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## An exploratory survey on the awareness and usage of clinical practice guidelines among clinical pharmacists



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## ABSTRACT

**Background:** The NHLBI has not developed clinical practice guidelines since 2007. As a result, multiple organizations have released competing guidelines. This has created confusion and debate among clinicians as to which recommendations are most applicable for practice.

**Objectives:** To explore preliminary attitudes, awareness, and usage of clinical practice guidelines in practice and teaching for hypertension, dyslipidemia and asthma among clinical pharmacists.

**Methods:** Clinical pharmacists across the US were surveyed electronically over a two week period in Spring 2019 regarding utilization and knowledge of practice guidelines for hypertension, dyslipidemia, and asthma. Clinical cases were included to evaluate application of guidelines. Descriptive statistics, Chi-square analysis, and Wilcoxon signed-rank test were conducted. Statistical significance level was set to 0.01 to account for multiple tests conducted on the same survey participants.

**Results:** Forty-eight, 34, and 28 pharmacists voluntarily completed hypertension, dyslipidemia, and asthma survey questions, respectively. Interactions by disease state ( $p < 0.001$ ) revealed more pharmacists (93%) reporting to have  $\leq 50\%$  patient load in managing asthma and more pharmacists (95%) had read the full summary/report of the most recent hypertension guideline. Primary reasons why the most recent guideline was not selected were also significantly different by disease state (interaction;  $p < 0.001$ ). For dyslipidemia and asthma, pharmacists had a higher mean rating of agreement ( $p < 0.007$ ) in having the most confidence in the most recent as compared to older guidelines. Proportionally more clinical cases were answered correctly (interaction;  $p < 0.001$ ) when pharmacists applied the most recent guideline for hypertension (84%), while the opposite outcome was found for asthma (27%).

**Conclusion:** While more pharmacists selected the most recent guideline for practice and teaching, there was inconsistent application of guidelines to clinical cases. Further studies with a larger representation of pharmacists are warranted to more definitively determine factors influencing guideline preference and usage.

## 1. Introduction

For generations, the National Heart, Lung, and Blood Institute (NHLBI) has issued clinical practice guidelines for the chronic management of blood pressure, dyslipidemia, and asthma. Over the past 10–15 years, several other organizations have developed guidelines of their own. This has resulted in multiple guidelines for individual diseases from different agencies that often lack agreement. Complicating this, in 2013, the NHLBI declared a refocus to “supporting and producing rigorous systematic reviews that can

then be used by other collaborating organizations to generate guideline products that serve the public interest”.<sup>1</sup> The long-trusted organization would no longer publish clinical practice guidelines. As a result, newer guidelines have been released with evolving evidence in the post-NHLBI era, oftentimes from multiple agencies. This has led to confusion among clinicians as to which guideline is “best” or considered the gold standard within disease states.

The NHLBI created the National High Blood Pressure Education Program (NHBPEP) in 1977, charging the Joint National Committee (JNC) to

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develop hypertension guidelines. With emerging evidence from clinical trials, new iterations were released over ensuing years, culminating in the publication of JNC-7 in December 2003.<sup>2</sup> By the time NHLBI declared their withdrawal from guideline development, members of the JNC-8 working group, appointed in 2008, had already spent several years working on the next iteration. Part of this panel submitted their work to a renowned medical journal in an attempt to become the next U.S. hypertension guideline. This resulted in “The 2014 Hypertension Guideline,” sometimes referred to as “JNC-8”.<sup>3</sup> Without endorsement by the NHLBI or other professional organizations, there was significant controversy over these recommendations.<sup>4</sup> As originally intended, the American College of Cardiology (ACC) and American Heart Association (AHA) collaborated with NHLBI in 2014 to create the most recent comprehensive hypertension guideline,<sup>5</sup> which was released in December 2017 (ACC/AHA 2017).

In 1985, the NHLBI introduced the National Cholesterol Education Program (NCEP) and the adult treatment panel (ATP) to publish their first cholesterol treatment guidelines, which were released in 1988.<sup>6</sup> In 2004, lead author, Scott Grundy, published the final version of ATP-III, with traditional emphasis on achieving LDL-cholesterol goals.<sup>7</sup> Following the announcement from NHLBI and unlike the “JNC-8” authors, the ATP-IV panel joined the ACC/AHA expert panel to complete new recommendations. Lead author, Neil Stone, released these guidelines in 2013, introducing major changes to the traditional practice philosophy.<sup>8</sup> Instead of LDL-cholesterol goals, proper statin intensity became the focus. In 2014, in response to the dynamic changes, the National Lipid Association (NLA) published recommendations<sup>9</sup> which largely resembled an evolved ATP-III document, even including Scott Grundy as a co-author, to provide a traditional alternative to the new philosophy introduced in the ACC/AHA 2013 guidelines. The U.S. Preventive Services Task Force (USPSTF) published updated guidance in 2015 on “Statin Use in Primary Prevention of Cardiovascular Disease in Adults”.<sup>10</sup> ACC released the “Expert Consensus Decision Pathway” update regarding non-statin therapy in 2016,<sup>11</sup> followed by a “focused update” in 2017<sup>12</sup> to highlight new data from the literature. This was endorsed by the NLA and started to combine treatment philosophies. Most recently, both Scott Grundy and Neil Stone published the ACC/AHA 2018 guidelines; continuing to bring the practitioners of each philosophy together for common consensus.<sup>13</sup>

The NHLBI convened the National Asthma Education and Prevention Program (NAEPP) to release their first set of guidelines “The Expert Panel Report” in 1991, with updates in 1997 (EPR-2), 2002 (update of EPR-2), and 2007 (EPR-3).<sup>14,15</sup> In 1993, NHLBI collaborated with the World Health Organization to create the Global Initiative for Asthma (GINA), with annual updates since 2002.<sup>16</sup> However, U.S. practitioners tended to defer to the EPR-3, many not acknowledging the international GINA guidelines. Despite GINA’s efforts, many countries still suffered suboptimal asthma management. This motivated a major revision in 2014 reflecting new asthma management evidence and algorithms to enhance implementation, resulting in GINA 2018<sup>16</sup> and subsequent annual iterations. In December 2020, NHLBI released the long-awaited update to its 2007 asthma guidelines.

