

# Journal Pre-proof

Parents' views on artificial intelligence for the daily management of childhood asthma: a survey

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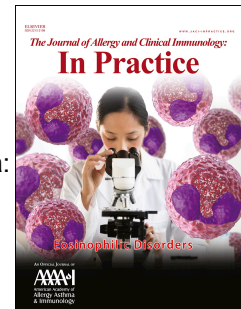
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# Parents' views on artificial intelligence for the daily management of childhood asthma: a survey

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## 26 **Clinical Implications**

27 The parents surveyed were divided about the implementation of artificial intelligence through  
28 an autonomous algorithmic decision system in the management of their child's asthma. Most  
29 preferred their physician to keep the control over the care provided to their child.

30

Journal Pre-proof

## **Parents' views on artificial intelligence for the daily management of childhood asthma: a survey**

As asthma is the most common noncommunicable disease in children worldwide, and as data sources (biomarkers, environmental data, connected objects) increase over the years, it becomes possible to create very large datasets (big data) and train algorithms with the most advanced techniques of artificial intelligence (AI) <sup>1</sup>. Soon, it may be possible to propose timely delivery of effective personalised treatments for children with asthma through algorithmic decision systems (ADS) autonomously suggesting changes in asthma treatments and indicating when a medical review is required. The primary aim of this study was to describe parents' perception of AI and to assess if they would accept/prefer an ADS for the management of their child's asthma over current physician-based management. A secondary objective was to identify the factors associated with a preference for using an ADS among the parents surveyed.

Methods of this study are described in this article's Online Repository at [www.jaci-inpractice.org](http://www.jaci-inpractice.org). Briefly, a cross-sectional survey was conducted in four paediatric hospitals of France with parents of children with asthma during the winter 2019-2020. Participants were asked on their views on AI in the field of medicine, on the place of AI in medical decisions about themselves and their child, and if they would accept/prefer an ADS which would avoid most follow-up medical consultations for the management of their child's asthma over their current physician-based management.

From the 321 eligible participants, 295 (92%) provided a complete questionnaire that could be included in the analysis (for characteristics, see Table E1 in this article's Online Repository at [www.jaci-inpractice.org](http://www.jaci-inpractice.org)).

Regarding parents' views on AI in the field of medicine, 158 (63%) and 202 (68%) parents agreed that AI could be useful in assisting physicians in the diagnosis and monitoring of diseases, respectively (See Figure E1 in this article's Online Repository at [www.jacipractice.org](http://www.jacipractice.org)). By contrast, only 44 (15%) and 41 (14%) thought that AI could replace physicians in diagnosing or monitoring diseases, respectively.

When asked to determine the respective positions of their doctor (human intelligence) and an AI for medical decisions concerning their child, 60 (23%) parents responded that these decisions should rely on their physician only, 174 (59%) on their physician sometimes assisted by AI, 48 (16%) on their physician often assisted by AI. Only 13 parents (4%) were supporting the idea of medical decisions relying on an AI supervised by their physician, and none supported the idea of medical decisions taken by an AI only.

When asked if they would accept to use an ADS for the management of their child's asthma, 158 parents (54%) responded positively. To estimate further if they would prefer an ADS-based management, they were asked to choose between a physician-based management allowing to obtain asthma control in 60% of cases, and an ADS-based management with rates of success between 50% and 90% (Figure 1). 134 (45%) parents never chose the ADS-based management even if this system was associated with a rate of success 30% higher than the physician-based management (level 0 of preference). At the opposite 11 parents (4%) preferred the ADS-based management even if it performed worse (by 10%) than the physician-based management (level 5). Between these two extremes, the cumulative number of parents that chose the ADS-based management over the physician-based management were 55 (19%), 96 (33%), 143 (48%) and 161 (55%) when the ADS-based management outperformed the physician-based management by 0% (level 4 of preference), 10% (level 3), 20% (level 2) and 30 % (level 1), respectively. In the multivariate analysis, parents were more prone to choose the ADS-based management if they had a professional/intermediate job

and owned a higher number of different digital devices, and less prone to choose the ADS-based management if they attached a great importance to the physician-patient relationship (Table 1).

