can be modifiable factors (eg, knowledge about adherence, illness beliefs, self-regulation skills) or nonmodifiable characteristics (eg, sociodemographics). As patient behaviors are essential to the success of asthma treatments, understanding what drives these behaviors is key to enhancing effective self-management.

**The health care professionals.** Health care services can influence asthma management in 2 main areas: directly on the asthma management process via *medical care (n)*, and indirectly on caregiver and patient behaviors via *behavioral care (o)*. The quality of medical care can be conceptualized as behaviors that strengthen the association between intrinsic and assessed asthma severity (ie, accurate diagnosis and review); and between assessed severity and prescribed drug exposure (ie, prescribing the appropriate treatment for the asthma severity level identified). The model stipulates that medical care is a necessary but not sufficient condition for treatment success. *Behavioral care* (also known as therapeutic education or self-management support) can have a major impact on treatment outcomes through influencing patient self-management. The model specifies that HCPs

influence determinants of patient and/or caregiver self-management behaviors through, for example, training inhaler technique, providing individualized asthma action plans, or assistance in identifying triggers. The performance of both medical and behavioral care is, just as for patients, influenced by *behavioral determinants (p)*. These can be modifiable factors (eg, HCPs' medical knowledge, communication skills, or access to training, equipment, and treatments), or nonmodifiable (eg, specialty, gender, age).

**Feedback loops.** The role of accurately assessing treatment outcomes and patients' behaviors in asthma care is modeled as *2 types of feedback loops* between these components and HCPs' and patients' behavior determinants. To the extent that *feedback on health outcomes* is regularly incorporated in follow-up consultations, it can have a positive effect on medical care as it informs the adjustment of asthma severity and corresponding treatment plan (step-up or step-down asthma severity and treatment prescription). *Feedback on patient behaviors* is also required for the correct interpretation of any changes in health outcomes and deciding which link in the causal sequence of asthma care is the best target for intervention. Similarly, patients would benefit in principle from assessing the effects of their behaviors regularly and using this information to adjust their behavior if needed.

## Research evidence, and implications for research and clinical practice

Developing the logic model enabled the conceptual categorization of the research literature in terms of its relevance for specific model components and relationships. Interpreted within this framework, the evidence points to specific research and clinical implications outlined in Table I and summarized below.

**From intrinsic to assessed severity (1).** Performing guideline-recommended activities such as applying comprehensive algorithms combining clinical assessment with objective tests is known to improve the accuracy of assessed asthma severity,[12] specified here as a moderating role of medical care on the link between intrinsic and assessed asthma severity. The assessment of severity remains a challenge, as asthma severity has proven difficult to define and measure, particularly to distinguish from asthma control.[13,14] Moreover, asthma misdiagnosis is still common, objective tests are often underused, and low agreement levels between HCPs are reported regarding diagnosis[15-18] despite several promising initiatives for improving diagnosis accuracy.[19,20] For adherence research, this implies that the accuracy of asthma severity assessment should ideally be accounted for or reviewed in study participants, as subsequent causal links may be weakened or severed by over- or underestimated severity. Improving the assessment of severity is a priority in asthma research. For the practitioner, reviewing asthma severity regularly via multiple guideline-recommended methods is a precondition for effective asthma care, as it allows a meaningful contribution of other patient, caregiver, and HCP behaviors.

**From assessed severity to prescribed drug exposure (2).** Asthma guidelines provide evidence-based treatment recommendations according to asthma severity steps, but HCP guideline nonadherence remains a challenge for asthma care.[21-23] Interventions for improving implementation of best practices show limited effects[24-26] and better strategies need to be developed and tested. Adherence studies need to assess and take into account prescribing practices. For practice, applying the stepwise approach to treatment prescription and reviewing prescribed treatment regularly to accommodate any changes in control would help tailor prescribed treatment to the appropriate asthma severity levels.[9]

**From prescribed to actual drug exposure—adherence and inhaler technique (3).** If assessment and prescription are appropriate, a good correspondence between the prescribed and actual exposure would ensure an optimal treatment effect. For inhaled medication, achieving the prescribed drug exposure involves adhering to recommendations regarding both use (timing and dosing) and technique (correct device use). When patients use inhalers less than prescribed and/or with poor technique, which often happens in practice,[27-29] this correspondence is reduced or nonexistent, with a negative impact on health.[2,30-32] The assessment of use and technique in research and clinical practice is usually based on scarce and less accurate information. Although electronic monitoring is the gold standard, its broader implementation still represents a challenge, and most studies rely on self-report or prescription and/or dispensing records[29,33] with few studies using multiple data sources.[34,35] Inhaler use is commonly evaluated via clinician checklist-based observation,[27,36] and only recently an integrated assessment of both aspects was developed that allows a more accurate assessment of their impact on actual versus prescribed drug exposure.[37] Given these considerations, both research and clinical practice should aim for comprehensive assessment of both use and technique, and tool development should continue to improve measurement validity and reliability.

