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Knowledge exchange between patient and pharmacist: a mixed methods study to explore the role of pharmacists in patient education and counseling in asthma and pulmonary arterial hypertension

Echanges de savoirs entre le patient et le pharmacien: une étude mixte pour explorer le rôle des pharmaciens dans l'éducation et le conseil dans l'asthme et l'hypertension artérielle pulmonaire

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Contributorship

- **Sophie RENET:** Conception or design of the work, Data collection, Data analysis and interpretation, Drafting the article, Final approval of the version to be published
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Declarations

Ethics approval and consent to participate

Participation in the study was voluntary. All participating patients signed informed consent, and all data were anonymized at the transcription stage, in line with articles L1121–1 and R1121–2 of the French code of public health, and the Paris Nanterre University doctoral school committee. The authors guarantee that the data and analyses presented are complete and accurate, and that the trial was conducted in full respect of the protocol.

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Consent for publication

Not applicable.

Availability of data and materials

The datasets used in the current study are available from the corresponding author on reasonable request.

Competing interests

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1 **Abstract**

2 **Objectives:** To better understand the role of pharmacists in patient education and counselling:
3 describe the perception of knowledge exchange (KE) between asthma/pulmonary arterial
4 hypertension patients and pharmacists (hospital/community) according to four dimensions
5 (4C-typology): Cure (C1), Care (C2); Coordination/supply chain (C3), Characteristics of the
6 pathophysiology/disease mechanisms (C4); factors correlated with KE.

7 **Methods:** A mixed-methods approach was used. Part A: data from semi-structured patient
8 interviews were processed (thematic analysis), and a questionnaire developed. Part B:
9 completed patient questionnaires were processed by correspondence factor analysis.

10 **Results:** KE (4C-typology) was correlated with pathology, disease severity, disease duration,
11 age, hospital/community pharmacist. Patients expected pharmacists to provide C2/C3
12 services. KE with pharmacists covered C1/C2/C3, and with physicians, C1/C2/C4. While
13 patients perceived KE as a means of self-learning to improve self-care skills, the two-way
14 nature meant it provided specific experiential information feedback to pharmacists.

15 **Conclusions:** This 4C-typology provides a holistic framework for optimising the
16 pharmacists' role in education and counselling of patients with chronic diseases.

17

18 **Abstract word count: 158 words**

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20 **Keywords:** Chronic care; Education and counselling; Pharmaceutical care; Mixed methods;
21 Correspondence analysis

22

23 **List of abbreviations**

24 CA: correspondence analysis; HP: healthcare professional; KE: knowledge exchange; PAH:
25 pulmonary arterial hypertension

26

27 **Highlights**

- 28 ▪ Pharmacy practice has evolved from drug distribution to education
- 29 ▪ Chronic patients acquire knowledge from experience of the disease and the healthcare
30 system
- 31 ▪ Chronic patients are often unaware of the educational role of pharmacists
- 32 ▪ Knowledge exchange covers 4 dimensions: cure, care, coordination/supply chain,
33 pathophysiology
- 34 ▪ An informal two-way education exists between respiratory patients and pharmacists

35

36

37 **Introduction**

38 Patient education and counselling (PEC) nowadays concerns all actors of the healthcare
39 system: the roles of most healthcare professionals (HPs) are currently evolving to include
40 more and more educational aspects. “Pharmaceutical care is the responsible provision of drug
41 therapy for the purpose of achieving definite outcomes that improve a patient’s quality of
42 life”(1,2). The scope of pharmaceutical practice has expanded significantly in recent years,
43 shifting away from the limited traditional functions such as dispensing medication, and
44 moving towards also including services that improve health outcomes, and provide care that is
45 more patient-focused. Studies have shown that the pharmacist’s attitude has a significant
46 impact on patient well-being, healthcare quality and outcomes, and patient satisfaction (3–7).
47 Pharmacists are in a privileged position to ensure the continuity of information on
48 pharmacological therapy and improve patient education (8).

49 As literature increasingly refers to knowledge that patients with chronic conditions acquire
50 from their own experience, it is important to recognise that nowadays, patients are dynamic,
51 context-aware and participatory (9), even in terms of pharmacy practice. Although patients
52 were previously seen as passive recipients of healthcare, patient management has evolved
53 over the years into a patient-centred endeavour, more recently becoming an active exchange
54 between two individuals and two social worlds, in what can be considered a partnership (10–
55 13). A patient-centred approach has been shown to improve patient experience of the
56 healthcare system significantly (14,15). By becoming active participants in the team, patients
57 and their next of kin are able to take an active role and make informed decisions with regard
58 to their own care. It also gives HPs a clearer understanding of what it is to live with a chronic
59 disease (16). Research into the pharmacist–patient relationship has to date only been
60 approached from the perspectives of quality of life, and health outcomes (4–6,17,18), and not
61 in terms of the dimension of knowledge. Knowledge exchange (KE) can be defined as a

