PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Patient financial incentives to improve asthma management: a systematic review
AUTHORS	Hine, Jasmine; Lee, Bohee; Bush, Andrew; De Simoni, Anna; Griffiths, Chris; Judah, G; Fleming, Louise

VERSION 1 – REVIEW

REVIEWER	Hohmann, Natalie S Auburn University - Harrison School of Pharmacy
REVIEW RETURNED	30-Dec-2022

GENERAL COMMENTS	Thank you for the opportunity to review this well-written manuscript. This study is a systematic review of published literature on financial incentives for asthma management. This is an important and interesting topic with implications for patient-centered care and public health. Study findings may be used by policymakers, clinics, or employers to inform the design of incentive-based programs to improve asthma medication adherence and other asthma management behaviors. Abstract: The abstract is well-written and makes sense. Conclusions follow from the results. If there is room in the word count, it may be helpful to add a description of the target population to the abstract's Eligibility Criteria section – for example, adults, adolescents, or children with asthma. Similarly, if there is room in the word count, it may be helpful to describe the types of study designs that were included – for example, RCTs, non-randomized interventions, cross-sectional descriptive studies, mixed methods studies, etc. Introduction: The introduction section is a good overview of the topic. It may be helpful to add definitions for each of the 9 domains in the financial incentives framework, for readers who are not familiar. Similarly, it may be helpful to describe a few examples of financial incentives in general, such as lotteries and contingency programs. Methods: The methods are appropriate for the study objective. Methods- Data Sources: The databases searched seem comprehensive and appropriate for the objective, and include grey literature. If hand-searched articles were included from the reference sections of eligible articles, it may be helpful to note that in this section, as well.

	Methods - Search Strategy: The search strategy seems comprehensive and is well-documented in the supplementary material. Methods – Eligibility Criteria: The eligibility criteria make sense and are organized into a PICOS format, which is easy to follow. Methods – Search Data Screening and Extraction: Procedures for data screening and extraction are sufficiently described. Methods – Risk of Bias: The instruments used to perform risk of bias assessments for RCTs and non-randomized interventions are described. It may be helpful to include a brief description of who performed the risk of bias assessments, such as the lead author, two independent investigators, etc. Methods – Synthesis: A narrative synthesis was performed, which makes sense and is appropriate given the heterogeneity of interventions and study designs. Results: Results are interesting and make sense. The results are organized according to asthma management behavior and financial incentive framework domain, which is helpful for readers and is a strength of this manuscript. When describing the asthma management behaviors in the Results section, it may be helpful to add some additional detail about the types of financial incentives that were used, to clarify which incentive types/structures were associated with changes in various asthma management behaviors and clinical outcomes. Similarly, if there is room in the word count it may be helpful to add some additional details about the clinical outcomes that were measured, as well as the asthma management behaviors (for example, the method used to measure medication adherence, such as Proportion of Days Covered [PDC]; or, the method used to measure attendance at asthma-related appointments, etc.). It may be helpful to add details about the participants to this section as well, to clarify which financial incentives/structures were associated with behavior changes in particular populations. When describing the financial incentives framework domains in the Results section, it may be helpful to add some additional detail in a few places. In the 'Target' sub-section, when stating that one study targeted an 'outcome' behavior, the authors may consider spelling out TSE as 'tobacco smoke exposure' again, for readers who may not be familiar and need a reminder. The summary of effective financial incentive domains is helpful. Discussion: The discussion section summarizes results of the review and compares and contrasts the study results to existing literature. Study strengths and limitations are discussed, as well as future research needs.

	In the sixth paragraph in the 'comparison with other studies' sub-section, it may be helpful to add some discussion of what other studies have found regarding impact of financial incentives on clinical outcomes for other diseases, if possible. Adding some discussion of the potential for interactions between different domains in the financial incentives framework may be helpful. For example, behavioral economics may suggest that smaller, more frequent rewards are preferred by some individuals compared to larger, more delayed rewards (an interaction between incentive magnitude and frequency). This may have implications for some of the findings discussed in the eighth paragraph of the 'comparison with other studies' sub-section. Conclusion: Conclusions make sense and follow from the results. It may be helpful to consider adding some additional detail to the conclusion to clarify the types of effective financial incentives found in this study, such as: "Studies that showed significant improvements in asthma management behaviors used 'positive gain', 'certain', 'fixed' financial incentives of smaller magnitude, given for 'all' instances of behaviour." Tables and Figures: Tables and figures are helpful and easy to read.

REVIEWER	Ji, Yunan Georgetown University
REVIEW RETURNED	21-Feb-2023

GENERAL COMMENTS	Thank you very much for a helpful and detailed review of the current literature on the impact of patient-side financial incentives in asthma management. I have two minor comments on the manuscript: 1. The current title "Financial incentives to improve asthma management" is ambiguous about the type of financial incentives. This paper surveys articles on patient-side (demand-side) incentives but there is a separate literature on supply-side incentives. It would be helpful to clarify this by changing the title to "Patient financial incentives..." or "Demand-side financial incentives...". 2. Since there is a large literature on financial incentives in health care, it would be helpful to have a longer discussion on why financial incentives might work differently for asthma than other conditions (e.g. perhaps because most incentives are targeted at the parents/guardians of CYP with asthma, as opposed to many other health conditions where the incentives may be directly target at the patient, etc.). A few words on what research on other health conditions have found would also help orient the reader.