**The impact of trigger exposure and management on asthma outcomes (4).** Guidelines recommend a systematic assessment of salient asthma triggers and enabling patients to manage triggers to improve asthma control.[6-10] Although the role of environmental triggers in asthma is well known and managing triggers has been linked to improved health outcomes,[38,39] trigger management has been less integrated in behavioral interventions and routine care.[40,41] Trigger sensitivity and exposure are rarely assessed in research and practice although valid instruments exist.[42,43] Research investigating the impact of adherence on asthma outcomes would ideally incorporate assessment of trigger exposure and trigger management actions performed, which would allow disentangling the impact of adherence from the role of triggers. In clinical practice, identifying salient triggers, inquiring systematically about possible exposure to triggers, and advising on strategies to avoid or reduce their impact could strengthen the impact of actual drug exposure on health outcomes.

**The role of symptom monitoring (5).** Recognizing symptoms and signs of deterioration is essential for managing asthma, because it guides remedial actions such as reliever use and trigger management; clinicians are encouraged to promote regular symptom monitoring as part of guided self-management.[9] Research on monitoring as a behavior in itself is however scarce and focuses on the effect of regular peak flow or symptom diary use on distal health outcomes[44-47] and rarely on proximal remedial behaviors.[48] Future research needs to investigate the role of symptom monitoring in asthma self-management and its association with other patient and/or caregiver behaviors. In

**TABLE I.** The logic model of asthma care (ACM-v1)—summary of research evidence and implications for research and clinical practice

| No. | Model component | What the literature shows | Research implications | Clinical implications |
|---|---|---|---|---|
| 1 | The relationship between intrinsic severity and assessed severity depends on the quality of medical care | Guideline-recommended care improves assessment accuracy; asthma severity proves difficult to define and measure; asthma misdiagnosis is still common; objective tests are underused; low agreement exists between HCPs | Take into account assessment accuracy in studies linking adherence and health outcomes; improve measurement of asthma severity | Assess and review asthma severity regularly via multiple guideline-recommended methods |
| 2 | The relationship between assessed severity and prescribed drug exposure depends on the quality of medical care | HCP nonadherence to guideline-recommended medication prescription remains a challenge; guideline implementation interventions are suboptimal | Develop and test new strategies for implementation of best practices; assess and take into account prescribing practices in adherence studies | Follow guideline-recommended step-wise approach to treatment prescription |
| 3 | The relationship between prescribed and actual drug exposure depends on patient and/or caregiver's regular use of medication and the correct use of inhaler devices | For inhaled treatment, medication use recommendations refer to dosing, timing, and device use; in asthma, these are often suboptimal, with negative impact on health; assessment of inhaler use and technique in research and clinical practice rely usually on scarce information | Consider using multiple tools to assess both use and technique; further develop electronic monitoring instruments to capture fine-grained data on adherence and thus on the link between prescribed and actual exposure | Assess both inhaler technique and use via state-of-the-art instruments to understand the link between prescribed and actual drug exposure |
| 4 | Trigger management influences trigger exposure and subsequently health outcomes | Trigger management is seldom addressed in routine care; there is limited research on its role on trigger exposure and health outcomes | Measure trigger management and exposure in adherence studies; investigate trigger management behaviors and their role in managing asthma | Identify relevant triggers and ask patients about exposure to these triggers to assess their impact on asthma control and SAE occurrence; check what strategies patients use to avoid or reduce the impact of relevant triggers |
| 5 | Symptom monitoring influences both adherence and trigger management | Symptom monitoring is a key component of guideline-recommended management; there is limited research on its effects, especially on adherence and trigger management | More research is needed on the role of symptom monitoring in asthma self-management in relation to adherence and triggers | Check if symptomatic patients use accurate methods to monitor symptoms and how they use this information to optimize adherence and trigger management |
| 6 | SAEs impact on patients' HRQoL, depending on how well they manage SAEs when they occur | Frequent SAEs impact on HRQoL; the degree to which SAE management by patients moderates the consequences of SAE is understudied | More research is needed on SAE management behaviors, and their role in managing asthma | Assess SAE and their impact on patients HRQoL, and what strategies patients are using to handle SAE |
| 7 | Patient and/or caregiver asthma management behaviors are driven by nonmodifiable and modifiable behavioral determinants, which may be behavior-specific or influence several behaviors | Determinants research focuses on implementation of prescribed medication use; their quality and theoretical basis is often suboptimal; limited evidence exists on determinants of other patient behaviors, and on caregiver behaviors | Investigate determinants of all patient and caregiver asthma management behaviors using state-of-the-art methodology and theory | Assess patients' knowledge, beliefs and/or motivation, self-management plans and/or strategies and skills, social support and/or perceived stigma in relation to performing key self-management behaviors |
| 8 | Behavioral care is the support delivered by HCPs to promote optimal asthma management by patients and caregivers | HCPs' adherence to guideline recommendations on behavioral care is low; effective self-management interventions are less implemented in routine care | Assess behavioral care in study settings to estimate its impact on asthma management | Support patient and caregiver behaviors by identifying and addressing key determinants of self-management |
| 9 | Modifiable and nonmodifiable factors influence the quality of medical and behavioral care | Internal and external influences on quality of care have been identified, but most studies show little theory use | Adapt theory-based models of HCP behavior from the implementation literature | Maintain professional training and identify gaps in knowledge and/or skills to identify training needs |