62 process that encourages the sharing of data, information, experience, expertise, and ideas that
63 are mutually beneficial to all parties. However, optimizing the practical organization of long-
64 term pharmaceutical care in chronic conditions requires a clear insight into how these
65 exchanges of knowledge between patients and pharmacists actually take place, and how this
66 has changed in recent years. Due to the evolution of the relationships between patients and
67 pharmacists, and the evolution of pharmaceutical services, the exchange of knowledge can be
68 categorised according to 4 aspects or dimensions (4C-typology): 1) “Cure” (C1), targeting the
69 disease and the drugs (two-way, especially with regard to experience of the effect of drugs);
70 2) “Care” (C2), based on reassurance, and psychological or administrative support (i.e., caring
71 for relationships, improved health maintenance such as “caring about”, “caring of”, “care-
72 giving”, “care-receiving”) (19,20); “Coordination/supply chain” (C3), drug use process (two-
73 way, with regard to problem solving); and “Characteristics of the pathophysiology and
74 disease mechanisms (C4)”.

75 To provide a reference case study from hospital to primary care, we chose to investigate two
76 contrasting chronic respiratory diseases, pulmonary arterial hypertension (PAH) and asthma.
77 PAH is rare whereas asthma is frequent. The level of knowledge with regard to these diseases
78 varies not only among patients but also among HPs (community and hospital). PAH and
79 asthma can place considerable limits on the physical, emotional, social and professional lives
80 of patients, with a significantly negative impact on quality of life (21,22). As current
81 guidelines and treatment strategies view education and patient-centred approaches as essential
82 components in the management of these conditions (23–28), pharmacists have an important
83 role to play, particularly in terms of PEC.

84 Using two chronic diseases, asthma and PAH, we sought to explore the role of pharmacists
85 (in primary care and hospital) in PEC by describing patients’ KE according to the 4C-

86 typology (C1, C2, C3, C4) and identifying correlations between KE and patient
87 characteristics.

88

89 **Methods**

90

91 *Study design*

92 We designed a mixed methods study, with two successive stages. For Part A, semi-structured
93 patient interviews were conducted and processed by thematic analysis. Based on relevant
94 results from the interviews, an ad hoc questionnaire was developed. In Part B, patients
95 answered the questionnaire developed in Part A. The protocol is summarised in Figure 1.

96

97 *Sample/Settings*

98 For Parts A and B, all eligible patients were >18 years of age, spoke the local language, and
99 gave their consent to answer the questions and complete the questionnaire. Only patients
100 currently being treated for asthma or PAH were included. Exclusion criteria were: inability to
101 communicate in the local language, severe mental illness, other severe disease, or patients on
102 the lung transplantation waiting list.

103 The semi-structured interviews (Part A) and questionnaires (Part B) were offered to patients
104 hospitalised in the pulmonology day-care unit of the Hospital study centre. The questionnaire
105 could also be completed on social networks and the websites of national patient associations
106 (Part B).

107

108 *Data Collection*

109 Part A: Based on our study objectives, a research worker in education sciences—who was
110 also the facilitator for the qualitative interviews—developed an initial interview guide.

111 Interviews were conducted until a saturation phase of data collection was reached; all were
112 recorded for transcription and analysis.

113 Part B: Questionnaires were offered to patients in the hospital (face-to-face) and via websites.
114 Participation was voluntary, and all participants provided informed consent. Data were
115 anonymised during the transcription phase, in line with articles L1121–1 and R1121–2 of the
116 national code of public health, and the local University doctoral school committee.

117

118 *Data Analysis*

119 Part A: Thematic analysis was performed (29) by two research workers in education sciences
120 and a pharmacist. Based on the results of the thematic analysis and a literature search, a
121 questionnaire was developed according to a 5-point Likert scale and tested by a panel of 10
122 patients (PAH and asthma).

123 Part B: Descriptive statistics of questionnaire data were summarised using median (IQR)
124 values for quantitative variables and numbers for qualitative variables. Correspondence
125 analysis (CA)—a multivariate statistical technique—was then used to extract and present the
126 main relevant information from the dataset as a multidimensional point cloud scatter plot
127 (30,31). CA projects this cloud into its largest silhouette by determining the factorial axes,
128 which are mutually independent, and calculated from the directions that explain the greatest
129 variation in the data. The two first factorial axes give the clearest representation of the
130 information contained in the data. Each factorial axis shows two contrasting behavioural
131 attitudes of KE between patients and their pharmacist, or their HP. CA can be presented as a
132 plot or a table. According to Sourial et al., “*CA can be a very helpful tool to uncover the*
133 *relationships among categorical variables (...). Because CA explores the clustering among*
134 *categorical variable responses, it can uncover how responses within and between variables*
135 *are related; knowledge that may not otherwise be discovered through pairwise analysis*”(30).

136 Three complementary disease-specific CAs were conducted (FactoMineR R package), and
137 named: CA-PHA, for PAH and asthma patients; CA-PH, for PAH patients only; CA-A, for
138 asthma only patients.

