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Bachelor thesis

The nature of text messages between (parents of) children with asthma and healthcare professionals.

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Abstract

Asthma is a common disease in pediatric care and affects nearly 600,000 people in the Netherlands, including 80,000 children. Monitoring asthma is challenging due to episodic symptoms. Home monitoring in combination with eHealth offers potential improvement in asthma care. Mobile technology such as text messaging allows exchange of personal information and develop a strong relationship between healthcare professionals (HCPs) and asthma patients. Mobile engagement platforms have positive effects on health outcomes, potentially reducing hospital admissions. However, little is known about the manner and content of the communication.
Data came from the puffer app study. The puffer-app study followed children aged 4 to 18 years old for six months, recruiting 30 participants from the asthma pediatric department of MST. The study involved the use of the puffer-app chat, a smart inhaler, and a lung function meter for monitoring asthma symptoms. Participants could send messages to HCPs through the chat, allowing them to contact the HCP 24/7, with good results.
Chat data from 30 participants of the puffer-app study was analyzed in this qualitative retrospective study. The data was loaded into the ATLAS.ti program for analysis. Coding was performed using the RIAS method. This method distinguishes between task-focused behaviors and socioemotional behaviors, a technical theme has been added to this method. Demographic data and reaction times were analyzed using median and interquartile range (IQR). Differences between age groups and genders were assessed using the Mann-Whitney U-test due to non-normal distribution of the data. A significance level of $p < 0.05$ was used to determine statistical significance.
Almost 70% of the codes in chat conversations are task-focused codes. The most common topics are the topics related to asthma symptoms and the feedback or advice topics. The updates of the (parents of) children with asthma are often in the presence or increase of symptoms (67%), because they then need help from the HCP. At the beginning of the chat conversations, the participants ask questions about the devices, once the nurse has explained this to them, questions about the devices decreased. During the course of the puffer app study, the participants might think less and less about uploading the data, requiring double the amount of reminders in the second half of the study period. During the study, participants learn which information is and is not useful to the HCP, so that they can answer more specifically and concisely.
This study shows that the HCP responded faster than the participants. Differences in sex and age groups seem to be significant, but due to limitations in this study nothing can be said with certainty. It might be important that therefore protocols will have to be adapted according to age and gender in order to meet the needs of the patients.

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1. Background

Asthma is a common disease in pediatric care and is caused by an inflammation of the lungs [1, 2]. Asthma affects nearly 600,000 people in the Netherlands, including 80,000 children [3]. Asthma has a major impact on the daily lives of children. Symptoms like coughing, wheezing, and shortness of breath[2, 4], can lead to fatigue in the classroom, school absenteeism, and reduce quality of life [5].

The goal of asthma treatment is to achieve good asthma control, to minimize symptom burden and risk of exacerbations [6, 7]. Unfortunately, poor medication adherence and inhalation technique, and psychological and environmental factors can lead to uncontrolled asthma [8]. Monitoring pediatric asthma is challenging due episodic symptoms and therefore often absent during clinical visitation.

Home monitoring in combination with eHealth interventions offer potential improvement in asthma care [9, 10]. Earlier studies showed that home monitoring can predict, monitor and improve asthma symptoms in children [9, 11, 12], but results are inconclusive. Home monitoring offers opportunities to monitor physiological variables through longitudinal measurements in daily life, beyond regular visits, and can provide caregivers with additional insights into the dynamics of asthma status [13, 14]. Several studies have already been conducted into the use of home monitoring [15-18]. In asthma care there is recently much focus on the application of mobile technology such as communication technologies [19, 20]. Using these technologies, asthma patients can receive social support, information, and advice from healthcare professionals (HCPs). Frequent text messaging allows for exchange of personal information and develop a strong relationship between HCP and asthma patients[19].

Previous eHealth studies showed generally positive outcomes of the use of online communication [10, 13, 21, 22]. Several studies showed that mobile engagement platforms have positive effects on health outcomes, potentially reducing hospital admissions [15, 16, 22-24]. A previous study showed that the internet-based asthma telemonitoring program increased self-management skills, improved asthma outcomes, and appeared to be an effective and well-accepted technology for the care of children with asthma and their caregivers [16]. Moreover, in other studies with a communication tool there was no significant effect found [22, 25]. Little is currently known about the manner and content of the communication, and it is therefore unclear what is effective or not effective.