| | | | | |
|---|---|---|---|---|
| 10 | Information about behavioral outcomes and patient and/or caregiver behaviors should inform future courses of action, both for the patient and/or caregiver and the HCP | Guidelines recommend assessment of patient behaviors and behavioral outcomes to guide interpretation of treatment effects on asthma outcomes; it is yet unclear whether this happens, and what impact it has on asthma care | Investigate how behaviors and outcomes are assessed, interpreted, and combined to inform patient and/or caregiver and HCP decision making in routine care | Routinely assess patient and/or caregiver behaviors and behavioral outcomes to arrive at accurate interpretations of the impact of treatment on health outcomes |

*HCPs*, Health care professionals; *HRQoL*, health-related quality of life; *SAE*, severe asthma exacerbation.

clinical practice, asthma outcomes would be further improved by advising patients on using accurate methods to monitor symptoms to optimize adherence and trigger management.

**SAE management as moderator of SAE effects on HRQoL (6).** Guidelines recommend advising patients on appropriate symptom management actions when symptoms increase, including use of reliever inhalers and accessing emergency care, as part of personalized action plans.[6-10] Research demonstrated that frequent SAEs affect HRQoL negatively,[49,50] and health care utilization behaviors during SAE influence the success of medical interventions.[51] Yet, evidence in this area is scarce. Future research needs to isolate effective SAE management behaviors and their specific contribution in managing asthma. In clinical practice, inquiring about patients' SAE management strategies is necessary to assess the potential impact of SAEs on patients' HRQoL; educating patients on best strategies may reduce the effect of SAEs on patients' lives.

**Determinants of patient and/or caregiver asthma management behaviors (7).** An increasing body of evidence suggests that patient and/or caregiver asthma management behaviors are driven by nonmodifiable and modifiable behavioral determinants in both adults[1] and children.[52] These may be behavior-specific (eg, treatment beliefs influencing medication implementation[53]) or influence several behaviors (eg, illness beliefs[54]). However, the quality and theoretical basis of studies is often suboptimal,[1] and evidence is limited on determinants specific to inhaler technique, symptom monitoring, triggers, and SAE management. To our knowledge, no study has examined the impact of common determinants on multiple behaviors. Evidence on determinants of caregiver behaviors is also scarce and mostly focused on individual characteristics, and less on interactive processes.[55-57] There is an urgent need for high-quality, theory-informed studies on the determinants of all asthma management behaviors. In clinical practice, assessing patients' and caregivers' knowledge, motivation, and skills on managing their asthma (eg, as part of therapeutic patient education) would allow understanding the modifiable causes of suboptimal self-management.

**Behavioral care targets patient and/or caregiver behavioral determinants (8).** To promote optimal asthma management, HCPs need to perform specific behavioral care activities that target indirectly patient and/or caregiver behaviors via behavioral determinants. Although diagnosis and prescribing practices have been extensively investigated, research on asthma self-management support practices is limited, and focuses on either HCP guideline adherence[23,58-61] or developing self-management interventions.[62,63] Research into causes of medication adherence would also need to map the behavioral content of self-management support in current routine care and estimate its contribution to treatment outcomes. Supporting self-management via multiple activities (eg, developing individual action plans, demonstrating the correct inhaler use, encouraging reminders use) needs to be integrated in routine asthma care.