139 In the interview guide and questionnaire, several questions covering patient perceptions of
140 drugs and pharmacists, and how patients acquire knowledge and skills relating to drugs and
141 illnesses, were introduced as potentially related qualitative variables. Factors such as
142 demographics (generation, sex, living area [village or town], job), clinical and biological
143 aspects (duration of asthma or PAH, severity grading, number of associated pathologies,
144 number of drugs taken daily, and hospital-administered drugs), and psychosocial (perception
145 of health status) aspects were also collected.

146

147 *Patient or public involvement*

148 The local patient organization checked and approved the semi-structured-interview guide, the
149 questionnaire, and the text of the informed consent.

150

151 **Results**

152

153 *Part A: Semi-structured interviews*

154 Over a 6-month period (from November 2013 to April 2014), 39 semi-structured interviews
155 were conducted (25 PAH patients, 14 asthma patients). Patient characteristics are presented in
156 Table 1.

157 From the results of the thematic analysis, a questionnaire was developed based on variables
158 that were assumed to be related. The *ad hoc* questionnaire comprised 57 questions: 10
159 questions addressed demographic and clinical and biological factors (i.e., age, severity
160 grading of PAH/asthma, sex) and perception of health status; 47 questions addressed patient

161 perception of pharmacists, needs, expectations, barriers with regard to pharmaceutical care
162 and services, and KE between patients and pharmacists and other HP.

163 *Part B: Questionnaire analysis*

164 Over six further months (from November 2014 to April 2015), 124 patients answered the
165 questionnaire (61 PAH patients, 63 asthma patients) (Table 1). Patient distribution by age-
166 group showed that PAH patients were older than those with asthma. Mean disease-duration
167 was 7.8 and 24.5 years for PAH patients and asthma patients, respectively. Over 70% of both
168 PAH and asthma patients had a New York Heart Association (NYHA) functional class or
169 Global Initiative for Asthma (GINA) classification of I or II. Asthma patients had a better
170 opinion of their health status than PAH patients: 67% (42/63) of asthma patients and 59%
171 (36/61) of PAH patients perceived their health status to be “very good” to “acceptable”.

172 *Nature and specific features of knowledge exchange*

173 Results from parts A and B confirmed that the KE between PAH or asthma patients and their
174 pharmacists or HPs covered the four aspects of the 4C-typology. Table 2 shows the four
175 aspects with examples of patients’ exact wording. Results of the three CAs (CA-PHA, CA-
176 PH, CA-A) are presented in Table 3. For patients, Care (C2) was an essential feature of their
177 relationship with pharmacists. Likewise, information on Coordination/supply chain (C3) was
178 exchanged between patients and pharmacists, and patients highlighted the importance of this
179 KE in the management of their chronic disease. Analysis of the relationship between asthma
180 patients and their community pharmacist showed that patients could be grouped into four
181 main behavioural attitudes in their KE (Figure 2 – CA-PA map). On factorial axis 1 (12.98%):
182 (1) patients who considered the community pharmacist as a genuine source of knowledge and
183 expertise, and a didactic person in terms of asthma and their general health, as opposed to (2)
184 patients who felt that physicians and nurses were the main source of knowledge because they
185 felt there were barriers, such as a lack of time (BarOfTps), in their experience of KE with the

186 pharmacist. On factorial axis 2 (9.04%): (3) patients who reported wishing the community
187 pharmacist had greater involvement in their care and who preferred to discuss asthma and
188 specific asthma drugs with other HPs as opposed to (4) patients who refuted the idea that HPs
189 have any role in patient education.

190 *Different types of knowledge exchange depending on the healthcare professional and the type*
191 *of disease*

192 The interviews and the three CAs (Table 3) showed that the type of KE patients had with
193 pharmacists (community/hospital) differed from that with other HPs, but also differed
194 according to their disease (asthma or PAH). Between patients and pharmacists, KE
195 corresponded to C1 (Cure), C2 (Care) and C3 (Coordination/supply chain), whereas it
196 covered C1 (Cure), C2 (Care) and C4 (Characteristics of the pathophysiology and disease
197 mechanisms) with physicians (GPs and specialists). Only six asthma and eight PAH patients
198 cited “Nurse” as a contact person of interest during the interviews. More specifically, the
199 interviews and results of the CA-A (Table 3) showed that asthma patients only discussed
200 information relating to Cure (C1) and Care (C2) with the community pharmacist. Asthma
201 patients had no interaction with hospital pharmacists who were not involved in the asthma
202 care pathway. However, the hospital pharmacist was seen as a genuine contact person of
203 interest for PAH patients (results from interviews and CA-PH [Table 3]). PAH patients
204 reported KE focusing on Cure (C1) and Supply chain (a subsection of C3) with hospital
205 pharmacists whereas with the community pharmacist, their KE focused essentially on Care
206 (C2) and Coordination (another subsection of C3) (shown by CA-PH factorial axes 1 and 2
207 [Table 3]).