REVIEWER	Kenyon, Chen Children's Hospital of Philadelphia
REVIEW RETURNED	07-Mar-2023

GENERAL COMMENTS	In this systematic review, the authors aim to summarize and critique the extant literature on the effect of financial incentive-based interventions on asthma management related behaviors. The author's search identified a small number of relevant articles, and their review highlights the characteristics of effective

	interventions and aims to evaluate the impact of financial-based incentives on processes and outcomes related to asthma. This review is well-written, clearly communicates the search strategies, uses an existing financial incentive intervention framework to critique and compare relevant studies, and effectively highlights/summarizes studies that utilize financial-based incentives to improve asthma-related behaviors. Furthermore, the authors effectively highlight the strengths and limitations of the review. However, there are some details that can be added or expanded upon that may make the review more comprehensive. Major Critiques: The sample size of included studies is quite limited at 8 studies. Providing financial incentives for asthma management behavior is a niche area of study, but it may be beneficial to expand the years that are searched to include 2022 or expand the inclusion criteria to include additional studies. For instance, did the authors use the reference sections of included studies to identify additional studies that may be relevant? They also mentioned reaching out to study authors for studies that were unavailable, but did they also recruit the assistance of a reference librarian who could assist with access to articles that were hard to find on-line or with standard institutional privileges. Furthermore, it should be noted in the limitation section that there are 4 studies that have the same/similar authorship in groups of 2 (the Baren et al. And Smith et al. Studies.) This study would benefit from a more robust explanation of socioeconomic demographic information that is provided in the highlighted studies, if any. As the authors of the review mentioned, the use of financial incentives may be more effective among individuals from lower socioeconomic backgrounds. The authors state that many of these studies were conducted in urban, minority communities – however these descriptions are not necessarily synonymous with lower socioeconomic background. This review may be more comprehensive if the authors provide details regarding socioeconomic status information provided in the articles that are presented, such as private versus government-issued insurance (Medicaid, etc.) in the US studies. Under the 'strengths and limitations' section, the authors mention the retention technique of reimbursing participants with a monetary reward. Hine et al., introduce an important point that this reimbursement may not illustrate a true representation of a control group's behavior. However, the authors do not mention the importance of compensating the control group in some way for the purpose of research ethics. Furthermore, given this consideration, the review may be more complete if the authors discuss what the other 5 studies did, if applicable, to compensate the control participants for their time and participation in the study. Given that the review's objective was to determine effective interventions and design characteristics for financial-based incentives, it would be great to include more specific objectives for future research, highlighting specific components of interventions that were deemed successful and potentially mentioning the need to stratify data based on the participants' age to determine what strategies are successful among children and young people.

	Minor Critiques: The two Smith et al studies followed similar procedures from the information included in Table 2, however one illustrated statistically significant results while the other did not. It would be interesting if the review authors described these studies more in detail to highlight what aspects of the study may have been different leading to the difference in significance that is noted between these studies, despite the similar approach. Page 14: Kenyon et al study: the authors state that the “financial incentive is contingent on full AM or PM dose of ICS inhaler detected by EMD” --> this is not correct, as stated. Review for accuracy/wording The description of the Jassal et al. article was difficult to follow in terms of the included participants (e.g. the urban triad population, the child triads, and control triads). It would be helpful if the review authors could detail this population more in terms of what the triads were and what was the inclusion criteria for this study in terms of tobacco use among the parents/caregivers/adult member of the triad, so that readers are able to more clearly understand the study design. The narrative synthesis approach was mentioned throughout the paper, it may not be clear to many readers what this means/represents. I believe the paper would benefit from additional details regarding the narrative synthesis approach and more details regarding the statistics that were evaluated during the review. Detailed Comments: Page 3, line 30: it may be beneficial to define the PICOS acronym in the abstract section, so that readers are aware of what this search strategy entails prior to reading. Page 5, lines 6-10: the authors begin the introduction section by highlighting the severity of asthma in the UK. However, 7/8 studies are conducted in the United States, so it may be beneficial to also highlight the severity of asthma and morbidity in the United States. Page 8, lines 27-35: the review may be more digestible if the authors include a 1-2 sentence summary of the purpose of a narrative synthesis, the approach, and any relevant citations. Page 9, line 17: the authors mention that four studies reported clinical outcomes and listed the citations that can be referenced, however, it may be easier for readers if the authors of the review briefly state what clinical outcomes were being assessed. Page 23-24 Lines 56-6: Sentences about inhaler technique and provider education, of which no included studies targeted are speculative/conjecture. Would jettison. Overall, the discussion is a bit long and could be tightened up. Page 24, lines 51-52: the authors state that financial incentives may be more effective when given to individuals from lower socioeconomic backgrounds and mention that this was found in several of the studies. While it may be true that these studies were

	conducted in lower SES populations (the authors should clarify whether this is indeed the case, as alluded to in the major comments above), the comparative nature of this assertion doesn't seem justified, as there appears to be no explicit comparison of low to high SES either within or between studies in this review suggesting this. The authors of the review may want to include more specific sociodemographic information, so that readers gain insight on specifics regarding the patient populations that were included.

VERSION 1 – AUTHOR RESPONSE

Reviewers Comments		**Responses**
1.0	***Reviewer: 1*** ***Dr. Natalie S Hohmann,*** ***Auburn University - Harrison School of Pharmacy*** Comments to the Author: Thank you for the opportunity to review this well-written manuscript. This study is a systematic review of published literature on financial incentives for asthma management. This is an important and interesting topic with implications for patient-centered care and public health. Study findings may be used by policymakers, clinics, or employers to inform the design of incentive-based programs to improve asthma medication adherence and other asthma management behaviors.	Thank you for these positive comments and the suggestions, all of which we appreciate and have provided responses below.
1.1	Abstract: The abstract is well-written and makes sense. Conclusions follow from the results. If there is room in the word count, **it may be helpful to add a description of the target population to the abstract's Eligibility Criteria section** – for example, adults, adolescents, or children with asthma. Similarly, if there is room in the word count, it **may be helpful to describe the**	Thank you for this comment, a description of the target population and study design has been added as follows: "Eligible articles assessed financial incentives to improve asthma management behaviours (attendance at appointments, medication adherence, tobacco smoke/allergen exposure, inhaler technique, asthma education) for asthma patients or parents/guardians of children with asthma. Eligible study design included: randomised controlled, controlled or quasi-randomised trials and retrospective/prospective cohort, case-controlled or pilot/feasibility studies"