### 1.1. Rationale

With the evolution and, sometimes controversy, over these guidelines, there is discord regarding standard use among clinicians. Staying-up-to-date is increasingly challenging for pharmacists as their role continues to evolve as medication therapy experts. Continuing education is a requirement of the pharmacy profession; however, studies have suggested that continuing education doesn’t necessarily change behavior or lead to better patient outcomes.<sup>17</sup> The pharmacy profession has implemented a continuous professional development (CPD) approach to teaching life-long learning in US pharmacy programs, although this is in the early stages of adoption. This is defined as an outcomes-focused learning cycle focused on improving professional practice performance.<sup>18</sup> In time, this method may be applied to continuing education programs to help pharmacists evaluate guideline appropriateness and guide optimal guideline selection.

Consequently, approaches to staying updated with the latest literature likely are still evolving and may not always be effective.

There are many unknowns when it comes to the current use and application of practice guidelines. These include, what factors do clinical pharmacists use to determine which new guideline is optimal for use? Individuals are likely to hold varying opinions and biases. Should practitioners simply use the most recent versions? Should they only use those endorsed by certain organizations? Which guidelines have included the most reliable evidence? Do practitioners only use new versions of guidelines they are already familiar with? It is important to inform clinical pharmacists of national practice trends in an effort to end discord among those in the profession and provide optimal patient care. Guidelines are meant to be used to assist with making proper clinical judgments, so a pharmacist must choose which one seems to be the best for that individual’s practice. Therefore, the objective of this exploratory study is to identify attitudes, awareness, and usage of clinical practice guidelines for hypertension, dyslipidemia and asthma among US clinical pharmacists since the withdrawal of the NHLBI from guideline development, in order to gain initial perspectives on factors influencing guideline selection from pharmacists across the country.

## 2. Methods

The University of Nebraska Medical Center (UNMC) and Southwestern Oklahoma State University (SWOSU) Colleges of Pharmacy jointly conducted this study. The study received IRB approval (017–19-EX) from UNMC in January 2019.

### 2.1. Design

A survey was created to determine demographics of participating clinical pharmacists; utilization and knowledge of guidelines for hypertension, dyslipidemia, and asthma; and ability of guideline application to clinical cases for each disease state [Appendix A]. This survey was designed to be administered at one-time as a cross-sectional, observational study to gain an initial snapshot of current guideline practices. There were 58 potential questions for the participants to answer, although they could choose to skip an entire topic (e.g. asthma) if they did not have clinical experience within that particular field. The format was a mixture of multiple choice and fill in the blank questions. For hypertension, pharmacists could select from JNC 7 (2003), JNC 8 (2014), or ACC/AHA (2017) guidelines; for dyslipidemia, choices included ATP III (2004), ACC/AHA (2013), NLA (2014), USPSTF (2016), ACC (2017), and ACC/AHA (2018); for asthma, the only two choices were ERP-3 (2007) and GINA (2018). Each disease state gave the pharmacist the option to type in their own preferred guideline in the event that it was not one of the pre-specified guidelines. Four cases were included in the survey for hypertension (as compared to one each for dyslipidemia and asthma) to incorporate the variety of patient histories and characteristics which would change the case answers.

Questions were modeled after previously validated surveys in studies by Virani<sup>19</sup> and Bucheit,<sup>20</sup> which surveyed clinicians’ understanding of cholesterol guidelines. Modifications were made to include relevancy to hypertension and asthma guidelines and clinical cases were created for all three disease states. Two of the investigators, who are practicing clinical pharmacist faculty at different institutions with experience in managing and teaching these three chronic disease states, constructed cases commonly encountered in practice, but which would have different solutions based on the guideline used. To assess the validity of the current survey, a group of ten local clinical pharmacists were consulted to review and pilot the survey to assess for appropriateness and to identify any common survey errors such as leading questions. The pilot data demonstrated consistent comprehension of questions among testers, as expected due to previous validation. The pilot data was not included in the analysis of the final data for the study.

#### 2.1.1. Participants and setting

This study utilized a voluntary sample design. The survey was emailed to approximately 2400 members of the American College of Clinical

Pharmacy (ACCP) Ambulatory Care Practice and Research Network (PRN). ACCP is a leading organization in clinical pharmacy practice, as nearly two-thirds have completed at least one year of residency training and two-thirds are Board certified by the Board of Pharmacy Specialties.<sup>21</sup> The Ambulatory Care PRN is comprised of clinical pharmacists with an emphasis on the provision of primary care for chronic diseases. This national organization is likely to encompass clinical pharmacists who have direct experience in managing hypertension, dyslipidemia and/or asthma. In adherence with the Ambulatory Care PRN rules for administration of electronic surveys, the survey was open to potential participants for a two-week period (January 28–February 10, 2019). The PRN members were initially emailed the survey link with a brief description of the study. A reminder email was sent as the two-week period neared its end.

Surveys were administered using Qualtrics software (Provo, UT), an online software platform used for data collection and analysis. This enabled the survey instrument to be distributed electronically and remotely to ACCP PRN pharmacists across the nation. At the start of the survey, potential study participants were provided with the purpose, sponsorship, and expectations of the study. They were also informed that there was no penalty for incorrect answers or non-participation. By proceeding with the survey, PRN members implied their informed consent to participate in the study. All submissions were anonymous, and all question responses were optional. No incentive was provided for participation to further maintain anonymity of survey respondents, which was important to minimize potential response bias.

### 2.1.2. Statistical analysis

Analyses were conducted for the subset of pharmacists who self-identified their practice within a particular disease state, and a pharmacist could answer questions for more than one disease state. Inter-response rates for disease states were determined. Data were summarized via descriptive statistics using means and standard deviations for age and frequencies and percentages for nominal responses. Categories were collapsed for time in practice ( $\leq 10$  years or  $> 10$  years) and to estimate the percentage of patients with whom they work to manage each disease state ( $\leq 50\%$  or  $> 50\%$ ). States in which pharmacists practiced were grouped into four regions (Northeast, Midwest, South, and Pacific/West) according to the statistical groupings of the U.S. Census.<sup>22</sup>

Univariate Chi-square analyses were conducted to compare results for the most recent guideline to older guidelines as selected by pharmacists or evaluate differences within each disease state. Expected frequencies were set to be equal among categories. Bivariate Chi-square analysis was used to test for interactions between disease states and other categorical variables. Expected frequencies were determined from the data using probability calculations.

Pharmacists rated their level of agreement to the statement, “I have the most confidence in the \_\_\_ guideline” using a five-point Likert scale of strongly agree (valued at 5) to strongly disagree (valued at 1). All pharmacists had the opportunity to answer this question for the most recent and for older guidelines. The Wilcoxon signed-rank test was used to compare results between the most recent guideline to older guidelines as rated by the same set of pharmacists. Results were summarized using means and standard deviations.