208 *Barriers and facilitators in the KE between patients and pharmacists*

209 Both asthma and PAH patients mentioned the existence of barriers in their interaction with
210 pharmacists, the most frequently cited criticism being the pharmacists’ lack of time or

211 availability for patients. For asthma patients (shown by CA-A), the environment of the
212 community pharmacy itself was perceived as a barrier because of the presence of other
213 customers and the over-the-counter discussion. In contrast, PAH patients perceived the
214 variability of the contact-person and the poor quality of exchange as barriers (shown by CA-
215 PH).

216 A number of facilitators were identified to reinforce the KE between patients and pharmacists.
217 The CA-PHA showed seven output variables that were significantly correlated with the
218 factorial axis 1: age, number of associated pathologies and number of pharmacies regularly
219 visited, level of patient satisfaction with regard to their pharmacist, patient perception of a
220 genuine partnership with all HPs. Six output variables were significantly correlated with the
221 factorial axis 2: number of drugs taken daily, number of concomitant diseases, number of
222 pharmacies visited regularly, perception of the pharmacist as a physician's partner, and drug
223 perception.

224 *Asthma and PAH patients were unaware of being a source of knowledge for pharmacists and*
225 *other HPs*

226 Although patients initially stated not having learned about PAH or asthma from their
227 experience of living with the disease, as the interviews progressed, they changed their minds
228 when examples of knowledge were given as scientific words (e.g., PAH, catheter) or drug
229 names (e.g., salbutamol, sildenafil, Coumadin). For example, two patients explained: *"Every*
230 *patient learns about his/her own illness. It's a good way to learn."* (PAH017 AUR FR). *"I*
231 *have learnt new vocabulary: PAH, the number of people concerned. I have learned to manage*
232 *and explain my illness. I was diagnosed when I had endocarditis. I have also learned things*
233 *that I did not know before about my treatment, the indication, the mechanism of action."*
234 (PAH013 PET TH). Patients reported having acquired knowledge through their experience of
235 the illness: acquisition of knowledge relating to PAH or asthma, and the respective

236 treatments, but also more generally about the care pathway, and healthcare in general.
237 Moreover, the verbatim language collected from the semi-structured interviews clearly
238 showed a genuine two-way KE between patients and their HPs, and not exclusively from the
239 HPs to the patients (Table 2). Pharmacists reported having learned certain things about PAH
240 from patients, such as symptoms, certain drug therapies (PAH008 LAU Gh) or information
241 about a clinical trial on asthma (PA003 PIQ Da) (Table 2). "*When I talk to the pharmacist*
242 *about Tracleer® (i.e., bosentan) or Adcirca® (i.e., tadalafil), he doesn't know these drugs.*
243 *I've been to several different pharmacies and none of them know them. They are not common*
244 *drugs. They know more about Adcirca® than Tracleer®"* (PAH012 MIA PA). Given the
245 rarity of PAH, these findings were more common among patients with PAH: indeed, in many
246 cases, only patients had any knowledge about the disease and its treatment specifics. Lastly, a
247 number of asthma patients refuted the idea that HPs had a role in healthcare training and
248 reported acquiring knowledge on diseases and treatments of asthma by reading specialised
249 articles and journals (shown by CA-A factorial axis 2).

250

251 **Discussion**

252 As the scope of pharmacy practice evolves, it is important to understand how pharmacists are
253 perceived by patients with chronic diseases, and how willing these patients are to take
254 advantage of expanded pharmacy services. The findings of our study make an important
255 contribution to the definition of “Pharmaceutical Care” and PEC roles, particularly with
256 regard to chronic patients. According to PAH and asthma patients, two-way KE covers four
257 aspects—Cure, Care, Coordination/supply chain, and Characteristics of the pathophysiology
258 and disease mechanisms— and is in fact one of the main components of pharmaceutical care.
259 These four aspects form the mainstay of the emerging role of pharmacists with the
260 expectations they reveal, and the clear distinctions between primary care and hospital care.

261 Our findings highlight the specific expectations of chronic respiratory disease patients with
262 regard to pharmacists, and notably the provision of Care, Coordination/supply chain, and
263 PEC, particularly in primary care. We also showed how patients with chronic diseases, who
264 acquire considerable knowledge via their personal experience of not only the disease but also
265 the healthcare system, can become a source of information and KE for pharmacists in an
266 informal two-way system. Our findings add an interesting new dimension to those of previous
267 studies that only described a one-way transfer of knowledge, from pharmacists to patients
268 (32–35). Although they were unaware of it at the outset, during the interviews patients came
269 to realise that through their experience of the illness, they had acquired knowledge about PAH
270 or asthma and their respective treatments, but also more generally about the care pathway and
271 overall care. Patients were seen to target the KE according to their specific requirements and
272 depending on which HP or healthcare setting (primary care or hospital) they were addressing.
273 *De facto*, within our cohort, we identified an active, self-directed learning process for
274 maintaining and developing skills, and that could be described as self-learning (36), or self-
275 regulated learning, which emphasises two aspects: self-regulation of information and
276 knowledge as well as self-regulation of care. At disease onset, most patients seek out as much
277 information as possible from the internet, newspapers, patient associations or different HPs,
278 etc. However, we also found that, as a result of either a saturation effect or anxiety, certain
279 patients were less intent on questioning their HP or completely stopped discussions with HPs.
280 Patients therefore self-regulated their own behaviour to take better care of themselves.
281 Compared to asthma patients, PAH patients were more likely to seek out further information
282 about the disease and drug therapies, sometimes via patient associations. In France, certain
283 PAH drugs (i.e., sildenafil, tadalafil) are only available in hospital pharmacies, whereas other
284 more common drugs used to treat this disease, such as warfarin or spironolactone, are only
285 dispensed by community pharmacists. PAH patients therefore have to deal with this dual