	types of study designs that were included – for example, RCTs, non-randomized interventions, cross-sectional descriptive studies, mixed methods studies, etc.	(Page 2)
1.2	Introduction: The introduction section is a good overview of the topic. It **may be helpful to add definitions for each of the 9 domains in the financial incentives framework**, for readers who are not familiar.	A brief description of each financial incentives domain has been added to this section of the introduction as well as a brief definition of each domain as follows: "The framework proposes nine domains (direction (framing of financial incentive), form (type of financial incentive), magnitude (total value of financial incentive offered across intervention), certainty (likelihood of receiving financial incentive after behaviour), target (type of behaviour financial incentive aims to improve), frequency (proportion of behaviour financially incentivised), immediacy (how soon after behaviour financial incentive is given), schedule (value of financial incentive for each instance of behaviour), and recipient (to whom financial incentive is given to), all of which have various dimensions" (Page 4-5)
1.3	Similarly, it may be helpful **to describe a few examples of financial incentives in general,** such as lotteries and contingency programs.	A sentence on typical financial incentive programmes has been added to the introduction as follows: "Typically, financial incentive programmes consist of monetary rewards (cash/vouchers) or a chance to win a monetary reward (lottery-style prize draws) contingent upon behaviour" (Page 4)
1.4	Methods: The methods are appropriate for the study objective.	Thank you
1.5	Methods- Data Sources: The databases searched seem comprehensive and appropriate for the	Thank you for this comment; hand-searches of reference sections of eligible articles were conducted; this detail has been added to data

	objective, and include grey literature. **If hand-searched articles were included from the reference sections of eligible articles, it may be helpful to note that in this section,** as well.	sources as follows: “The reference lists of eligible articles were also hand-searched” (Page 5)
1.6	Methods - Search Strategy: The search strategy seems comprehensive and is well-documented in the supplementary material. Methods – Eligibility Criteria: The eligibility criteria make sense and are organized into a PICOS format, which is easy to follow. Methods – Search Data Screening and Extraction: Procedures for data screening and extraction are sufficiently described.	Thank you for all these positive comments about the methods.
1.7	Methods – Risk of Bias: The instruments used to perform risk of bias assessments for RCTs and non-randomized interventions are described. It **may be helpful to include a brief description of who performed the risk of bias assessments,** such as the lead author, two independent investigators, etc.	Thank you, initials of research team members who performed risk of bias has now been included as follows: “…and non-randomised studies were assessed using the Cochrane risk of bias in non-randomised studies of interventions (ROBINS-I) [21] by two researchers (JH, BL) independently” (Page 8)
1.8	Methods – Synthesis: A narrative synthesis was performed, which makes sense and is appropriate given the heterogeneity of interventions and study designs.	Thank you
1.9	Results: Results are interesting and make sense. The results are organized according to asthma management behavior and	Thank you

	financial incentive framework domain, which is helpful for readers and is a strength of this manuscript.	
1.10	When describing the asthma management behaviors in the Results section, **it may be helpful to add some additional detail about the types of financial incentives that were used, to clarify which incentive types/structures were associated with changes in various asthma management behaviors and clinical outcomes.** Similarly, if there is room in the word count **it may be helpful to add some additional details about the clinical outcomes that were measured, as well as the asthma management behaviors** (for example, the method used to measure medication adherence, such as Proportion of Days Covered [PDC]; or, the method used to measure attendance at asthma-related appointments, etc.). It may be helpful **to add details about the participants to this section as well,** to clarify which financial incentives/structures were associated with behavior changes in particular populations.	Thank you for these comments, I have added some further detail of a) types of financial incentives used for each asthma management behaviour, b) how asthma management behaviours were measured and c) which participants these interventions were targeting, as follows: *Attendance at asthma related appoints:* "All studies assessed attendance by self-report which was confirmed objectively by looking at medical records. Studies explored multicomponent interventions including financial incentives (transportation vouchers to patients/cash to parents) alongside free medication, reminders [27] and appointment time preferences [26] or asthma coaching [28,29]. There was mixed effectiveness; three studies showed significant benefit [26-28]. These were two studies providing transportation vouchers to patients [26,27] and one study providing cash to parents of children with asthma [29]" *Smoke/allergen exposure:* "One RCT testing financial incentives alone in the form of cash (given to maternal caregiver of child with asthma and one chosen member of social network who both actively smoke and contribute to child's tobacco smoke exposure, TSE) showed no effect on reducing passive TSE measured by mean change in monthly paediatric salivary cotinine levels [30]" *Medication adherence:* "Three non-randomised pre-post studies targeted medication adherence whilst also assessing feasibility/acceptability of financial incentives in the form of cash or vouchers given to patients (aged 5-18). All studies measured adherence using electronic monitoring devices and all interventions were multicomponent including financial incentives

		alongside electronic reminders [31], electronic reminders and weekly feedback [32] and electronic reminders, asthma education, tailored feedback, reinforcement, and other rewards [33]. Only one study showed significant improvement in adherence when providing cash [32]" (Pages 9-10) Clinical outcome measures are also detailed here from what was available in the papers. Additional detail at the beginning of the results section (end of study characteristics) has been added as follows: "Four studies reported clinical outcomes throughout the intervention including subsequent hospitalisations [26,32], asthma symptoms [28] and asthma control [33]; none of which demonstrated any significant improvements" (Page 9)
1.11	When describing the financial incentives framework domains in the Results section, **it may be helpful to add some additional detail in a few places.** In the 'Target' sub-section, when stating that one study targeted an 'outcome' behavior, the authors may consider spelling out TSE as 'tobacco smoke exposure' again, for readers who may not be familiar and need a reminder. The summary of effective financial incentive domains is helpful.	The word limit made it difficult to provide further detail; however, TSE was expanded as follows: "one study targeted an 'outcome' behaviour (tobacco smoke exposure, TSE [28])" (Page 10)
1.12	Discussion: The discussion section summarizes results of the review and compares and	Thank you for these positive comments about the discussion.