**Determinants of HCP asthma care behaviors (9).** The quality of routine medical and behavioral care is determined by modifiable and nonmodifiable factors that can be internal (eg, knowledge, motivation, skills)[58,59,64-67] or external (eg, time per patient, financial incentives).[59,64,66,68,69] Prior studies show

limited use of behavioral theory, despite widespread recognition of its value in implementation research.[70-72] Further research is needed to adapt existing HCP behavior models to asthma care. For clinicians, maintaining professional training on both medical and behavioral care would facilitate the provision of high-quality care.

**Feedback from health outcomes and patient and/or caregiver behaviors (10).** Clinical guidelines recommend assessment of patient behaviors to guide interpretation of treatment effects on asthma outcomes.[6-10] For example, comprehensive feedback can guide the clinician to target suboptimal drug exposure via medical care (eg, reconsider treatment via shared decision making[73,74]) or/and behavioral care (eg, improve inhaler technique via guided practice or inhaler adherence via reviewing recent inhaler use and discussing adherence-related barriers and goals[75,76]). It is yet unclear whether comprehensive feedback is obtained in routine care, and what is its impact on decision making for HCPs and patients and/or caregivers. Research needs to identify how behaviors and outcomes are assessed and interpreted jointly to inform decision making. Behaviors and behavioral outcomes need to be routinely assessed and combined to arrive at accurate interpretations of asthma outcomes.

## DISCUSSION

Based on guidelines, empirical literature, and patient, HCP, and expert input, a logic model of asthma care (ACM-v1) has been developed that highlights the contributions of patient, caregiver, and HCP behaviors to the causal sequence of asthma management. The ACM-v1 represents a much-needed contribution to asthma care, as it allows a theory-based integration of research and clinical care through several possible practical applications. First, it can be used to identify key gaps in our understanding of asthma management, and thus guide the focus of researchers and funders. Second, it can help researchers improve study design by guiding the selection of concepts and hypotheses to balance theoretical considerations with the resources available. In the ASTRO-LAB project,[5] for example, the ACM-v1 guided the selection of measurement tools and data collection procedures to allow insights into the asthma management process as well as patient, caregiver, and HCP behaviors and determinants. Third, HCPs can apply ACM-v1 to better understand the complex behavioral influences on asthma care, and select specific medical or behavioral care activities based on their expected impact on the process. Fourth, for those developing behavioral interventions to improve asthma care, ACM-v1 can guide the initial phase of needs assessment, based on which further work may select intervention objectives, behavior change methods, and produce program content, implementation, and evaluation procedures.[11,77] Hence, ACM-v1 could benefit the organization and advancement of both asthma care research and clinical practice.

ACM-v1 is ready for use in clinical care in 2 ways. First, the clinical implications outlined in Table I are adaptable to checklist or interview guide format to audit current practice, and can be used by clinicians and management staff to identify current strengths and goals for improvement in asthma care delivery in line with asthma guidelines. Second, clinicians may use the graphical representation of ACM-v1 as a case management tool to ensure that all relevant medical and behavioral support has been taken into account when providing care and interpreting treatment outcomes (eg, ascertain to what extent poor outcomes may be due to treatment decisions or patient behaviors). Moreover, it represents a framework in which communication tools for guideline implementation can be developed, and updates of asthma management guidelines can structure practice-based and research input and formulate recommendations and research needs. These practical applications await further testing.

The current ACM version is limited by the contextual constraints of its development—for use within the ASTRO-LAB study and predefined timelines—and by the availability of empirical data on specific components. Given the study focus on routine asthma care in a specific sociocultural context, the model selects primary moderators of asthma management and excludes details on each of these components, roles of other actors (eg, policy makers, administrators, or product developers), or health economic components. In line with IM methodology, it is designed to be complemented by specific determinant maps, which may depend on the characteristics of target groups (eg, age, health literacy, cultural context). Similarly, cost implications can be superposed on model components, following IM-based procedures for intervention evaluation. Moreover, ACM assumes a relatively stable model structure across different asthma populations, which requires further testing. Our targeted literature reviews indicated limited evidence for some components and therefore ACM-v1 would benefit from new empirical studies, which might confirm or suggest improvements of the model. Further systematic reviews and expert consensus studies are necessary to strengthen the model.

ACM-v1 represents an initial proposal for an integrative theoretical framework of asthma care combining medical and behavior change principles, and aims to facilitate the translation of research into clinical practice of the management of asthma, as an example of chronic (respiratory) condition. As such, it opens opportunities for improvement or adaptation to different research contexts and respiratory conditions.

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