286 delivery process and described it as a real *constraint*. Our findings showed that they did not
287 ask for support from their HP in learning how to cope with PAH, thus displaying a certain
288 autonomy. In this model of autonomic behaviour, patients and their pharmacists “*actively*
289 *exchange*” ideas, “*explicitly negotiate*” differences, and share influence and power (37,38).
290 As previously mentioned, patients were sometimes at the heart of the KE with their
291 pharmacists or physicians; at other times, they were a relay or facilitator of knowledge and
292 information exchange between HPs. Their roles in information and knowledge processes were
293 seen to be highly significant, especially in the case of a rare disease. HPs limited knowledge
294 of PAH, and the complexity of the drug use process, likely result in a feeling of isolation in
295 certain patients at various stages of the care pathway. This also highlights the role of patients
296 as relays and facilitators of the information and knowledge process between HPs, outpatients,
297 and different hospital departments as well as among caregivers.
298 Although it is widely acknowledged in the literature that certain chronic patients become
299 experts over time (39,40), these are however, not representative of the entire population of
300 patients with chronic diseases. Patients living with a chronic health condition are nevertheless
301 in a position to legitimately be able to share information or knowledge with pharmacists and
302 other HPs, even if they have not as yet been awarded the title of “expert patients”. This can
303 form the basis of a highly beneficial collaboration between patients and pharmacists to
304 optimise pharmaceutical care, therapeutic education, and patient education and counselling.

305

306 **Limits**

307 Our study was limited for two respiratory chronic diseases: asthma and PAH, that probably
308 not provide generalizable results for other disease as acute disease for example. In our study,
309 the majority of asthma patients had severe asthma. However, according to national Health
310 Insurance data, only 6% of asthmatics have severe asthma, i.e., a far smaller proportion than

311 in our cohort. This difference can be explained by the fact that most of our study participants
312 were recruited in the day-hospital, whereas patients with moderate asthma are usually
313 managed in primary care; the real difference in sample size between moderate asthma and
314 PAH populations is therefore less notable. We did however observe significant differences
315 between the two patient cohorts due to application of the principle of saturation for the
316 qualitative study (Part A), as explained above. The objective of the study was to provide a
317 comprehensive description of a phenomenon. The sample size for qualitative studies is
318 generally small. To minimise the biases described above, we chose a mixed-methods design.
319 This study format is useful for combining several perspectives and providing more
320 comprehensive evidence to answer complex research questions, especially in the fields of
321 public health and health service research. We integrated both quantitative and qualitative data
322 to ensure contrasting observations were shown and explained. The quantitative results were
323 essential to frame the qualitative phase in terms of sampling and data collection (41,42).

324

325 **Conclusion**

326 How can the role played by pharmacists in PEC be accurately described? We found that
327 patients with chronic-respiratory conditions readily acknowledge that pharmacists do more
328 than just count pills and have a role to play in terms of care and education. These patients
329 want to have access to expanded pharmacy services, focusing mainly on care,
330 coordination/supply chain and PEC, particularly in primary care. Our findings show that
331 informal learning exchanges between respiratory patients and pharmacists do exist. The
332 results of our correspondence factor analysis showed that the intensity and nature of the
333 exchanges are correlated with five variables: pathology, disease severity, disease duration,
334 patient age and pharmacist's workplace (hospital, community). These types of KE are seen by
335 patients as a form of self-learning by which they can acquire self-care skills. Furthermore, this

336 is clearly a two-way process, whereby specific experiential knowledge feedback on a current
337 disease—in this case, PAH—is shared with community pharmacists. This two-way KE
338 highlights not only the active role these patients can play, but also the extent to which they are
339 encouraged by their pharmacists (43).