Statistical significance was set to 0.01 to account for the increased likelihood of finding significant outcomes when conducting multiple tests on the same data set. The  $n$  of 57 participants needed for the study was determined from the results of Bucheit,<sup>20</sup> and an online calculator<sup>23</sup> was used for sample size by inputting the proportion of pharmacists who were able to identify the four statin benefit groups (72%) versus a population value of 50% with a dichotomous primary endpoint. Results by Virani,<sup>19</sup> the other study used to create the survey for this study, were not applied to determine sample size due to there being an equal number of pharmacists who were able to identify the four statin groups. Due to the lack of control over sample size with a voluntary response design, the  $n$  needed to find a statistically significant outcome of pharmacists who selected the most recent guideline for treating hypertension, dyslipidemia, and asthma were also determined

*a posteriori* using an online calculator for sample size<sup>23</sup> by inputting the proportion found for the study group versus a population value of 50% with a dichotomous primary endpoint. All sample size calculations employed an alpha of 0.01 and 80% power. All data were analyzed using JASP (Version 0.11.0) [JASP Team (2019), Amsterdam, the Netherlands].

Confidentiality of online data was maintained by not generating any hard copies of the raw data and by safeguarding electronic files on a password protected computer in password protected files. No participant names were gathered from the survey, and potential identifying information such as gender, age, and location (i.e., state and primary practice setting) were analyzed and reported as separate factors. Although Qualtrics does provide an IP address, this information was omitted from working data files and was not used for any purpose. No individual responses were reported, and items having smaller responses (i.e., an individual survey respondent from one state) were generalized into broader categories (i.e., U.S. region).

## 3. Results

### 3.1. Demographics

Fifty-four pharmacists responded, resulting in a 2.3% response rate. Most pharmacists (89%) completed survey questions for hypertension ( $n = 48$ ) as compared to dyslipidemia ( $n = 34$ ; 63%) and asthma ( $n = 28$ ; 52%). Thirty pharmacists who completed hypertension questions also completed those for dyslipidemia, and 27 pharmacists who completed dyslipidemia questions also completed those for asthma. Overall, 23 pharmacists completed questions for all three disease states, and 35 pharmacists completed questions for two of the three disease states.

The average age of all survey participants was  $34.8 \pm 7.7$  years, and, across disease states, proportionally more pharmacists practiced  $\leq 10$  years ( $p \leq 0.121$ ) (Table 1). Significantly more female pharmacists ( $p < 0.008$ ), more pharmacists from a Family Practice/Primary Care clinic ( $p < 0.001$ ), and more pharmacists both teaching in classrooms and precepting students ( $p < 0.001$ ) completed survey questions across disease states. Across disease states, more pharmacists tended to hold a BCACP certification ( $p < 0.098$ ) and proportionally more pharmacists were from the Midwest ( $p = 0.050$ ). However, no differences were detected for other board certifications ( $p > 0.386$ ) or among practice settings ( $p > 0.836$ ). The only significant interaction for demographics ( $p = 0.005$ ) was detected between disease state and estimated percentage of patients with whom pharmacists worked to manage each disease state ( $>50\%$  vs.  $\leq 50\%$ ); this was due to significantly more pharmacists reporting to have  $\leq 50\%$  patient load in managing asthma ( $p < 0.001$ ) as compared to hypertension and dyslipidemia.

#### 3.1.1. Guideline selection and awareness for practice

Proportionally more pharmacists selected the most recent guideline for treating hypertension (ACC/AHA 2017 at 65%;  $p = 0.043$ ), dyslipidemia (ACC/AHA 2018 at 62%,  $p = 0.170$ ), and asthma (GINA 2018 at 67%;  $p = 0.083$ ) in practice as compared to using older guidelines (Table 2). Older guidelines selected for hypertension consisted of only JNC-8 (2014) and for asthma, only ERP-3 (2007). The 38% of pharmacists who selected older guidelines for dyslipidemia in practice consisted of 32% using ACC/AHA (2013), 3% ACC (2017), and 3% AACE (2017). *A posteriori* calculations<sup>23</sup> revealed that a total sample size of 134 (versus 48), 207 (versus 34), and 102 (versus 27), of pharmacists practicing in hypertension, dyslipidemia, and asthma disease states respectively, would have been needed to find significance at 1% alpha and 80% power using the outcomes found in this study.

A significant interaction was found ( $p < 0.001$ ) between disease state and for length of time the most recent guideline has been used (Table 3); there was a trend for the majority of pharmacists (74%) to have used the most recent guidelines for hypertension for  $>1$  year ( $p = 0.012$ ) whereas significantly fewer (9%) reported to have used the most recent guideline to treat dyslipidemia for  $>1$  year ( $p < 0.001$ ) and half (50%) reported to