	contrasts the study results to existing literature. Study strengths and limitations are discussed, as well as future research needs.	
1.13	In the sixth paragraph in the 'comparison with other studies' sub-section, **it may be helpful to add some discussion of what other studies have found regarding impact of financial incentives on clinical outcomes for other diseases,** if possible.	Thank you for this comment. There are few studies that explore clinical outcomes; however, a few examples of studies that do explore this have been added and briefly discussed as follows: "More recent studies assessing financial incentives to improve paediatric diabetes self-management report findings of both self-management behaviours and whether this translates to changes in average blood glucose levels (HbA1c) [38-40]." (Page 14)
1.14	**Adding some discussion of the potential for interactions between different domains in the financial incentives framework may be helpful.** For example, behavioral economics may suggest that smaller, more frequent rewards are preferred by some individuals compared to larger, more delayed rewards (an interaction between incentive magnitude and frequency). **This may have implications for some of the findings discussed in the eighth paragraph of the 'comparison with other studies' sub-section.**	We have inserted a brief sentence on the possible interaction between the domains as follows: "It is possible that there is some interaction between domains which could contribute to the effectiveness of financial incentives but needs further exploration. For example, if frequent and smaller incentives are preferred compared to one large reward this may suggest interaction between magnitude and frequency. However, these interactions may also be person specific". (Page 15)
1.15	Conclusion: Conclusions make sense and follow from the results. **It may be helpful to consider adding some additional detail to the conclusion to clarify the types of effective financial incentives found in this study,** such as: "Studies that showed significant improvements in asthma management behaviors used 'positive gain', 'certain', 'fixed' financial incentives of smaller magnitude, given for 'all' instances of behaviour."	Thank you for this comment. Your suggested paragraph: "Studies that showed significant improvements in asthma management behaviours used 'positive gain', 'certain', 'fixed' financial incentives of smaller magnitude, given for 'all' instances of behaviour" has been added to conclusion. (Page 17)

1.16	Tables and Figures: Tables and figures are helpful and easy to read.	That's great, thank you.
2.0	***Reviewer 2*** ***Dr. Yunan Ji,*** ***Georgetown University*** Comments to the Author: Thank you very much for a helpful and detailed review of the current literature on the impact of patient-side financial incentives in asthma management. I have two minor comments on the manuscript:	Thank you for these positive comments and the suggestions below, all of which we appreciate.
2.1	1.The current title "Financial incentives to improve asthma management" is ambiguous about the type of financial incentives. This paper surveys articles on patient-side (demand-side) incentives but there is a separate literature on supply-side incentives. **It would be helpful to clarify this by changing the title to "Patient financial incentives..."** or "Demand-side financial incentives...".	Thank you for this comment, the title of the systematic review has been changed to: 'Patient financial incentives to improve asthma management: a systematic review" for clarity.
2.2	2. Since there is a large literature on financial incentives in health care, **it would be helpful to have a longer discussion on why financial incentives might work differently for asthma than other conditions** (e.g. perhaps because most incentives are targeted at the parents/guardians of CYP with asthma, as opposed to many other health conditions where the incentives may be directly target at the patient, etc.).	There is some discussion of the effects of financial incentives for different populations in both the introduction (as detailed here: "most studies provide financial incentives to adults to facilitate behaviour change that aim to improve their health or the health of their young children. However, there is a growing body of evidence for financial incentives given directly to CYP to facilitate their own healthy behaviour change - a recent review highlighted their benefits for healthy eating in school-aged children and improving glycaemic control in adolescents, with some studies showing long-term improvements for both these behaviours [17]" – page 4) and also within the results (as detailed within each asthma management behaviour (page 9-10) and within recipients domain of financial incentives framework (page 12)).

		However, to address how financial incentives work differently in asthma compared to other conditions would be speculative. We have inserted the following sentence to the introduction: “It is unknown as to whether or why financial incentives are effective in different conditions; however, little is known about financial incentive use in asthma care” (Page 5)
2.3	A few words **on what research on other health conditions have found** would also help orient the reader.	Thank you for this comment. As detailed above for one of Reviewer 1’s similar comment: There are few studies that explore clinical outcomes; however, a few examples of studies that do explore this have been added and briefly discussed as follows: “More recent studies assessing financial incentives to improve paediatric diabetes self-management report findings of both self-management behaviours and whether this translates to changes in average blood glucose levels (HbA1c) [38-40]. (Page 14)
3.0	***Reviewer 3*** ***Dr. Chen Kenyon*** ***Children's Hospital of Philadelphia*** Comments to the Author: In this systematic review, the authors aim to summarize and critique the extant literature on the effect of financial incentive-based interventions on asthma management related behaviors. The author’s search identified a small number	Thank you for these positive and constructive suggestions, all of which we appreciate and have provided some responses below.

	of relevant articles, and their review highlights the characteristics of effective interventions and aims to evaluate the impact of financial-based incentives on processes and outcomes related to asthma. This review is well-written, clearly communicates the search strategies, uses an existing financial incentive intervention framework to critique and compare relevant studies, and effectively highlights/summarizes studies that utilize financial-based incentives to improve asthma-related behaviors. Furthermore, the authors effectively highlight the strengths and limitations of the review. However, there are some details that can be added or expanded upon that may make the review more comprehensive.	
3.1	Major Critiques: The sample size of included studies is quite limited at 8 studies. Providing financial incentives for asthma management behavior is a niche area of study, **but it may be beneficial to expand the years that are searched to include 2022 or expand the inclusion criteria to include additional studies.**	We agree. An updated search to incorporate 2022 was conducted identifying 167 new articles, which were screened for eligibility by 2 members of the review team. However, no further eligible articles were identified. The updated search and screening figures have been added throughout the manuscript where appropriate, including the PRISMA flow diagram (Figure 1) and in the study selection within the results section (Page 8).
3.2	For instance, did the authors **use the reference sections of included studies to identify additional studies that may be relevant?**	Thank you for this comment. Yes, hand-searches of reference sections of eligible articles were conducted; this detail has been added to data sources as follows: “The reference lists of eligible articles were also hand-searched” (Page 5)