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442 **Figure legends**

443

444 **Figure 1. Mixed Methods study**

445 CA, Correspondence Analysis; PAH, pulmonary arterial hypertension; CA-PHA, PAH and
446 asthma patients; CA-PH, PAH patients only; CA-A, asthma only patients

447 Figure 1. Méthode mixte

448 CA: Analyse des correspondance; PAH: hypertension artérielle pulmonaire; CA-PHA: PAH et patients
449 asthmatiques; CA-PH: PAH patients, CA-A: patients asthmatiques

450 **Figure 2. Four behaviour types observed in patients with asthma with regard to**
451 **healthcare professionals. Picture of the 124-dimensional cloud of CA-A, projected on**
452 **factorial axes 1 (12.98%) and 2 (9.04%)**

453 Figure 2: Quatre comportements observes chez les patients asthmatiques vis-à-vis des
454 professionnels de santé. La figure montre le nuage à 124 dimensions de la CA-A, projetée sur
455 les axes factoriels 1 (12,98 %) et 2 (9,04%)

456 **Table 1. Patient characteristics**457 **Tableau 1. Caractéristiques des patients**

Characteristics	Part A: Qualitative analysis		Part B: Quantitative analysis	
	PAH	Asthma	PAH	Asthma
Disease				
Number of patients (n)	25	14	61	63
Sex ratio (N = male/N = female)	0.56 (9/16)	0.75 (6/8)	1.77 (39/22)	1.63 (39/24)
Generation (N) Age				
<1942	4	1	9	0
1943-1959	11	3	24	16
1960-1979	6	6	23	30
1980-1997	4	4	5	17
Living area				
>10,000 inhabitants (N)	17	13	39	54
<10,000 inhabitants (N)	8	1	22	9
Disease duration (date from initial disease diagnosis) (years)	8.7	14.9	7.8	24.5
Classification of disease* (N)				
I	4	4	16	33
II	11	0	28	14
III	6	1	5	7
IV	4	9	12	9
Mean of drugs taken daily	8	4	8.5	3.7
Perceptions of health status (N)				

very good	1	3	2	7
good	9	3	23	27
acceptable	3	6	11	8
bad	9	2	21	14
very bad	3	0	4	7

458 PAH, pulmonary arterial hypertension

459 * World Health Organization/New York Heart Association (NYHA) Functional Classification
460 for PAH patients and Global Initiative for Asthma (GINA) Classification of Asthma Severity
461 for asthma patients.

Table 2. Typology of knowledge exchange between asthma/pulmonary arterial hypertension patients and pharmacists, illustrated with some exact wording from the semi-structured interviews (Part A) with patients

Tableau 2. Typologie des échanges de savoirs entre les patients asthmatiques et ceux atteints d’hypertension artérielle pulmonaire avec les pharmaciens, illustrés par les verbatim énoncés par les patients Durant les entretiens semi-dirigés (partie A)

Types of knowledge exchanged	Knowledge transfer from Patients to Pharmacists	Knowledge transfer from Pharmacists to Patients
<p>C1: "cure"</p>	<p>“The pharmacist asks questions about the clinical trial protocol; he follows the treatment” (PA003 PIQ Da).</p> <p>"There are two ladies who work at the hospital pharmacy ... And then we talk a little bit, about the disease, the new treatment...if it is effective" (PAH010 GAR AN)</p> <p>“When I tell the community pharmacist about about Tracleer® or Adcirca®, he does not know these drugs.</p>	<p><u>Physicians and pharmacist:</u></p> <p>"If there are drug interactions, I will ask the doctor or rather the pharmacist. If it's for me, I ask the GP” (PAH013 PET TH).</p> <p>"If I need help with my drug supply or superficial things in life, I'll see the pharmacist. I juggle between the pulmonologist, the doctor, the pharmacist according to the degree of information and the type of help I am looking for” (PA003 PIQ DA).</p> <p><u>Pharmacist:</u></p> <p>"She explains the dosages and tells me how to use the inhaler" (PH014 BAS</p>

	<p>I have been to many different pharmacies and none of them know them. These are not common drugs" (PAH012 MIA PA).</p>	<p>ST). "He tells me if there is a contraindication" (PH009 ZEG MA). "If I need syrup for a dry cough for example. It's not related to my illness so I ask the pharmacist " (PAH010 GAR AN).</p>
<p>C2: "care"</p>	<p>"I also think that I taught him a few things. How to take it. How Amandine manages her illness (...) "(PA006 DRO MY).</p>	<p>"From a practical standpoint, a pharmacist is: someone to talk to, friendly, a bit like a psychologist" (PA002 PIC KE) "(...) There are the medical aspects, and all the incidental support (...). And essentially, it is true that it is moral support "(PA006 DRO MY). "At the pharmacy, I feel like I can get things off my chest" (PH005 DAV MO).</p>
<p>C3: "coordination & supply chain"</p>	<p>"Making Volibris® available in the community pharmacy would be more convenient. My community pharmacist made inquiries about optimizing the delivery circuit and being able to dispense Volibris®</p>	<p>"In more rural areas, pharmacists are in contact with nurses, with everyone, so they actually make up a whole new group of healthcare professionals who are there to help you when you have problems" (PA006 DRO MY)</p>

	<p>(...) In rural areas, it would be useful because needs are greater than in the city " (PH016 GAB EL).</p>	<p>“He tries to make things easier for me, he helps me” (PH002 HER JE).</p> <p>“There is a community pharmacist in my town who dispenses my hospital treatments for PAH” (PH005 DAV MO).</p>
<p>C4: "characteristics of pathophysiology and disease mechanisms"</p>	<p><u>Physicians and pharmacist:</u></p> <p>“My GP was on vacation so I went to see someone else. When he gave me a treatment for my cold, I told him that I had PAH and he told me he knew nothing about it. So I told him a little about it, a rare disease. (...) Even the pharmacist, when I first went to see her, she also asked me what PAH was. She knew nothing about it" (PAH008 LAU GH).</p>	<p>“The doctor has already told me everything. For other treatments not related to my illness (...) I ask the pharmacist” (PH010 GAR AN).</p> <p>"If it is about asthma, I ask the doctor” (PA003 PIQ DA).</p>

Table 3. Results of correspondence analysis of the knowledge exchange between asthma and pulmonary arterial hypertension patients with their healthcare professionals.