**Table 1**  
Pharmacist and practice characteristics of survey respondents for each disease state.

	Hypertension n = 48	Dyslipidemia n = 34	Asthma n = 28	P value for the interaction <sup>a</sup>
<b>Pharmacist characteristics</b>				
Age, mean years (SD) <sup>b</sup>	34.2 (6.7)	34.9 (6.4)	35.3 (8.3)	0.775
Gender, n (%) <sup>b</sup>				0.894
Female	38 (79)	27 (79)	21 (75)	
Male	10 (21)	7 (21)	7 (25)	
P value within disease state <sup>§</sup>	< 0.001	< 0.001	0.008	
Time in practice, n (%) <sup>b</sup>				0.717
≤ 10 years	35 (73)	23 (68)	18 (64)	
>10 years	13 (27)	11 (32)	10 (36)	
P value within disease state <sup>§</sup>	0.001	0.036	0.121	
Board certifications, n (%) <sup>b</sup>				0.990
BCACP	22 (48)	16 (50)	11 (42)	
BCPS	11 (24)	9 (28)	8 (31)	
Both BCACP and BCPS	5 (11)	3 (9)	3 (12)	
None	8 (17)	4 (13)	4 (15)	
No response	2	2	2	
P value within disease state <sup>§</sup>	0.002	0.004	0.098	
Other certifications, n (%) <sup>b</sup>				0.710
Yes	21 (44)	16 (47)	15 (54)	
No	27 (56)	18 (53)	13 (46)	
P value within disease state <sup>§</sup>	0.386	0.732	0.705	
<b>Practice characteristics</b>				
Practice specialty, n (%) <sup>b</sup>				0.882
Family practice/primary care	39 (81)	28 (82)	24 (86)	
Other: ambulatory care, anticoagulation clinic, community, internal medicine, managed care, pulmonology, women's health	9 (19)	6 (18)	4 (14)	
P value within disease state <sup>c</sup>	< 0.001	< 0.001	< 0.001	
Practice setting, n (%) <sup>b</sup>				0.956
Academic Medical Center	14 (29)	7 (21)	6 (21)	
Community Health Center	12 (25)	9 (26)	6 (21)	
Physician Group Practice	12 (25)	9 (26)	9 (32)	
Other: Community Pharmacy, Government Facility, Inpatient Community Hospital (non-academic), Integrated Health System, Rural Pharmacy, Private Practice	10 (21)	9 (26)	7 (25)	
P value within disease state <sup>c</sup>	0.881	0.950	0.836	
Estimated percentage of patients the respondent works with to manage the specific disease state, n (%) <sup>b</sup>				0.005
≤ 50%	28 (58)	21 (62)	26 (93)	
>50%	20 (42)	13 (38)	2 (7)	
P value within disease state <sup>§</sup>	0.240	0.145	< 0.001	
Teaching responsibility, n (%) <sup>b</sup>				0.952
Academic Classroom	2 (4)	0 (0.0)	1 (4)	
Precept Students	18 (38)	14 (41)	11 (39)	
Both Academic Classroom and Precept Students	27 (56)	19 (56)	15 (54)	
Do not teach	1 (2)	1 (3)	1 (4)	
P value within disease state <sup>§</sup>	< 0.001	< 0.001	< 0.001	
Region of the United States in which practice, n (%) <sup>b, d</sup>				0.997
Midwest	20 (42)	12 (35)	11 (39)	
Northeast	7 (15)	6 (18)	5 (18)	
South	10 (21)	7 (21)	5 (18)	
Pacific and West	11 (23)	9 (26)	7 (25)	
P value within disease state <sup>§</sup>	0.050	0.481	0.330	

<sup>a</sup> Analysis of variance was conducted across disease states to evaluate whether mean age was different. Bivariate Chi Square Analysis investigated the interaction between disease state and demographic characteristic using probability calculations. Counts for “No response” were not included in totals. Alpha was set to 0.01.

<sup>b</sup> SD = Standard Deviation; n = number; % = percentages calculated using the total n of responses, not including counts of “No response.” “Other” responses were written in by respondents.

<sup>c</sup> Univariate Chi Square Analysis was conducted within disease state to evaluate whether study demographics of the observed counts were different than expected if equal. Counts for “No response” were not included in either statistical analysis or totals used to calculate percentages. Alpha was set to 0.01.

<sup>d</sup> States were grouped into regions as defined by the U.S. Census.<sup>22</sup>

have used the most recent asthma guideline for >1 year ( $P = 1.00$ ). Another significant interaction was found ( $p < 0.001$ ) between disease state and pharmacists' level of awareness of the most recent guideline; almost all (95%) pharmacists reported reading the summary/full report of the ACC/AHA 2017 hypertension guidelines ( $p < 0.001$ ). By comparison, 71% of pharmacists reported “reading the summary/full report” of the ACC/AHA 2018 lipid guidelines ( $P < 0.001$ ), while less than half (43%)

reported “reading the summary/full report” of the GINA 2018 asthma guidelines ( $p = 0.002$ ). In addition, 23% and 43% of pharmacists for dyslipidemia and asthma, respectively, reported “to be aware of some of the content of the most recent guidelines, but had not read the summary or the full report”.

When asked why they selected the most recent guidelines, pharmacists across all three disease states chose the top two reasons of “I agree with all

**Table 2**

Evaluation of the usage of clinical practice guidelines in practice, teaching, and the survey clinical cases.

	Hypertension <sup>a</sup>	Dyslipidemia <sup>a</sup>	Asthma <sup>a</sup>	P value for the interaction <sup>b</sup>
	n = 48	n = 34	n = 28	
<b>Guidelines used</b>				
<b>In Practice, n (%)<sup>c</sup></b>				0.922
Most recent guideline	31 (65)	21 (62)	18 (67)	
Older guidelines	17 (35)	13 (38)	9 (33)	
No response	0	0	1	
P value within disease state <sup>d</sup>	0.043	0.170	0.083	
<b>In Teaching, n (%)<sup>c</sup></b>				0.918
Most recent guideline	27 (75)	21 (72)	14 (78)	
Older guidelines	9 (25)	8 (28)	4 (22)	
Combination of recent and older guidelines	2	2	2	
Do not teach this disease state	3	2	7	
Do not teach	1	1	1	
No response	6	0	0	
P value within disease state <sup>d</sup>	0.003	0.016	0.018	
<b>In clinical cases, n (%)<sup>c</sup></b>				0.380
Most recent guideline	97 (67)	15 (54)	15 (68)	
Older guidelines	48 (33)	13 (46)	7 (32)	
No specific guidelines selected	20	6	6	
Did not answer case	27	0	0	
P value within disease state <sup>d</sup>	<0.001	0.705	0.088	

<sup>a</sup> The most recent guideline for hypertension was ACC/AHA (2017) and older guidelines only included JNC-8 (2014). For dyslipidemia, the most recent guideline was ACC/AHA (2018) and older guidelines included ACC/AHA (2013), ACC (2017), and AACE (2017). For asthma, the most recent guideline was GINA (2018) and older guidelines only included ERP-3 (2007).

<sup>b</sup> Bivariate Chi Square Analysis investigated the interaction between disease state and guideline selected using probability calculations. Counts for "Combination of recent and older guidelines," "Do not teach the disease state," "No response," "No specific guidelines selected," and "Did not answer case" were not included in statistical analysis. Alpha was set to 0.01.

<sup>c</sup> n = number; % = percentages calculated using the total n of responses, not including counts of "Do not teach the disease state," "Do not teach," "No response," and "Did not answer questions." For High Blood pressure, the 48 survey respondents could answer up to four clinical questions, resulting in a total n of 192.