3.3	They also mentioned reaching out to study authors for studies that were unavailable, but **did they also recruit the assistance of a reference librarian who could assist with access to articles** that were hard to find on-line or with standard institutional privileges.	Thank you for this comment. A reference librarian was not used as all selected articles were obtained in their full text form. The only exceptions were abstracts-only submitted for conferences where no full text was available.
3.4	Furthermore, it should be **noted in the limitation section that there are 4 studies that have the same/similar authorship in groups of 2** (the Baren et al. And Smith et al. Studies.)	Thank you. This has been acknowledged as a limitation and a brief description has been added to strengths and limitations section of discussion as follows: In addition, the studies that targeted attendance at asthma-related appointments can be grouped into two; where studies are replications of each other from same/similar authorships but on larger scales [26,27 and 28,29] which could reduce generalisability of results. (Page 16)
3.5	This study would benefit from a **more robust explanation of socioeconomic demographic information that is provided in the highlighted studies, if any**. As the authors of the review mentioned, the use of financial incentives may be more effective among individuals from lower socioeconomic backgrounds. The authors state that many of these studies were conducted in urban, minority communities – however **these descriptions are not necessarily synonymous with lower socioeconomic background.** This review may be more comprehensive if the authors provide **details regarding socioeconomic status information provided in the articles that are presented, such as private versus**	Thank you for this comment, we agree a robust description of socioeconomic demographic information is needed. Additional detail has been identified from the studies and added to the recipients sub-heading in the results as follows: “All US studies targeted urban minority populations [26-30, 32,33]; four of which were also described as poor/low-income [26,28,29,30]. Three US studies specifically recruited participants with either government (e.g., Medicaid) or no insurance [28,29,33] and three studies reported participant health insurance at baseline, where between 73%-79% had government or no insurance [26,27,32] and one study reported >70% of participants’ annual income was below the poverty level [30]. The UK study had no inclusion criteria specific to ethnicity or socioeconomic status, but did recruit participants from the NHS (government-funded healthcare system) [31]”

	government-issued insurance (Medicaid, etc.) in the US studies.	(Page 12) Additional discussion has also been added of the effect of financial incentives upon lower socioeconomic groups: “There is some evidence to support this in our findings. Included US studies recruited from poor/low-income populations [26,28-30] or enrolled participants with primarily government-funded healthcare insurance [26-29,32,33] with majority offering smaller financial incentives [26-29,32,33]; five of which demonstrated asthma management behaviour change [26-28,32,33]. However, as there is no compairson of low to high socioeconomic status within or between studies, this concept needs further exploration” (Page 14-15)
3.6	Under the 'strengths and limitations’ section, the authors mention the retention technique of reimbursing participants with a monetary reward. Hine et al., introduce an important point that this reimbursement may not illustrate a true representation of a control group’s behavior. **However, the authors do not mention the importance of compensating the control group in some way for the purpose of research ethics.**	Thank you for this comment, we agree that compensating participants in the control group for the purpose of ethics is important. A sentence has been inserted as follows: “However, compensation for those randomised to a control group for their time and expenses incurred as part of the study (for example, travel to study visits) is important for research ethics. The three remaining randomised studies did not report any form of reimbursement for those in the control group [26-28]” (Page 16-17)
3.7	Furthermore, given this consideration, **the review may be more complete if the authors discuss what the other 5 studies did, if applicable, to compensate the control participants** for their time and participation in the study.	Thank you. There were 3 studies that reported financial compensation and details are included in the discussion, the remaining 3 studies that had control groups did not report any other compensation for these participants and the other 2 studies were non-randomised and therefore did not have a control group to reimburse.

		A brief summary of this has been added as follows: “Two studies included in this review adopted this technique by providing $20 reimbursement to parents/social network members for completion of each study visit [29,30]. One of these studies reimbursed parents in both the control and intervention (in addition to the money in the intervention) arm [29] whereas one study gave this reimbursement to control participants only [30]. One non-randomised study provided $15 to parents for enrolling their child in the programme [32]**.** Providing a financial reward to those in the control group may have altered engagement with the study, perhaps not giving a true representation of patient behaviour. However, compensation for those randomised to a control group is important for research ethics. The three remaining randomised studies did not report any form of reimbursement for those in the control group [26-28]” (Page 16-17)
3.8	Given that the review’s objective was to determine effective interventions and design characteristics for financial-based incentives, **it would be great to include more specific objectives for future research, highlighting specific components of interventions that were deemed successful** and potentially mentioning the need to **stratify data based on the participants’ age to determine what strategies are successful among children and young people.**	Thank you, we agree and some more detailed objectives for future research has been added as follows: “Similarly, it would be helpful for studies to stratify data based upon participant age and socioeconomic status to determine any financial incentive effectiveness differences. Cost-effectiveness should also be explored to assess the suitability of using financial incentives within standard clinical practice” (Page 17)
3.9	Minor Critiques: The two Smith et al studies followed similar procedures from the information included in Table 2, **however one illustrated statistically significant results while the other did not. It would be interesting if the review authors described these studies more in detail** to highlight what aspects of the	Thank you for this comment. These two studies are almost identical in study design; however, more discussion on this is provided as follows: “In addition, two studies conducted by similar research groups [28,29] only found one intervention to be significant [29]. Although interventions were similar in design, this difference in significance could have been related to the far smaller sample size for the significant study as well as all participants being