Mobile text messaging is a common mode of communication these days and intervention studies demonstrate the effectiveness of messaging systems in the self-management of asthma as a way of home monitoring [24, 26-29]. An intervention study demonstrated the effectiveness of messaging systems in the self-management of asthma in adolescents [26]. Yet it is unclear if messaging systems are also effective for pediatric asthma care. Also, little is known about the content of the mobile text message and the way in which interactions between asthma patients and practitioners take place [19]. To provide more insight into these messaging systems in pediatric asthma care, this study wants to analyze the chat data of a successful eHealth pilot to investigate what topics are common and whether there are any patterns. No studies investigated possible patterns and therefore this study focusses on patterns such as frequency of topics or decreasing or increasing topics over time.

In 2018, a pilot study was conducted at Medisch Spectrum Twente (MST) using the puffer app. This app enabled the (parents of) children with asthma to exchange text messages with an HCP in a chat function of the puffer-app. The children also received two devices to take home, these were lung function meters and smart inhalers. In combination with the data from these devices, a VAS score and the chat, the asthma patient was closely monitored by the HCP. The HCP provided feedback on the data via the chat, or advice was given. It was possible for the (parents of the) asthma patients to contact the HCP 24/7 for as example to ask questions or give an update about their asthma symptoms. This way of communication ensures, for example, that patients quickly received advice about what they can do to reduce their asthma symptoms. In the event of serious symptoms, parents could be asked to bring their child to the outpatient clinic [30]. This pilot found that there were 85% fewer

hospital admissions, 81% fewer emergency visits and 83% fewer outpatient visits during the puffer app pilot study [31].

In this manuscript, the focus will be on the text messages in the puffer-app, exchanged between patient and HCP by performing a content analysis and thus highlight the most important features of the messages. The primary research question is: “What are the topics and patterns in the chats between the HCP and (parents of) children who participated in asthma pediatric care?”

The secondary research questions of this study investigated what topics were discussed frequently, how the topics change over time, whether there are differences between different age groups or genders, and how quickly the chat messages were responded to.

2. Method

This study took place at the children's outpatient clinic of Medisch Spectrum Twente (MST), in Enschede.

2.1 Design

This is a qualitative retrospective study in which the content of chat conversations between HCP and (parents of) patient is investigated. The data in this study was collected as part of the puffer-app study [31].

2.2 Puffer-app

The puffer-app pilot was a half-year exploratory study with a quasi-experiment single arm pretest-posttest design. The participants consisted of the puffer-app and two monitoring devices so measurements can be taken, a smart inhaler and a long function meter. These measurements and VAS score were done twice a week as standard, the HCP could also ask to measure more often, for example in case of asthma symptoms. The participants could always send messages to the HCP, the HCP checked the puffer-app daily for new content. The chat function allowed the (parents of) patients to ask questions about, for example, asthma symptoms or medication use. The puffer-app study revealed a high feasibility for the use of ambulatory pediatric asthma care supported by combined sensing technology that monitors moderate-to-severe asthma and provides timely and substantiated medical anticipation.

2.3 Subjects

In the puffer-app study children from 4 through 18 years old were followed for half a year. The inclusion and exclusion criteria of the puffer-app pilot can be found in table 1. During the regular visit to the outpatient clinic, the children who fit these criteria and their parent(s)/caregiver(s) were informed about the puffer-app pilot. The puffer-app study recruited children from the pediatric department of MST between July 2018 and May 2019 by using consecutive sampling. In the informed consent of the puffer-app, the parents and children have given permission for the data to be used for further research. 33 children were included in the puffer app study, 30 of these have successfully completed the study and will be included in this study.

Table 1: Inclusion and exclusion criteria Puffer-app pilot

Inclusion criteria	**Exclusion criteria**
- 4 to 18 years old - Children with moderate-to-severe pediatrician-diagnosed asthma	- Children with comorbid chronic diseases - Children/parents unable to understand or speak Dutch

2.4 Analysis

The word documents with the chat data were loaded in the ATLAS.ti program (version 23). One of the chats contained two participants. These were two children with asthma who came from the same family. This chat has been disassembled by the researcher. Messages intended for both children were included in both chats.