<sup>d</sup> Univariate Chi Square Analysis was conducted within disease state to evaluate whether observed counts of the most recent guideline and the total of older guidelines were different than expected if equal. Counts for "Combination of recent and older guidelines," "Do not teach the disease state," "No response," "No specific guidelines selected," and "Did not answer case" were not included in either statistical analysis or totals used to calculate percentages. Alpha was set to 0.01.

or most of the recommendations compared to other guidelines" and "I always reference the most recently published guideline" (Table 3); these findings were significant ( $p < 0.001$ ). A significant interaction was found ( $p < 0.001$ ) between disease state and the reasons why pharmacists did not select the most recent guideline. For hypertension, the top two reasons were different from the other disease states; these included, "I do not agree with the treatment recommendations made in these guidelines," and "I am aware of the data but do not believe that it constitutes a guideline change as this time" ( $p < 0.001$ ). In contrast, the main reason that pharmacists were not using the most recent guideline for dyslipidemia or asthma was, "I am not very familiar with this guideline" ( $p = 0.002$ ).

Across disease states, pharmacists had a higher level of agreement to the statement that they "had most confidence in the most recent guidelines as compared to older guidelines" for hypertension ( $p = 0.097$ ), dyslipidemia ( $p = 0.001$ ), and asthma ( $p = 0.007$ ) (Table 3). For dyslipidemia, no difference in ratings were found when comparing mean agreement in confidence for the older guidelines of ACC/AHA (2013) versus ACC (2017) ( $3.3 \pm 1.1$  versus  $3.3 \pm 0.9$ , respectively;  $p = 0.893$ ). Therefore, their ratings were

composed by pharmacist and compared against the corresponding pharmacist rating for the most recent dyslipidemia guideline, ACC/AHA (2018). No specific rating statement was available in the survey for AACE (2017), due to this guideline having been typed in by one pharmacist as their preferred guideline for dyslipidemia practice.

### 3.1.2. Guidelines selection for teaching

Significantly more pharmacists who taught hypertension (75%) reported teaching the most recent guideline ( $p = 0.003$ ) (Table 2). Similarly, proportionally more pharmacists taught the most recent dyslipidemia (72%) and asthma (78%) guidelines ( $p < 0.02$ ). Two pharmacists reported teaching a combination of the most recent and older guidelines for all three disease states.

### 3.1.3. Guideline application to clinical cases

Participants were asked to apply guidelines to answer four clinical cases for hypertension with the appropriate blood pressure (BP) goal, one clinical case for dyslipidemia with the appropriate goal and treatment recommendation, and one clinical case for asthma with the appropriate treatment recommendation [Appendix A]. Significantly more pharmacists (67%;  $p < 0.001$ ) reported applying the most recent guideline (ACC/AHA 2017) as compared to older guidelines to answer the four hypertension survey cases (Table 2). Proportionally more pharmacists (68%,  $p = 0.088$ ) applied the most recent guideline (GINA 2018) to answer the asthma case. In contrast, only about half of the pharmacists applied the most recent guideline (ACC/AHA 2018) as compared to older guidelines to answer the dyslipidemia case (54% versus 46%;  $p = 0.705$ ). Of those using older guidelines for the dyslipidemia case, 36% applied ACC/AHA (2013) and 10% ACC (2017).

An interaction was detected ( $p < 0.001$ ) between disease state and correctness of response based on which guideline was selected to answer clinical cases (Table 4). There was a tendency ( $p = 0.011$ ) for more pharmacists to answer the four hypertension clinical cases correctly when referencing the most recent guideline (84% correct) as compared to when referencing the older guideline (65%). In contrast, there was a trend ( $p = 0.077$ ) for fewer pharmacists to recommend a correct pharmacotherapeutic agent when using the most recent guideline (53%) as compared to those using older guidelines for dyslipidemia (85%). Significantly fewer pharmacists answered the asthma case correctly when using the most recent guideline (27%) as compared to using the older guideline (100%).

Overall application of the most recent and older guidelines was inconsistent within pharmacists. In evaluating pharmacist selection of the most recent guidelines (Table 2), a numerically higher percentage of pharmacists reported to teach the most recent guideline across disease states (weighted average of 75%) as compared to practice (weighted average of 64%) or clinical case application (weighted average of 65%). Proportionally fewer pharmacists applied the most recent guideline to the dyslipidemia clinical case (54%) as compared to hypertension and asthma cases. Several pharmacists did not indicate specific guidelines for their recommendations across disease states, and 14% of the possible 192 recommendations were unanswered for the hypertension survey cases. For the hypertension clinical cases, only 16 pharmacists consistently used the most recent guideline across all four clinical cases, while 8 pharmacists used the older guideline for all cases and 16 pharmacists used a combination of the most recent guideline with the older guideline and/or selected no specific guideline. The breakdown of pharmacists answering each hypertension clinical case revealed a lower percentage of pharmacists using the most recent guideline to answer case 4 as compared to the previous three cases (46% versus 63% weighted average), while more pharmacists did not specify the guideline they used for case 4 (29% versus 6% weighted average). Proportionally fewer pharmacists answered hypertension case 2 correctly when using the most recent guideline (70% versus weighted average of 88%), while fewer answered case 3 correctly when applying the older guideline (29% versus weighted average of 79%). Agreement upon a BP target for each question ranged from 46 to 63%, with most pharmacists recommending  $< 130/80$  or  $< 140/90$  mmHg across the four hypertension clinical cases.