This study highlights three important points: (1) parents were divided on whether to adopt ADS for the management of their child's asthma; (2) this division was mainly based on socio-economic factors, with parents with higher levels of employment being more likely to use ADS than socially disadvantaged ones; (3) 64% of the parents surveyed would not accept an ADS even if it provided better asthma control than usual care.

The development of AI applications divides people. In an online survey of 1183 adult patients with chronic diseases in France (77 with asthma), only 50% of the patients felt that the development of digital tools and AI in healthcare was an important opportunity<sup>2</sup>. Higher levels of education, higher levels of employment and higher household income have frequently been found to be associated with positive views on AI and support for its development<sup>3-6</sup>. The reluctance of parents belonging to the least-favored social classes to use an ADS for their child's asthma management remains of great concern for the future development of AI systems. If parents from lower social classes are reluctant to provide data to train ADS, they will be underrepresented in the final ADS developed to guide the management of childhood asthma and will receive suboptimal care compared to higher social classes.

Another important finding of this study is that most of the parents surveyed were not ready for an AI-based management of asthma. Loss of human control is a concern that has been expressed by patients in previous studies<sup>2,7</sup>. Patients think that AI might help physicians in the management of conditions, but that medical decisions should remain the prerogative of physicians. Loss of human contact is another concern expressed by patients. Lack of verbal

and nonverbal communication, lack of emotion and lack of empathy with AI were the main limitations that have been reported by patients<sup>7</sup>.

This study has some limitations. First, it is a cross-sectional survey, and the opinions reflected in the winter 2019-2020 may change overtime. Second, the opinions expressed by French parents may not reflect those from other countries. Third, a qualitative study would have been more appropriate to assess participants' understanding of AI in general and their vision on how it could be applied in childhood asthma management.

In conclusion, the parents surveyed were divided about the implementation of a high level of automation using an ADS for the management of their child's asthma. They preferred their physician to keep the control over the care provided to their child and valued the physician-patient relationship.

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**Figure legends**

Figure 1: Parents' strength of preference for an algorithmic decision system (ADS)-based management over current physician-based management depending on the success rate of the ADS.

Table E1: Participant's characteristics

| Characteristic                                                            | Total         |
|---------------------------------------------------------------------------|---------------|
|                                                                           | n=295         |
| Age (years) – n (%)                                                       |               |
| • < 45 years                                                              | 248 (84%)     |
| • ≥ 45 years                                                              | 47 (16%)      |
| Female sex – n (%)                                                        | 232 (79%)     |
| Educational level – n (%)                                                 |               |
| • Undergraduate/graduate                                                  | 172 (58%)     |
| • High school                                                             | 97 (33%)      |
| • Middle school                                                           | 26 (9%)       |
| Job – n (%)                                                               |               |
| • Professional/intermediate                                               | 112 (38%)     |
| • Others                                                                  | 183 (62%)     |
| Child's asthma – n (%)                                                    |               |
| • Hospital admission for asthma in the previous 12 months                 | 45 (15%)      |
| • Emergency department visit for asthma in the previous 12 months         | 89 (30%)      |
| • Controller treatment                                                    | 257 (87%)     |
| Self-efficacy score (/5) – med (IQR)                                      | 4.5 (4.2-4.8) |
| Equipment in digital devices (/5) - med (IQR)                             | 3 (2-3)       |
| Digital literacy (/6) – med (IQR)                                         | 4 (4-4)       |
| Need for humanity in the physician-patient relationship (/5) – med (IQR)  | 5 (5-5)       |
| Knowledge of AI (/5) – med (IQR)                                          | 4 (3-5)       |
| Data concerns linked to data collection, privacy, misuse (/4) – med (IQR) | 1 (1-1)       |