Datasaturation was found after thirty chat conversations. All thirty chats were summary open coded in the explorational phase of coding. These codes were linked to each other and organized in themes using axial coding in the specification phase. A common tool in analyzing communication is the Roter Interaction Analysis System (RIAS) method. This method distinguishes between task-focused behaviors and socioemotional behaviors [32]. To analyze the content of the chats, a theme about technological information has been added in addition to the two existing themes of the RIAS method, task-focused behaviors and socioemotional behaviors. In the last phase, the reductional phase, the themes were used to get an answer to the research question.

Demographics were expressed as median +/- IQR because it was non-normally distributed data. The reaction time was calculated by the researcher and visually inspected for normal distribution. The data was not normally distributed so a median (IQR) was used. The reaction time was calculated by the researcher when response was expected, and the response is in the same day. This was determined because it turned out that the patient was also called if an answer took longer, in these cases no response took place via the chat. These cases where no response occurred, no response time was calculated by the researcher.
Differences in topics and patterns between different age groups and genders were analyzed in RStudio, version 1.4.1103, by using a Mann-Whitney U-test. This test was used because all data appeared to be non-normally distributed, and the variables were independent. If $p < 0.05$, the difference between groups was considered significant. For the secondary question about different in age groups it was decided to set the limit at the mean age of the participants, which is 11.1 years old. This is also the age at which children in the Netherlands go from primary school to secondary school.

3. Results

3.1 Topics and patterns

Thirty children were included in this study (median age 10.7 years, 22 boys). The demographic information of these children is shown in table 2. A total of 2.949 text messages were exchanged between (parents of) children with asthma and the HCPs. Of these chat messages, 1.230 (41.7%) were sent by the (parents of) children with asthma and 1.719 (58.3%) by the HCPs.

Table 2: Patient characteristics (N=30)

Characteristics	Value	1rd Quartile	3rd Quartile
Age (years), median (IQR)	10.7 (6.0)	8.5	14.4
Gender (male), n (%)	22 (73)		

3.1.1 Topics

There were 18 different axial codes used, which appeared 1.940 times in all chat conversations. The themes, underlying axial codes and definition of these codes are shown in table 3. The number of times these codes appears in the chats is not normally distributed. The median is 70.5 with IQR 45.25 - 88.74.

Table 3: Themes and axial codes

Themes	Axial codes	Definition
Task-focused behavior		
	Ask about asthma symptoms	The HCP asks about possible asthma symptoms.
	Upload reminder data	The HCP reminds the participant to upload the standard data.
	Additional data requested	HCP want extra data to monitor the patient more closely.
	Other issues regarding asthma	Messages about issues that may affect asthma.
	Asthma symptoms update	Participant updates the HCP about their asthma symptoms.
	Tips and advice	The HCP gives tips or advice to help the patient about their asthma.
	Feedback data	The HCP explains what he/she thinks of the submitted data of the patient.
	Medication use	Questions or updates about medication use from HCP and participant.
	Medicine requested	Participant asks to prescribe medication.
	Help requested from HCP	Participant needs help/advice from the HCP.
Socio-emotional behaviors		
	Arrange a contact time	If there is something that cannot be discussed/resolved via chat, a moment will be planned for it.
	Compliment	HCP compliments the participant for several reasons.
	Other issues without regard to asthma	Messages about issues in private life without regard to asthma.
	Show compassion	HCP shows if he/she is happy for the patient or sympathizes with the patient.
	To thank	HCP thanks for data or participant thanks for tips or advice.
Technological information		
	Error message or problem device	One of the devices gives an error message or no longer works properly.

	Question about device	Participant does not understand a device and asks HCP for help.
	Synchronization needed	HCP asks the participant to synchronize devices so that the data passes through to HCP.