	study may have been different leading to the difference in significance that is noted between these studies, despite the similar approach.	offered a financial incentive, regardless of their group allocation" (Page 9)
3.10	Page 14: Kenyon et al study: the authors state that the "financial incentive is contingent on full AM or PM dose of ICS inhaler detected by EMD" --> **this is not correct, as stated. Review for accuracy/wording**	Thank you for spotting the error, apologies for this. This has been updated to financial incentive is contingent on 'each' dose not 'full' in financial incentives framework results table (now supplemental material 3)
3.11	The description of the Jassal et al. article was difficult to follow in terms of the **included participants (e.g. the urban triad population, the child triads, and control triads). It would be helpful if the review authors could detail this population more** in terms of what the triads were and what was the inclusion criteria for this study in terms of **tobacco use among the parents/caregivers/adult member of the triad,** so that readers are able to more clearly understand the study design.	Thank you, we agree this is confusing for the reader. Additional description of target population has been added to now supplemental material 2 (key study characteristics and results table) as follows: -Participants were recruited in triads inclusive of 1) children with asthma (2-12 years old), 2) their maternal caregiver and 3) adult member of caregiver/child's social network. -Maternal caregiver and social network member were active smokers who contributed to child's TSE. -No maternal caregiver/social network member age restrictions -Total number of participants (n=135) -Total number of triads inclusive of: maternal caregiver, social network member, child (n=45) -Urban population Some detail has also been added within the results section under tobacco/smoke exposure sub-heading as follows: "One RCT testing financial incentives alone in the form of cash (given to maternal caregiver of child with asthma and one chosen member of social network who both actively smoke and contribute to child's tobacco smoke exposure, TSE)…It

		was reported that only 1/90 adult participants (maternal caregivers/social network member) earned the maximum financial incentive, with an average earning of $100/$250 per month. All control triads (child, maternal caregiver and social network member) were given $20 reimbursement each month for study participation ($120 maximum)" (Page 10)
3.12	The narrative synthesis approach was mentioned throughout the paper, **it may not be clear to many readers what this means/represents.** I believe the paper would benefit from **additional details regarding the narrative synthesis approach and more details regarding the statistics that were evaluated during the review.**	Thank you for this comment, additional details of the purpose/aims of a narrative synthesis have been added as follows: "A narrative synthesis aims to combine and summarise findings from studies using text and is typically used when an meta-analysis is not appropriate [24]" (Page 8) All data was reported per individual study rather than any additional analysis and therefore the following has been amended: "Standardised metrics were used to present intervention effects per study such as p-values, mean differences, and odds ratios, dependent upon study analysis methods" (Page 8)
3.13	Detailed Comments: Page 3, line 30: it may be beneficial to **define the PICOS acronym in the abstract section,** so that readers are aware of what this search strategy entails prior to reading.	Thank you for this comment, further detail of the PICOS has been added to the abstract in addition to a description of asthma management behaviours as follows: "Eligible articles assessed financial incentives to improve asthma management behaviours (attendance at appointments, medication adherence, tobacco smoke/allergen exposure, inhaler technique, asthma education) for asthma patients or parents/guardians of children with asthma. Eligible study design included: randomised controlled, controlled or quasi-randomised trials

		and retrospective/prospective cohort, case-controlled or pilot/feasibility studies" (Page 2)
3.14	Page 5, lines 6-10: the authors begin the introduction section by highlighting the severity of asthma in the UK. However, 7/8 studies are conducted in the United States, so **it may be beneficial to also highlight the severity of asthma and morbidity in the United States.**	Some asthma statistics for the US have been added to the introduction as follows: "Asthma is one of the most common chronic conditions in the UK and the US affecting approximately 5.4 million individuals (4.3 million adults and 1.1 million children) [1] and 25 million individuals (almost 21 million adults and 4.8 million children), respectively [2] (Page 4)
3.15	Page 8, lines 27-35: the review may be more digestible if the authors **include a 1-2 sentence summary of the purpose of a narrative synthesis, the approach, and any relevant citations.**	Thank you for this comment, a sentence on the aim of a narrative synthesis has been added as follows: "A narrative synthesis aims to combine and summarise findings from studies using text and is typically used when an meta-analysis is not appropriate [24]" (Page 8)
3.16	Page 9, line 17: the authors mention that four studies reported clinical outcomes and listed the citations that can be referenced, however, **it may be easier for readers if the authors of the review briefly state what clinical outcomes were being assessed.**	Thank you, some more detail on the clinical outcomes has been added to the study characteristics section within the results as follows: "Four studies reported clinical outcomes throughout the intervention including subsequent hospitalisations [26,32], asthma symptoms [28] and asthma control [33]; none of which demonstrated any significant improvements" (Page 9)
3.17	Page 23-24 Lines 56-6: Sentences about **inhaler technique and provider education, of which no included**	The following sentences regarding inhaler technique and provider education have been removed: "This review found no studies using

	studies targeted are speculative/conjecture. Would jettison.	financial incentives to improve inhaler technique or asthma education. Healthcare professionals are primarily responsible for the provision of asthma education and assessing patient inhaler technique, suggesting they would be more likely to receive financial incentives compared to patients. Additionally, providing financial incentives to patients within this context may only be practical if encouraging engagement with these healthcare professional services, rather than engagement with the behaviour itself"
3.18	Overall, the discussion **is a bit long and could be tightened up.**	We have reviewed the discussion, to which obviously there have been additions in line with these helpful suggestions and tried to remove excess verbiage.
3.19	Page 24, lines 51-52: the authors state that financial incentives may be more effective when given to individuals from lower socioeconomic backgrounds and mention that this was found in several of the studies. While it may be true that these studies were conducted in lower SES populations (the authors **should clarify whether this is indeed the case, as alluded to in the major comments above), the comparative nature of this assertion doesn't seem justified, as there appears to be no explicit comparison of low to high SES either within or between studies in this review suggesting this.** The authors of the review **may want to include more specific sociodemographic information, so that readers gain insight on specifics** regarding the patient populations that were included.	Thank you again for this comment, as detailed in above comments additional detail of socioeconomic status has been added to this point in the discussion as follows: "There is some evidence to support this in our findings. Included US studies recruited from poor/low-income populations [26,28-30] or enrolled participants with primarily government-funded healthcare insurance [26-29,32,33] with majority offering smaller financial incentives [26-29,32,33]; five of which demonstrated asthma management behaviour change [26-28,32,33]. However, as there is no compairson of low to high socioeconomic status within or between studies, this concept needs further exploration." (Page 14-15) This concept has also been suggested as an area of future research as follows: "Similarly, it would be helpful for studies to stratify data based upon participant age and socioeconomic status to determine any financial incentive effectiveness differences" (Page 17)