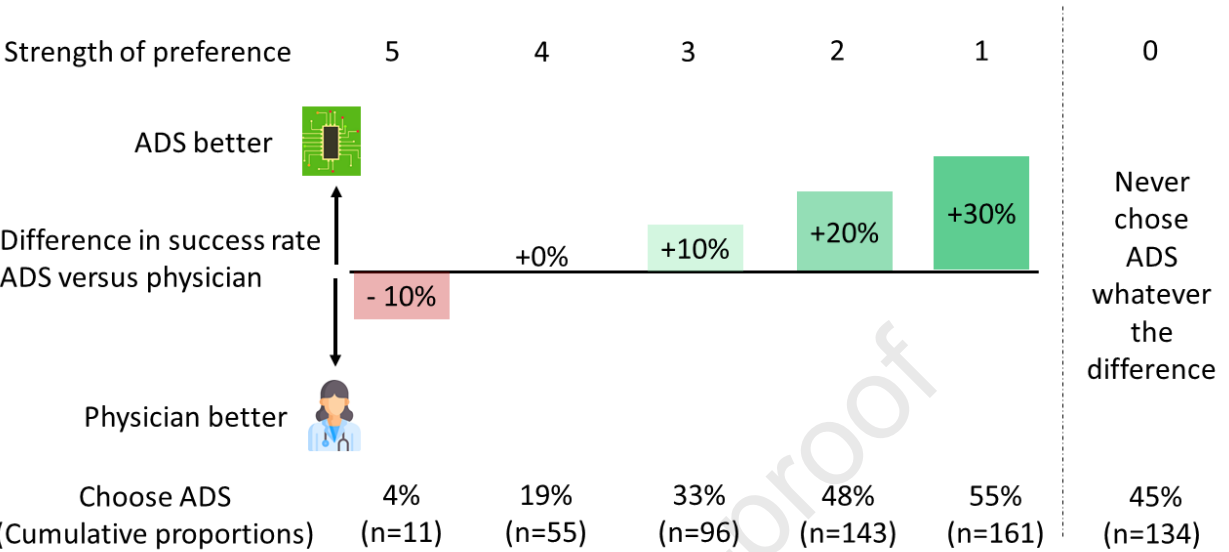
IQR: interquartile range; med: median

Table 1: Univariate and multivariate analysis of factors associated with preference for adoption of an algorithmic decision system for the management of childhood asthma over current physician management.

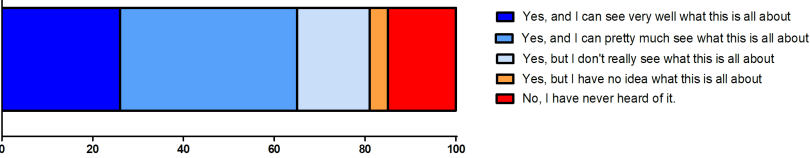
| Variable                                                          | Univariate analysis |         | Multivariate analysis |         |
|-------------------------------------------------------------------|---------------------|---------|-----------------------|---------|
|                                                                   | Odds Ratio (95% CI) | p-value | Odds Ratio (95% CI)   | p-value |
| Age (years)                                                       |                     |         |                       |         |
| • $\geq 45$ years                                                 | 0.82 (0.46-1.46)    | 0.51    | -                     | -       |
| • $< 45$ years (reference)                                        | 1.00                |         |                       |         |
| Sex of participant                                                |                     |         |                       |         |
| • Female                                                          | 1.16 (0.69-1.94)    | 0.58    | -                     | -       |
| • Male (reference)                                                | 1.00                |         |                       |         |
| Educational level                                                 |                     |         |                       |         |
| • Undergraduate or graduate degree                                | 6.54 (2.50-17.08)   | $<0.01$ | 2.73 (0.96-7.76)      | 0.06    |
| • High school                                                     | 2.73 (1.01-7.38)    | 0.048   | 1.90 (0.68-5.33)      | 0.22    |
| • Middle school (reference)                                       | 1.00                |         | 1.00                  |         |
| Job                                                               |                     |         |                       |         |
| • Professional/intermediate                                       | 2.96 (1.91-4.60)    | $<0.01$ | 2.06 (1.24-3.42)      | $<0.01$ |
| • Others (reference)                                              | 1.00                |         | 1.00                  |         |
| Child's asthma                                                    |                     |         |                       |         |
| • Hospital admission for asthma in the previous 12 months         |                     |         |                       |         |
| o Yes                                                             | 0.82 (0.46-1.48)    | 0.51    | -                     | -       |
| o No (reference)                                                  | 1.00                |         |                       |         |
| • Emergency department visit for asthma in the previous 12 months |                     |         |                       |         |
| o Yes                                                             | 0.75 (0.47-1.19)    | 0.22    | -                     | -       |
| o No (reference)                                                  | 1.00                |         |                       |         |
| • Controller treatment                                            |                     |         |                       |         |
| o Yes                                                             | 0.91 (0.49-1.70)    | 0.77    | -                     | -       |