PAH, pulmonary arterial hypertension; CA-PHA, correspondence analysis for PAH and asthma patients; CA-PH, correspondence analysis for PAH patients; CA-A, correspondence analysis for asthma patients

Tableau 3. Résultats des analyses de correspondances des échanges de savoirs des patients asthmatiques et ceux atteints d’hypertensions artérielle pulmonaire avec leurs professionnels de santé

Correspondence analysis	CA-PHA: PAH and asthma patients		CA-PH: PAH patients		CA-A: asthma patients	
Factorial axes	Axis 1 (12.69%)	Axis 2 (8.04%)	Axis 1 (14.4%)	Axis 2 (7.34%)	Axis 1 (12.98%)	Axis 2 (9.04%)
Behaviour of patients	Community pharmacist Care Cure Supply chain	Physicians, nurse Cure	Hospital pharmacist Cure Supply chain Community pharmacist Care	Community pharmacist Care Coordination	Community pharmacist Cure	Wish for a stronger involvement of the community pharmacist Care Coordination

	<p>Things not shared with the pharmacist concerning illness, treatment, and specific treatment</p> <p>Barriers: lack of time, other chronic patients, different contact persons, heterogeneity of the discussion between pharmacists.</p> <p>Information on AS or PAH learned from conferences</p>	<p>Community pharmacist</p> <p>Care</p> <p>Cure</p> <p>Supply chain</p>	<p>Things not shared with the pharmacist concerning PAH and specific treatment</p> <p>Barriers: lack of time, other patients, different contact persons, heterogeneity of the discussion between pharmacists</p>	<p>Hospital pharmacist</p> <p>Cure</p> <p>Supply chain</p>	<p>Physicians, nurse</p> <p>Cure</p> <p>Barriers: lack of time, lack of personalised care, generics</p>	<p>No healthcare professional</p>
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Part A: Thematic Analysis

39 semi-structured interviews with asthma and pulmonary arterial hypertension (PAH) patients

Questionnaire
(5-point Likert scale)

Part B: Quantitative analysis

124 patients (63 asthma and 61 PAH)

Descriptive Statistics

Correspondence Analysis (CA)

Identification of the number of CA according to the results:
CA-PHA, CA-A, CA-PH

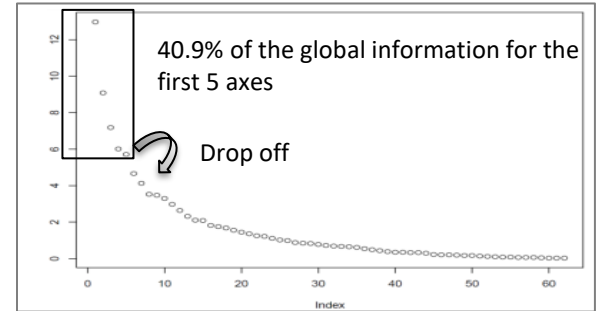
For each CA (CA-PHA, CA-A, CA-PH)

1. Analysis of the histogram of eigenvalues of the analysis of deviations from expected values: Identification of the percentage of information by axis to determine the number of axes studied. All the axes studied should contain around 40% of the global information and the axes studied were before dropping out
2. Analysis of the picture of the 124-dimensional cloud projected on factorial axes 1 and 2: a correlation affirmed whether the different points corresponding to different modalities of a variable showed a progression alongside an axis with \cos^2 near 1
3. Analysis of correlated factors on axes 1 and 2

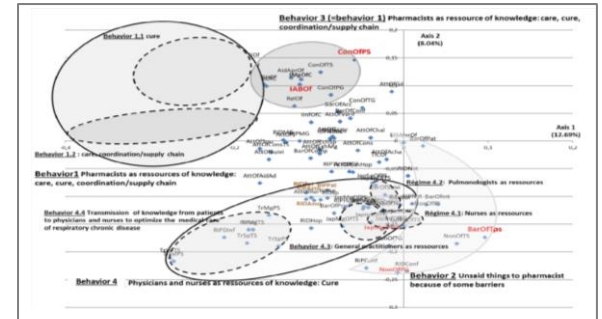
Results (part A)

Results (part B)