VERSION 2 – REVIEW

REVIEWER	Hohmann, Natalie S Auburn University - Harrison School of Pharmacy
REVIEW RETURNED	02-May-2023

GENERAL COMMENTS	Thank you for the opportunity to review this interesting manuscript. The authors have sufficiently addressed the reviewer comments. In the Results section, it may be helpful to clarify some of the wording added in the revision. 1) For the sentence referring to the two papers by Smith and colleagues, it may be helpful to mention the difference in coaching location/timing for the interventions (asthma coaching via a telephone call 2-days and 5-days after the ED visit, versus asthma coaching in the ED). This article may be helpful: https://www.atsjournals.org/doi/full/10.1513/pats.p09st6 Original sentence: “Although interventions were similar in design, this difference in significance could have been related to the far smaller sample size for the significant study as well as all participants being offered a financial incentive, regardless of their group allocation.” Suggest revising to something like: “Although the financial incentives were similar in each study, the difference in statistical significance may be related to differences in the location and timing of the asthma coaching offered alongside the financial incentives (coaching via a telephone call 2-days and 5-days after an ED visit, versus coaching in the ED), as well as differences in sample size and incentivization of control-group participants." It may also be helpful to clarify this in the Table of the narrative synthesis results for the Smith et al. 2006 paper by mentioning that the coaching took place in the ED. Original phrase: “Intervention: Financial incentives ($15 - cheque) + asthma coaching” Suggest revising to something like: “Intervention: Financial incentives ($15 - cheque) + asthma coaching in the ED” 2) For the sentence summarizing the types of clinical outcomes examined in the studies (lines 33-36), it may be helpful to clarify the results for the study reporting changes in asthma symptoms. The sentence mentions that no studies demonstrated any significant improvements in clinical outcomes: “Four studies reported clinical outcomes throughout the intervention including subsequent hospitalisations [26,32], asthma symptoms [28] and asthma control [33]; none of which demonstrated any significant improvements.” In the Table of the narrative synthesis results for the Smith et al. 2004 paper, the Results column seems to suggest that there was a significant difference in asthma symptoms between groups. If this is the case, it would help to check the wording in the previous sentence quoted above and throughout the manuscript to make

	sure that the results for asthma symptoms are correct and consistent.

REVIEWER	Kenyon, Chen Children's Hospital of Philadelphia
REVIEW RETURNED	06-May-2023

GENERAL COMMENTS	The authors did a nice job of incorporating reviewer feedback. The review is both more detailed and easier for readers to understand, and I appreciate them updating their literature search. Below are some additional minor revisions that can be made. Page 6 of 72, line 14-15: this wording can potentially be improved Potential sentence restructure: “It is unknown as to if and why financial incentives are effective in different conditions, and little is known about financial incentive use in asthma care Page 6 of 72, line 40-42: this wording can potentially be improved “It was not appropriate or possible to involve patients or the public in the research design, conduct, reporting, or dissemination plans. Page 13 of 72, lines 9-19: it is great that the authors expanded upon the included sociodemographic information, however, this paragraph is difficult to follow given that several percentages are cited. It may be beneficial to break up the sentences more to allow the reader to digest the specifics of the insurance status percentages that the authors included. Page 15 of 72, line 55: include “total” before “financial incentive uptake” Page 16 of 72, line 4: this wording can potentially be improved to allow the sentence to flow “...which may contribute to determining why an intervention is or is not effective, or insight on ways to improve the intervention. Page 31, line 35-37 (table): in reference to the Kenyon et al article, the financial incentive is not contingent on full AM or PM dose of ICS inhaler detected by the electronic monitoring device --> this sentence is incorrect as written, it may be better to omit this sentence Children could still receive $0.25 if they took 1 of their 2 prescribed doses of their AM medication Page 33 of 72: Given that some of these studies are evaluating the acceptability/feasibility as their primary outcome (ie. the article by Kenyon et al.), the authors of this systematic review may want to highlight whether the outcome is primary or secondary.

VERSION 2 – AUTHOR RESPONSE

1	**Reviewer: 1** **Dr. Natalie S Hohmann, Auburn University -**	Thank you very much for taking the time to review this major revision to the manuscript and

	Harrison School of Pharmacy Comments to the Author: Thank you for the opportunity to review this interesting manuscript. The authors have sufficiently addressed the reviewer comments.	for your positive and constructive comments in this second review. Please below the changes made as per your suggestions.
1.1	In the Results section, it may be helpful to clarify some of the wording added in the revision. For the sentence referring to the two papers by Smith and colleagues, it may be helpful to mention the difference in coaching location/timing for the interventions (asthma coaching via a telephone call 2-days and 5-days after the ED visit, versus asthma coaching in the ED). This article may be helpful: https://www.atsjournals.org/doi/full/10.1513/pats.p09st6 Original sentence: “Although interventions were similar in design, this difference in significance could have been related to the far smaller sample size for the significant study as well as all participants being offered a financial incentive, regardless of their group allocation.” Suggest revising to something like: “Although the financial incentives were similar in each study, the difference in statistical significance may be related to differences in the location and timing of the asthma coaching offered alongside the financial incentives (coaching via a telephone call 2-days and 5-days after an ED visit, versus coaching in the ED), as well as differences in sample size and incentivization of control-group participants."	Thank you for this comment, the revised sentence you suggested has been added to the results section: “Although the financial incentives were similar in each study, the difference in statistical significance may be related to differences in the location and timing of the asthma coaching offered alongside the financial incentives (coaching via a telephone call 2-days and 5-days after an ED visit, versus coaching in the ED), as well as differences in sample size and incentivisation of control-group participants." (page 9)
1.2	It may also be helpful to clarify this in the Table of the narrative synthesis results for the Smith et al. 2006 paper by mentioning that the coaching took place in the ED. Original phrase: “Intervention: Financial incentives ($15 - cheque) + asthma coaching”	Thank you, I have added your suggested revision to the table of the asthma management behaviour results (Supplemental Material 2).