| o No (reference)                                           | 1.00             |       |                  |      |
|------------------------------------------------------------|------------------|-------|------------------|------|
| Self-efficacy score                                        | 1.34 (0.85-2.11) | 0.21  | -                | -    |
| Equipment in digital devices                               | 1.44 (1.17-1.79) | <0.01 | 1.29 (1.02-1.62) | 0.03 |
| Digital literacy                                           | 1.55 (1.21-1.99) | <0.01 | 1.22 (0.92-1.61) | 0.18 |
| Need for humanity in the physician-patient relationship    | 0.66 (0.40-1.06) | 0.08  | 0.56 (0.34-0.93) | 0.02 |
| Knowledge of AI                                            | 1.40 (1.18-1.66) | <0.01 | 1.10 (0.90-1.34) | 0.36 |
| Data concerns (linked to data collection, privacy, misuse) | 1.08 (0.82-1.43) | 0.58  | -                | -    |

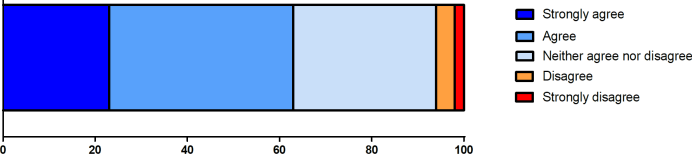
Parents’ strength of preference for an ADS-based management of childhood asthma, compared to physician-based management, using varying rates of success in achieving asthma control



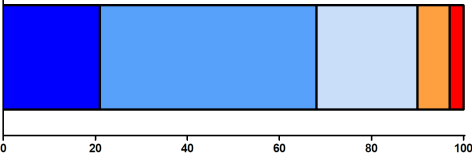
Have you ever heard of artificial intelligence?



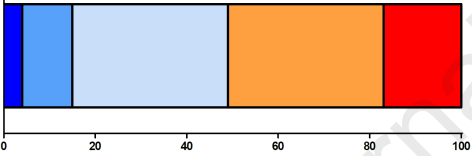
Artificial intelligence could be useful to physicians for the diagnosis of certain diseases.



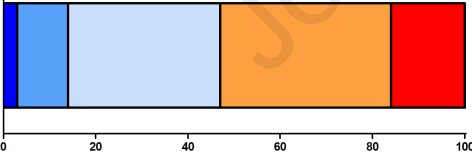
Artificial intelligence could be useful to physicians for the follow-up of certain diseases.



Artificial intelligence could replace physicians for the diagnosis of certain diseases



Artificial intelligence could replace physicians for the follow-up of certain diseases.



## **Online Repository Text File**

### **Parents' views on artificial intelligence for the daily management of childhood asthma: a survey**

#### **E-repository Methods**

A cross-sectional survey was conducted from September 1, 2019 to February 1, 2020 in four paediatric hospitals located in different regions of France (Brest, Lyon, Nice, and Paris). Two of these hospitals have dedicated departments for paediatric pulmonology (Paris and Lyon), whereas the two others have general paediatric departments (Brest and Nice). Consecutive parents of a child aged between 6 and 11 years with a physician-diagnosis of asthma attending an outpatient visit and/or lung function tests were proposed to complete a questionnaire. The questionnaire was self-administered either on paper or online. All participants provided informed verbal consent. The study was approved by the ethics committee from Necker-Enfants Malades hospital (CENEM 2019-15-DD).