**Table 3**  
Evaluation of pharmacist attitudes and awareness of clinical practice guidelines.

	Hypertension <sup>a</sup>	Dyslipidemia <sup>a</sup>	Asthma <sup>a</sup>	P value for the interaction <sup>b</sup>
	n = 48	n = 34	n = 28	
Length of time the most recent guideline has been used, n (%) <sup>c</sup>				< 0.001
>1 year	20 (74)	2 (9)	9 (50)	
< 1 year	7 (26)	20 (91)	9 (50)	
No response	4	0	1	
N/A/ – Using an older guideline	17	12	9	
P value within disease state <sup>d</sup>	0.012	< 0.001	1.000	
Pharmacists' knowledge of the most recent guideline, n(%) <sup>c</sup>				< 0.001
I have read the summary/full report.	40 (95)	24 (71)	12 (43)	
I am aware of some of the content, but have not read the summary or the full report.	1 (2)	8 (23)	12 (43)	
I am aware of its existence, but not aware of its contents.	1 (2)	1 (3)	1 (3)	
I am not aware of this guideline.	0 (0)	1 (3)	3 (11)	
No response	6	0	0	
P value within disease state <sup>d</sup>	< 0.001	< 0.001	0.002	
Reasons why the most recent guideline was selected, n (%) <sup>c</sup>				0.825
I agree with all or most of the recommendations compared to other guidelines.	12 (44)	12 (55)	9 (50)	
I always reference the most recently published guideline.	12 (44)	8 (36)	8 (44)	
I do not agree with some or all of the recommendations in other guidelines.	1 (4)	1 (4)	0 (0.0)	
It is the easiest to follow among the other published guidelines.	1 (4)	0 (0.0)	1 (6)	
The clinic or organization I am employed at has mandated use of this guideline.	0 (0)	1 (4)	0 (0)	
Other: Providers prefer	1 (4)	0 (0)	0 (0)	
No response	4	0	1	
N/A – Using an older guideline	17	12	9	
P value within disease state <sup>d</sup>	<0.001	<0.001	<0.001	
Reasons why the most recent guideline was not selected, n (%) <sup>c</sup>				< 0.001
I do not agree with the treatment recommendations made in these guidelines.	8 (35)	0 (0.0)	0 (0.0)	
I am aware of the data but do not believe that it constitutes a guideline change at this time.	6 (26)	0 (0.0)	1 (8)	
The providers at my clinic do not use these guidelines and, therefore, I do not either.	4 (17)	1 (8)	2 (17)	
I am not very familiar with this guideline.	1 (4)	6 (50)	7 (58)	
The quality measures in my workplace do not align with these guidelines.	2 (9)	0 (0)	0 (0.0)	
I am not aware of the data supporting these guidelines.	0 (0.0)	1 (8)	1 (8)	
I do not have time to read guidelines.	0 (0.0)	0 (0)	1 (8)	
Other: Recommendations made on a smaller / less inclusive body of evidence	2 (9)	0 (0)	0 (0)	
Other: Use the most recent guideline combined with the new guideline.	0 (0)	2 (17)	0 (0)	
Other: Too new / Still reviewing the changes.	0 (0)	2 (17)	0 (0)	
No response	3	2	0	
N/A - Using the most recent guideline	31	22	9	
P value within disease state <sup>d</sup>	<0.001	0.002	<0.001	
Pharmacists' level of agreement to having the most confidence in the specified guideline, mean rating (SD)				–
Most recent guideline	3.9 (0.9)	4.0 (0.8)	3.9 (0.7)	
Older guidelines	3.4 (1.3)	3.3 (0.7)	3.1 (1.0)	
No response, n	13	2	2	
P value within disease state <sup>d</sup>	0.097	0.001	0.007	

Alpha was set to 0.01.

<sup>a</sup> The most recent guideline for hypertension was ACC/AHA (2017) and older guidelines only included JNC-8 (2014). For dyslipidemia, the most recent guideline was ACC/AHA (2018) and older guidelines included ACC/AHA (2013), ACC (2017), and AACE (2017). For asthma, the most recent guideline was GINA (2018) and the older guidelines only included ERP-3 (2007).

<sup>b</sup> Bivariate Chi Square Analysis investigated the interaction between disease state and pharmacist attitudes or awareness of clinical practice guidelines. Counts for “Do not teach the disease state,” “No response,” and “Did not answer questions” were not included in totals. No comparison across diseases states was made for pharmacist's level of agreement in having the most confidence in a guideline.

<sup>c</sup> SD = Standard Deviation; n = number; % = percentages calculated using the total n of responses, not including counts of “No response” and “N/A - Using the most recent guideline.” Survey respondents could choose more than one response for reasons why or why not the most recent guideline was selected.

<sup>d</sup> Univariate Chi Square Analysis was conducted within disease state to evaluate whether the observed counts of pharmacist attitudes or awareness were different than expected if equal. Counts for “No response,” and “N/A - Using the most recent guideline” were not included in totals. Wilcoxon signed-rank test investigated the difference in agreement to having a high confidence level (5 = Strongly agree to 1 = Strongly disagree) in the most recent as compared to older guidelines when rated by the same pharmacists. Alpha was set to 0.01.

### 3.1.4. Factors that influence overall adoption of new guidelines into clinical practice

Thirty-five pharmacists (65% of the 54 survey respondents) answered the final survey questions (data not shown) – these pharmacists had answered survey questions for two out of the three disease states. Proportionally, more pharmacists (n = 25/35, 71.4%, p = 0.017) reported to adopt new guidelines into clinical practice within six months of release or as soon as they have a chance to read them. Four primary reasons influenced their adoption of new guidelines into practice; these included: (1) “If they agree with it” (65.7%), (2) “ease of use” (51.4%), (3) “after learning

about it from a reliable organization” (51.4%), and (4) “if my clinic/organization mandates it” (42.9%).

## 4. Discussion

Clinical pharmacists are required to uphold the highest standards of integrity and honesty, always working in the best interest of patients. They must commit to lifelong learning, self-assessment, and self-development, as well as providing professional education to other healthcare professions.<sup>24</sup> It is vital to know which compilations of evidence are most

**Table 4**

Evaluation of the correctness of responses to the survey clinical cases based on practice guideline selected or the most recent guideline for each disease state.

	Hypertension <sup>†</sup>	Dyslipidemia <sup>a</sup>	Asthma <sup>a</sup>	P value for the interaction <sup>b</sup>
	n = 192	n = 34	n = 27	
Based on guideline selected, n (%) <sup>c</sup>				<0.001
Most recent guideline - Correct	81 (84)	8 (53)	4 (27)	
Most recent guideline - Incorrect	16 (16)	7 (47)	11 (73)	
Older guidelines - Correct	31 (65)	11 (85)	7 (100.0)	
Older guidelines - Incorrect	17 (35)	2 (15)	0 (0.0)	
No specific guideline selected	20	6	6	
Did not answer case	27	0	0	
P value within disease state <sup>d</sup>	0.011	0.077	0.001	

<sup>a</sup> The most recent guideline for hypertension was ACC/AHA (2017) and older guidelines only included JNC-8 (2014). For dyslipidemia, the most recent guideline was ACC/AHA (2018) and older guidelines included ACC/AHA (2013), ACC (2017), and AACE (2017). For asthma, the most recent guideline was GINA (2018) and the older guidelines only included ERP-3 (2007). For High Blood pressure, the 48 survey respondents could answer up to four clinical questions, resulting in a total n of 192.

<sup>b</sup> Bivariate Chi Square Analysis investigated the interaction between disease states and correctness of response based on guideline applied to survey clinical cases. Counts for “No specific guideline selected” and “Did not answer case” were not included in totals. Alpha was set to 0.01.