	Suggest revising to something like: “Intervention: Financial incentives ($15 - cheque) + asthma coaching in the ED”	
1.3	For the sentence summarizing the types of clinical outcomes examined in the studies (lines 33-36), it may be helpful to clarify the results for the study reporting changes in asthma symptoms. The sentence mentions that no studies demonstrated any significant improvements in clinical outcomes: “Four studies reported clinical outcomes throughout the intervention including subsequent hospitalisations [26,32], asthma symptoms [28] and asthma control [33]; none of which demonstrated any significant improvements.” In the Table of the narrative synthesis results for the Smith et al. 2004 paper, the Results column seems to suggest that there was a significant difference in asthma symptoms between groups. If this is the case, it would help to check the wording in the previous sentence quoted above and throughout the manuscript to make sure that the results for asthma symptoms are correct and consistent.	Thank you very much for this comment. This has been updated to: “Four studies reported clinical outcomes throughout the intervention including subsequent hospitalisations [26,32], asthma symptoms [28] and asthma control [33]. Only one study showed a significant difference in decrease of asthma symptoms post-intervention between control and intervention; however, this difference was not sustained at 6-month follow-up [28].” (page 9)
2	**Reviewer: 3** **Dr. Chen Kenyon, Children's Hospital of Philadelphia** Comments to the Author: The authors did a nice job of incorporating reviewer feedback. The review is both more detailed and easier for readers to understand, and I appreciate them updating their literature search. Below are some additional minor revisions that can be made.	Thank you very much for taking the time to review this major revision of the manuscript and for your positive and constructive comments in this second review. Please below the changes made as per your suggestions.
2.1	Page 6 of 72, line 14-15: this wording can potentially be improved Potential sentence restructure: “It is unknown as to if and why financial incentives are effective in different conditions, and little is known about financial incentive use in asthma	Thank you for this comment, the sentence you suggested has been added to the introduction: “It is unknown as to if and why financial incentives are effective in different conditions,

	care	and little is known about financial incentive use in asthma care” (page 5)
2.2	Page 6 of 72, line 40-42: this wording can potentially be improved “It was not appropriate or possible to involve patients or the public in the research design, conduct, reporting, or dissemination plans.	Thank you for this comment, this was mandatory wording copied from BMJ Open re the involvement or PPI which was required to be entered into the manuscript, and therefore we refer to the editor as to whether this needs revising/updating.
2.3	Page 13 of 72, lines 9-19: it is great that the authors expanded upon the included sociodemographic information, however, this paragraph is difficult to follow given that several percentages are cited. It may be beneficial to break up the sentences more to allow the reader to digest the specifics of the insurance status percentages that the authors included.	Thank you, the sentences have now been re-arranged and broken up more, to allow for an easier read, as follows: "All US studies targeted urban minority populations [26-30, 32,33]; four of which were described as poor/low-income [26,28-30] with one study reporting >70% of participants’ annual income was below the poverty level [30]. Six studies reported health insurance status; three specifically recruited participants with either government (e.g., Medicaid) or no insurance [28,29,33] and three reported between 73-79% of participants had government or no insurance at baseline [26,27,32]. The UK study recruited participants from the NHS (government-funded healthcare system) [31]" (page 12)
2.4	Page 15 of 72, line 55: include “total” before “financial incentive uptake”	Thank you, the word ‘total’ has been added before financial incentive uptake (page 15)
2.5	Page 16 of 72, line 4: this wording can potentially be improved to allow the sentence to flow “...which may contribute to determining why an	Thank you, this sentence has been updated to: “… which may contribute to the understanding as to why an intervention is or is not effective, or

	intervention is or is not effective, or insight on ways to improve the intervention.	provide insight on how the intervention could be improved" (page 15)
2.6	Page 31, line 35-37 (table): in reference to the Kenyon et al article, the financial incentive is not contingent on full AM or PM dose of ICS inhaler detected by the electronic monitoring device --> this sentence is incorrect as written, it may be better to omit this sentence Children could still receive $0.25 if they took 1 of their 2 prescribed doses of their AM medication	Thank you for this comment, this was updated in the financial incentive domains table (Supplemental Material 3), but not the asthma management behaviours table (Supplemental Material 2), many apologies. This has now been updated in both tables to: "each AM or PM dose" And is supported by the following text for clarity: "(e.g., children could still receive $0.25 if they took 1 of their 2 prescribed doses per AM or PM)"
2.7	Page 33 of 72: Given that some of these studies are evaluating the acceptability/feasibility as their primary outcome (ie. the article by Kenyon et al.), the authors of this systematic review may want to highlight whether the outcome is primary or secondary.	Thank you for this comment. Those studies that are either pilot or feasibility studies have been identified by a '*' in the asthma management behaviours table (Supplemental material 2), which has also now been added to the financial incentives domains table (Supplemental material 3). In the asthma management table (Supplemental Material 2), there is also detail as to whether the feasibility/acceptability is the primary outcome. This detail has also been added to the manuscript, specifically the medication adherence studies as they all assessed feasibility/acceptability: "All studies were feasibility studies; two of which assessed feasibility/acceptability and medication adherence as the primary outcome [31,33] and one that solely assessed feasibility/acceptability

		as the primary outcome, with medication adherence as a secondary outcome [32]” (page 10)