Table 4 shows the frequency of the different codes. Within this ‘Task-focused behavior’ theme, ‘Asthma symptoms update’ is the most common with 19.8%. In this code, (the parents of) the asthma patient provides an update on the current health symptoms. The second most common code is 'Feedback data’ with 18.5% and 'Ask about asthma symptoms with 17.5%. Within the socioemotional theme the least common code is ‘Arrange a contact time’ with 4.9%, this code can be sent from patient and HCP if they want to arrange a call moment or want to meet in real life. 'Arrange a contact time' was in 73.9% of the cases initiated by the HCP. The most common code under the socioemotional theme is ‘Show compassion’ with 41.4%. The theme 'technological information' is the least common in the chats of the puffer app, only 6.4% of the codes falls under this theme. Within this theme 'Question about device' occurs the least often, in 20.0% of the cases.

Table 4: The number of occurrences of themes and codes (N=1940)

Themes – axial codes	Value N(%)
Task-focused behavior	1341 (69.1)
Asthma symptoms update	265 (19.8)
Feedback data	248 (18.5)
Ask about asthma symptoms	235 (17.5)
Tips and advice	227 (16.9)
Other issues regarding asthma	156 (11.6)
Medication use	133 (9.9)
Upload reminder data	104 (7.8)
Additional data requested	104 (7.8)
Help requested from HCP	85 (6.3)
Medicine requested	39 (2.9)
Socioemotional behaviors	474 (24.4)
Show compassion	196 (41.4)
To thank	136 (28.7)
Compliment	91 (19.2)
Other issues without regard to asthma	54 (11.4)
Arrange a contact time	23 (4.9)
Technological information	125 (6.4)
Error message or problem device	59 (47.2)
Synchronization needed	53 (42.4)
Question about device	25 (20.0)

3.2.2 Patterns

The code 'Asthma symptoms update' had in most cases negative content (67%). Negative updates in this case means that things are getting worse with the patient and that the patient suffers from asthma symptoms in any form at all. The positive messages (32%) consisted of improvements of these symptoms. Table 5 shows examples of these quotes.

Table 5: Examples of positive and negative quotes.

Positive quotes	“I've been doing very well the last few days” (Participant 16) “Hello, […] is doing well. His asthma has not been bothered during the whole holiday.” (Parent of participant 19)

Negative quotes	“She suffers a lot from her asthma. Two very bad days behind her.” (Parent of participant 15) “Yesterday and tonight stuffy, very bad night again. Coughing and indicates pain. Still lying in bed exhausted.” (Parent of participant 20)

Reminders were used in 27 chats, the distribution of which can be seen in figure 1. One reminder was sent in seven of these 27 chats, and there is also a chat where ten reminders were required. Since one chat conversation has about 100 chat messages in total, a distinction is made between the first and last 50 chat messages. 66% of the reminders were sent in the last half of the chat conversations.

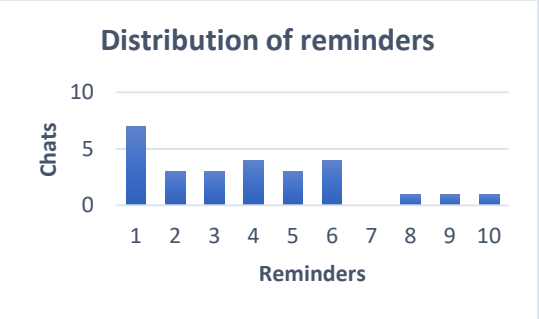

Figure 1: Number of reminders sent in chats.

The code ‘Show compassion’ is used in 24 of the 30 chat conversations. In the first 50 messages this code is used 95 times, this is 48.5% of the total 196 times this code is used. In 45.9% of this code, compassion is shown in combination with a 'task-focuses behavior' code. Figure 2 shows the distribution of the 'Show compassion' code. In the first chat conversations this code is used less constantly than in the later chat conversations.

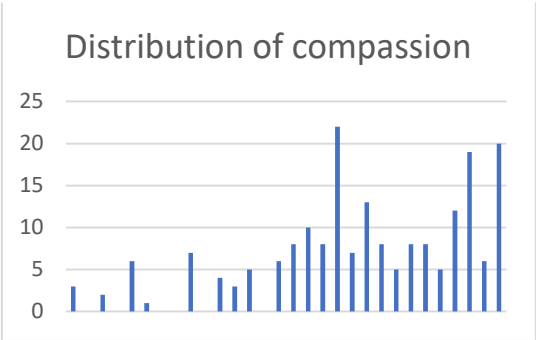

Figure 2: Distribution of ‘Show compassion’ code.