<sup>c</sup> n = number; % = percentages calculated using the total n of responses, not including counts of “No specific guideline provided” and “No response.” Total n for Hypertension was higher due to four clinical questions being asked in the survey as compared to one for Dyslipidemia and Asthma.

<sup>d</sup> Bivariate Chi Square Analysis within disease investigated the interaction between guideline selected and correctness of response. When the recommendation from the most recent guideline was used only, univariate Chi Square Analysis was conducted within disease state to evaluate correctness of response. Counts for “No specific guideline selected” and “Did not answer case” were not included in totals. Alpha was set to 0.01.

valid to ensure proper teaching and modeling of practice. With the cessation of NHLBI producing guidelines, several different organizations have published practice recommendations within respective disease states over the last ten years. Having multiple guidelines for a single disease can clearly cause confusion, debate, and even legal ramifications. It can be difficult for clinicians to keep up with the most current literature, especially for a broad variety of chronic disease states. Many rely on the expert summation of evidence-based practice guidelines. While personally reviewing the evidence is always best, many pharmacists would benefit from knowing their peers' trusted sources. Therefore, this survey was used to explore how clinical pharmacists are incorporating these guidelines into their practices and serves as a pilot to future related studies.

These preliminary results suggest the majority of pharmacists reported using the most recent guidelines in practice and teaching, although with variable rates. A higher proportion of pharmacists reported using the most recent guideline for hypertension for more than one year as compared to dyslipidemia and asthma. However, both dyslipidemia and asthma guidelines were released in 2018 and therefore at the time of this survey, had only been published for <1 year. The reasons for referencing the most recent guideline were similar across all three disease states, whereas reasons for not using the most recent guideline was different for hypertension as compared to dyslipidemia and asthma. In addition, pharmacists' knowledge of the most recent guideline varied across disease state; the highest proportion of pharmacists had read the summary/full report for hypertension, but fewest for asthma.

Applicable to teaching, an article by Brown, highlighted the importance of educating pharmacy students to critically analyze the recommendations made in clinical practice guidelines vs simply trusting and memorizing them. This is emphasized since varying levels of evidence go into making each recommendation and some will be stronger than others, especially between a variety of guideline authors.<sup>25</sup> This strategy is an important skill set for future pharmacists to develop as multiple guidelines from varying organizations are published.

There was inconsistent application of the most recent guidelines in the clinical cases. This was especially apparent regarding asthma guidelines, where most respondents reported using GINA in practice, but then answered the case with ERP-3 recommendations. Moreover, for asthma, the lowest proportion of pharmacists answered the case study correctly when using the most recent guideline, whereas the highest proportion answered correctly when using the older guideline, as compared to hypertension and dyslipidemia.

Regarding the four hypertension cases, there were considerable differences in identifying the correct BP goal, despite the majority of pharmacists

referencing ACC/AHA 2017. While clinical pharmacists are known to excel at following guidelines, results suggest that pharmacists did not fully apply the new guidelines; there were different interpretations of the guidelines as they were applied to different clinical situations; and/or older recommendations were thought to still be current. This is similar to results also seen by Bucheit et al.<sup>20</sup> who found 92.3% clinical pharmacists reported reading the summary or full report of the 2013 ACC/AHA cholesterol guidelines but application of the guidelines showed less congruency with just 72.9% of clinical pharmacists able to identify the four statin benefit groups. Similarly, in a study by Lowenstern et al., clinician responses to hypothetical cases assessing for statin prescribing did not always agree with observed prescribing rates for similar clinical cases where agreement was highest at 64% among the statin benefit groups.<sup>26</sup> In our study, specific cases were used to highlight the differences in treatment recommendations depending on the guideline utilized. Our results further support the findings of Bucheit et al.<sup>20</sup> and Lowenstern et al.<sup>26</sup> that there are important knowledge and application gaps or even clinical inertia when applying clinical practice guidelines. Perhaps ingrained practice habits were difficult to overcome while trying to apply the most current guidelines to case questions. It is also possible that clinical pharmacists believed they should select the most current guidelines, because it is professionally expected to always be “up to date”. Practice habits in answering the survey's case questions, however, portrayed their true guideline allegiance. It is also possible some pharmacists blended recommendations from different guidelines or used clinical judgment based on an individual patient's situation. The use of clinical judgment was thought to be a major factor in a study by Ramsaran et al. that identified common reasons for non-adherence to the 2013 ACC/AHA cholesterol guidelines.<sup>27</sup> An article in the Journal of the American College of Cardiology recently highlighted the significant impact therapeutic inertia has on cardiovascular disease.<sup>28</sup> In this article, authors recognized that a more effective approach for educating clinicians on guidelines is to provide face-to-face education and feedback on the clinician's performance rather than just encouraging clinicians to familiarize themselves with practice guidelines. Future studies should focus on why pharmacists make recommendations that are not consistent with the latest guidelines (e.g. patient variables, personal experience, different interpretations of the guidelines, disagreement with some but not all guideline recommendations, etc.) and strategies for overcoming clinical inertia.

#### 4.1. Limitations

The primary limitation to this exploratory study was the low response rate. While a large pool of pharmacists was recruited via e-mail, this

study truly employed a voluntary response sample. That is, researchers made no direct or personal contacts with potential survey respondents, and did not include an incentive for participation. In addition, it is also not possible to know how many pharmacists actually received the survey email. Low response rate may also have been influenced by the ACCP PRN requirement of limiting the survey to a two-week period.

Another factor which may have reduced response rate was that this survey captured data on three chronic disease states that previously had published guidelines from NHLBI. It is possible that narrowing the survey to one single disease state would have made it more focused and, therefore, may have improved the number of clinicians who felt qualified to complete the survey. In addition, a smaller number of pharmacists completed the dyslipidemia and asthma portions of the survey. Presenting hypertension questions first in the survey could have contributed to this outcome. The higher response rate for hypertension also could be attributed to more pharmacists managing hypertension than asthma in practice, as related to the high prevalence of hypertension in the U.S.<sup>29</sup> Therefore, a larger follow-up study could include multiple surveys (one over each disease state) over longer survey periods, or even a separate study for each disease state.