A cross-sectional survey was chosen because the main objective of the study was to assess if parents would accept and/or prefer an ADS for the management of their child's asthma over current physician-based management, allowing the use of closed questions.

Participants were asked to respond to questions about potential explanatory variables of their preference for adopting an ADS for self-management of asthma rather than their current doctor-based management. The questionnaire was pre-tested with 12 parents from the Necker-Enfants Malades hospital. The choice of the variables was based on a review of the literature, and included respondent's characteristics (age, gender, level of education, level of job), children's asthma severity, perceived self-efficacy in asthma management, equipment in digital devices, digital literacy, perceived importance of the physician-patient relationship,

perceived knowledge of AI and concerns about the use of data (see supplementary material for details).

On the same questionnaire, participants were then asked to answer questions related to:

- Their views on AI in the field of medicine.
- Their views on the place of AI in medical decisions about themselves and their child.
- Their views on the use of an ADS for asthma management. To achieve this objective, the participants were first presented the following introduction: *“Several research teams around the world are working on a mobile application, available on smartphones, that can autonomously determine the asthma treatments your child needs. Such an application corresponds in scientific language to an "algorithmic decision system". Most follow-up medical consultations would no longer be necessary, as the mobile application would provide parents directions without requiring the intervention of their physician.”*

Parents were first asked the following yes/no question: *“Would you be willing to use a mobile application with an algorithm decision system for the management of your child's asthma, instead of the usual follow-up by your doctor, if scientific studies showed that the mobile application was at least as effective as the usual follow-up by your doctor?”*

Then, to estimate parents' strength of preference for an ADS-based management of their child's asthma over current physician-based management, five similar questions were added and required parents to choose between the two types of management: a physician-based asthma management with a fixed imaginary rate of success of 60% (asthma control obtained in 60% of patients), and an ADS-based management with an imaginary rate of asthma control obtained in 50%, 60%, 70%, 80%, 90% of patients for each question, respectively. The rate at which participants chose the ADS over the

physician-based management defined their “strength of preference for ADS”, from 0 (refusal of ADS regardless of success rate) to 5 (choice of ADS with a success rate of 50%, below the 60% rate of the physician-based management).

The primary outcome was the strength of preference of parents for the ADS over current physician management. Secondary outcomes were the proportion of parents who answered yes to the yes/no question on the adoption of ADS, and the parents’ views on each modality of using AI in medicine using Likert-scales rating their agreement with each proposal from 0 (strongly disagree) to 5 (strongly agree).

### **Statistics**

Categorical variables are reported as proportions and percentages. Since most of the continuous variables did not follow a normal distribution, they have been summarized with medians and their interquartile range (IQ1-3). The continuous variables were compared using the Kruskal-Wallis test and the categorical variables using the Chi-2 and Fisher’s exact tests. Univariate ordinal logistic regression was used to quantify the relationships between the strength of preference for the ADS and each predefined potential explanatory variable. Variables that were found to be related to the preference for the ADS ( $p < 0.10$ ) were then entered into a multivariable ordinal logistic regression model. Significance was set at  $p \leq 0.05$ . Analyses were performed with SAS version 9.3 software (SAS Institute, Inc, Cary, NC), and graphics with GraphPad prism software v5.03 (La Jolia, California).

With 13 predefined potential explanatory variables, and a minimal number of 20 events per variable, 260 questionnaires needed to be completed to run the ordinal logistic regression model. We estimated that 20% of the questionnaires may be returned incomplete and aimed to propose the questionnaire to 312 parents, to ensure the obtention of 260 complete questionnaires.

**Figure legend:**

Figure E1: Parents' views on artificial intelligence in the field of medicine

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