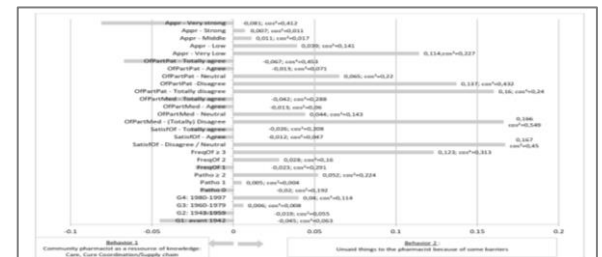
Final Results



Example of a histogram



Example of the picture of the 124-dimensional cloud projected on factorial axes 1-2 of CA-PHA



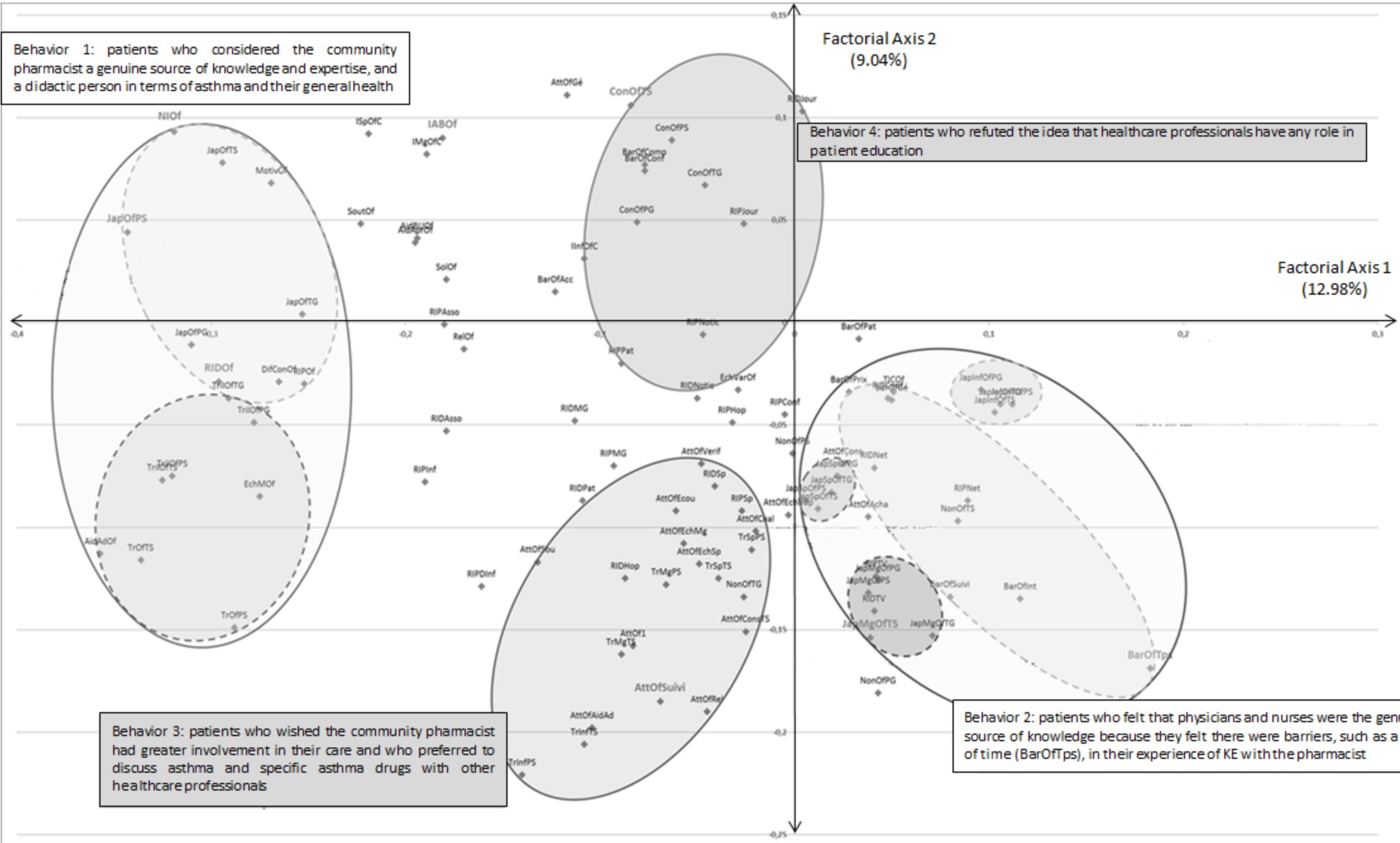
Example of the correlation analysis on axis 1 on CA-PHA

Behavior 1: patients who considered the community pharmacist a genuine source of knowledge and expertise, and a didactic person in terms of asthma and their general health

Factorial Axis 2
(9.04%)

Behavior 4: patients who refuted the idea that healthcare professionals have any role in patient education

Factorial Axis 1
(12.98%)



Behavior 3: patients who wished the community pharmacist had greater involvement in their care and who preferred to discuss asthma and specific asthma drugs with other healthcare professionals

Behavior 2: patients who felt that physicians and nurses were the genuine source of knowledge because they felt there were barriers, such as a lack of time (BarOfTps), in their experience of KE with the pharmacist