It should be pointed out that it is common for response rates of web surveys to be lower than other survey modes.<sup>30</sup> In support of this, the National Pharmacist Workforce Study 2019<sup>31</sup> had a response rate of 5.8%, and a 2020 membership survey as conducted by the ACCP PRN had a response rate around 12% (B. Zobeck, personal communication, March 17, 2021). Coincidentally, 261 pharmacists responded Ambulatory Care as their primary employment practice setting in the National Pharmacist Workforce Study 2019, while 259 pharmacists responded to the 2020 ACCP PRN membership survey. Using the average of these as the number of pharmacists in this practice area who are willing to answer online surveys, then the calculation of response rate of this study increases from 2.3% to 18.5%.

In evaluating the demographics of the survey respondents who were recruited from the ACCP PRN, it was not surprising that a larger proportion in this study were females; this is similar to the finding by the National Pharmacist Workforce Study 2019<sup>31</sup> that the majority of pharmacists in full- and part-time practice were female. In contrast to the National Pharmacist Workforce Study 2019, this study found a higher percentage of survey respondents were from the Midwest and fewer were from the South. In addition, more survey respondents practiced in medical or hospital settings as compared to a community pharmacy setting<sup>31</sup> While the actual distribution of ACCP PRN pharmacists nationwide is not reported in the National Pharmacist Workforce Study 2019,<sup>31</sup> the difference of job setting is not surprising due to the nature of the work of Ambulatory Care pharmacists.

Pharmacists in this study were on average fairly early in their careers, with an average age in the mid-thirties and having practiced  $\leq 10$  years. Similarly, most respondents of the 2020 ACCP PRN membership survey had been members of the ACCP (77.2%) and Ambulatory Care PRN (83.0%) for less than ten years (B. Zobeck, personal communication, March 17, 2021). Likewise, the highest proportion of respondents to the National Pharmacist Workforce Study 2019<sup>31</sup> was found between 31 and 40 years old (28.9%). This also opens questions for further research: Are younger pharmacists more active in ACCP PRNs? Are younger pharmacists more likely to participate in online surveys? Were younger pharmacists taught some topics differently than older pharmacists; all would have learned asthma well after the NHLBI 2007 guidelines and would have known GINA, while more seasoned pharmacists still recall the older guideline? Do older pharmacists get “set in their ways”? Why did younger pharmacists claim to use GINA 2018, but went on to utilize the 2007 guidelines in the clinical cases? These questions should be explored in future research.

To account for multiple tests conducted on the same subjects, the significance level was lowered from the standard alpha of 0.05 to 0.01 to decrease the Type I error. Researchers recognized that a lower alpha decreased power, which was already lowered by the small sample size. However, this trade-off was deemed by the authors to be necessary, so that changing the response of one pharmacist was less likely to result in an incorrect significant finding. Overall, this exploratory study revealed important differences in pharmacist utilization and application of guidelines

despite its small sample size, which generates the impetus for further scholarly projects on this topic.

To our knowledge, this is the first study that has surveyed clinical pharmacists about all of the most recently published guidelines within a disease state. Despite the small sample size, overall survey results suggest clinical pharmacists may not always select the most recent practice guidelines, and application of guidelines is not always consistent. This is an important initial finding that warrants larger research efforts. Although clinical judgment is a part of practicing medicine, discord among use of practice guidelines across the profession is confusing for patients and clinicians. In all three of these disease states, different professional organizations have published guidelines over the last ten years. Instead of working separately, ideally organizations could come together to create a more unified approach that would enhance unity upon adoption of new iterations. This preliminary survey may generate future, larger studies focusing on each individual disease state. This survey also excluded prescribers such as physicians, advanced nurse practitioners, and physician assistants. These clinicians may have different experiences or answers, and, therefore, should be considered for future studies. In addition, researchers may investigate whether the reputation of individual organizations influences guideline adoption. As pay-for-performance measures are implemented, it is hypothesized this factor could further influence adoption of guideline-based recommendations, but again may cause some controversy based on which guideline is chosen if there are inconsistencies in clinical practice.

## 5. Conclusion and relevance

This exploratory survey of clinical pharmacists involved in the management of hypertension, dyslipidemia, and/or asthma explores the awareness, attitudes, and application of guidelines within each disease state. Although the majority of pharmacists reported using the most recent guidelines for practice and teaching, there is still substantial variability among application of the guidelines. Identifying practice trends can inform pharmacists to peer preferences. Identifying factors that most influence clinical pharmacists to utilize clinical practice guidelines can inform guideline authors and assist in implementation of future guidelines. Further studies are warranted to more definitively determine factors influencing guideline preference and usage.

## Declaration of Competing Interest

All authors confirm no disclosures for a conflict of interest.

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None.

## Appendix A. Appendix

### A.1. Hypertension Clinical Cases

Which blood pressure goal would you choose for the following patients?

1. 50 year-old adult male with 10-year ASCVD risk of 12%
2. 34 year-old adult female with 10-year ASCVD risk of 3%
3. 75 year-old adult male with CAD and no other comorbidities
4. 42 year-old adult female with diabetes and 10-year ASCVD risk of 5%

Answers and percent correct for each hypertension case by guideline:

1. < 130/80 and 89% (ACC/AHA 2017), < 140/90 and 86% (“JNC-8”)
2. < 130/80 and 70% (ACC/AHA 2017), < 140/90 and 80% (“JNC-8”)
3. < 130/80 and 87% (ACC/AHA 2017), < 150/90 and 29% (“JNC-8”)
4. < 130/80 and 89% (ACC/AHA 2017), < 140/90 and 70% (“JNC-8”)



### A.2. Dyslipidemia Clinical Case

What cholesterol treatment goal(s) and pharmacotherapy would you choose for the following patient?

1. 54 year-old adult male with hypertension and 10-year ASCVD risk of 12%, HDL = 43 mg/dL, LDL = 135 mg/dL, and non-HDL = 150 mg/dL.

Answers for dyslipidemia case by guideline:

1. Moderate intensity (ACC/AHA 2018), moderate to high intensity (ACC/AHA 2013)

### A.3. Asthma Clinical Case

1. In an adult with mild (intermittent) asthma, which of the following is the most appropriate treatment?

- a. Short-acting beta 2 agonist PRN
- b. Short-acting beta-2 agonist PRN AND low-dose inhaled corticosteroid scheduled
- c. Short-acting beta 2 agonist PRN AND low-dose inhaled corticosteroid scheduled AND long-acting beta 2 agonist scheduled
- d. None of the above

Answers for asthma case by guideline:

1. (b) Short-acting beta-2 agonist PRN AND low-dose inhaled corticosteroid scheduled (GINA 2018), (a) Short-acting beta-2 agonist PRN (EPR-3)

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