In 25 of the 30 chat conversations there were questions asked about the devices. In the first half of the conversation there were more question asked (68%) about the devices than in the last half (32%).

3.3 Response time

The (parents of) children with asthma responded with a median of 139(23 – 404) minutes and the HCP responded with a median of 81.5(19 – 213) minutes. The HCP responded significant ($p<0.05$) faster than the (parents of) children with asthma.

3.4 Differences between groups

3.4.1 Differences between boys and girls

In the chat with (the parents of) a boy there were more messages sent (110.5) compared to the amount of chat messages in a chat with (the parents of) a girl (64.6). Also, the chat with (the parents of) a boy has more codes (84.1) added to these chat messages compared to the (parents with a) girl (45.1). The difference in the amount of chat messages and codes are both significant ($p<0.05$).

3.4.2 Differences between age groups

The (parents of) younger children sent more chat messages (126) compared to the older group (62.1). Also the younger group has more codes linked to the messages (95.5) compared to the older group (49.2). The difference of the amount of chat messages is significant ($p<0.05$), the difference of the number of codes is also significant ($p<0.05$).

4. Discussion

This study has provided insight into the content of the chat conversations between HCP and patient. It has been shown that a chat can contribute to better and faster care for children with asthma in various ways. For example, asthma symptoms are indicated by the patient and the HCP can give health advice to the patient with the goal to prevent aggravation of symptoms. The insights that emerged in this study are important for the future of home monitoring.

4.1 Findings

4.1.1 Topics and patterns

What emerged about the frequency of the codes is that almost 70% of the codes fall under the theme 'task-focused behaviors'. Updates about the symptoms are often given by the patient, and the HCP regularly asks about the asthma symptoms. This data is regularly fed back to the patient and tips and advice are given. Other studies showed that task-focused behavior is much more prevalent in online communication compared to the other themes [19, 33]. It also agrees that biomedical topics, such as symptoms, are the most common [19].

One of the patterns is that the majority of the reminders are sent in the last half of the chat conversation, indicating that compliance to update the data is decreasing over time. Research has been done into how participants can be kept involved, but it appears to be difficult to implement this in practice [34-36].

Another pattern is that in the beginning of the chat there were more questions needed from the HCP to obtain the necessary information. The participants seem to have a better understanding of what is important for the HCP to know about their asthma and gave a more concise answer later in the chat. It might be that during participation the participants learn what they should and should not pay attention to regarding their asthma.

The last pattern under this theme is that in most cases an ‘Asthma symptoms update’ was given by the (parents of the) patient if the patient's health deteriorates and fewer updates were given to the HCP if the patient is doing well. Another study showed the same, here 32% of the updates were positive and 68% negative [19]. This seems logical, because help is only requested from the HCP in the event of a deterioration.

The socioemotional theme is mainly needed to comfort the patient. These topics are also important to keep the patient involved and make them feel appreciated. That this is more important for the patient is supported by a study showing that 46.5% of the messages from the HCP are socioemotional, while 75.5% of the messages of the patient are socioemotional [19]. A pattern that could be seen with the code 'Show compassion' is that the code is used more consistently in the last chat conversations than in the first chat conversations. This can be explained by the development of the HCP.

Within the technological theme, the (parents of) patients indicated 59 times that there was a problem with a device and 25 questions were asked about the device(s). These risks are almost impossible to avoid, but in the puffer app most of the problems were solved by using the chat. These questions about the devices are mainly experienced in the first half of the chat conversation. The issues with technology in general hinder the effects of eHealth, such as patient safety or quality of care [37].

4.1.2 Response time

The HCP responded significantly faster than the (parents of) children with asthma. However, there is a large spread. At the beginning of the study, it is not part of the routine to open the app every time for possible chat messages. Later in the study this seemed to become more automatic for both parties. For the HCP, the number of participants increases, and they must respond more often to a chat message.

4.1.3 Differences between groups

4.1.3.1 Differences between boys and girls

This study showed that significantly more chat messages are sent by boys. Moreover, more codes are linked to the messages in the boys' chat, indicating that more topics are discussed in the boys' chat that are relevant to this research. The distribution of age in the two sexes is not equal and therefore cannot be completely corrected. The girls have a median age of 11.4 (9-14) years, while the median for boys is 10.1 (8-14) years. Differences can be explained because boys are more likely to develop asthma at a younger age compared to girls [38, 39]. In addition, boys are more likely to have severe asthma symptoms compared to girls. So boys may have more reasons to send a message to the HCP.

4.1.3.2 Differences between age groups

Children under 11.1 years old have significant more chat messages in the chat conversations, and also more codes are linked to these messages. This difference can be explained by the fact that the parents of the younger children often have contact with the HCP, and the older children often manage the app themselves. Because the older children chat with the HCP themselves, parents have less supervision on how frequent there is contact, and this is more often forgotten because children are less concerned with this.

4.2 Limitations

The puffer app continued to evolve throughout the study. The working method of the HCP also developed during the study, experience was gained so the HCP could work as effectively as possible. As a result, there will be a difference between the first participants and the later participants of the study. These differences will mainly be visible in the response time, and in the number of messages. However, both parties (participants and HCP) experienced these developments. That is why it was decided to use averages in the results, so that the differences are corrected as well as possible.
There are also doubts about the results of the differences between genders and sexes. It is difficult to find out whether the parents or the child were chatting with the HCP, so it is not possible to completely correct for this.
Because the data of the chat has to be interpreted by the researcher, it can be partly subjectively analyzed. To reduce this effect the researcher evaluated the coding with external researchers and performed the coding a second time.

4.3 Strenghts

Data saturation was found after thirty chat conversations. This were all participants of the puffer-app study, so the internal validity is high. External factors such as the season when participating (related to pollen) have had little or no influence on the results of this study.
The RIAS method is derived from social exchange theories related to interpersonal influence, problem-solving, and reciprocity for analysis of medical interactions [32]. This is a widely used international observation system with proven validity and reliability in pediatric care [19, 32]. The RIAS method uses a standardized coding scheme with predefined categories. This has the advantage of ensuring consistency and reproducibility in the analysis, enabling comparisons between different chat conversations. Also, the RIAS method has proven to be valid and reliable in pediatric care, reliable in telemedicine [32, 40]. Also the technology-related theme was found reliable [40].

4.3 Further research

Possible follow-up research could focus on the direct consequences of the tips and advice given by the HCP in the chat. For example by evaluating the improvement of lung function technique after feedback on the lung function data. Unfortunately, these data were not available in this study, but could be of value in future research.
The good results of the puffer-app show that it is of added value in pediatric asthma care. An online communication tool could also be used for other chronic diseases or other age groups. It may also be important to set up protocols based on the age and gender of the patient. Because asthma is not present in the same way for all ages and genders.

In the distant future, Artificial Intelligence (AI) could potentially assist HCPs in this, by providing 24/7 tips and advice, and thereby reducing the workload of HCP. AI could even use previous chat conversation to personalize the language to the level of the patient [41, 42]. However, more research in this field is needed and issues like data privacy should be solved first[42].

4.4 Conclusion

Almost 70% of the codes in chat conversations are task-focused codes. The most common topics are the topics related to asthma symptoms and giving feedback and advice to the patients. The updates of the symptoms are mostly given when the patient's asthma symptoms get worse. Over time, the answers of the participants become more specific and concise. Also, the majority of the reminders are sent in the last half of the chat conversation. The socio-emotional theme is mainly for the patient, the HCP also seems to learn the importance of this over time. This ensures that, for example, the code 'Show compassion' is used much more consistently later in the chat conversation. The technical theme mainly consists of questions and problems with the devices. The questions are mainly asked in the first half of the chat and resolved through the chat.

This study shows that the HCP responded faster than the participants. Differences in sex and age groups seem to be significant, but due to limitations in this study nothing can be said with certainty. It might be important that therefore protocols will have to be adapted according to age and gender in order to meet the needs of the patients.

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