RESEARCH ARTICLE

General practitioner–pharmacist collaboration in Germany: an explanatory model

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Abstract

Background In Germany, no validated measure and model of pharmacist-physician collaboration existed. *Objectives* To provide evidence for the factor structure of the previously validated Frequency of Inter-professional Collaboration Instrument and the Attitudes Toward Collaboration Instrument in measuring attitudes toward and frequency of collaboration from the general practitioner's perspective in the context of primary care in Germany; to develop an explanatory model which illustrates factors influencing collaboration. *Setting* The study was conducted in the primary health care sector in Mecklenburg-Western Pomerania, Germany with a cohort of general practitioners. *Method* The two measures were translated into German and the survey was administered to 1438 practitioners. Exploratory factor analysis was used to assess the structure of the instruments. Structural equation modelling was used to determine how demographic variables and attitudes influence collaborative behaviour. *Main outcome measure* Outcome measure comprised frequency of and attitudes toward collaboration among German general practitioners and an explanatory model of practitioner-pharmacist collaboration. *Results* A response rate of 35.9% was achieved. Exploratory factor analysis revealed one factor for the instrument measuring attitudes and two factors for frequency. The factors were interpreted as 'Communication and Collaboration' and 'Pharmacist medication management'. The significant demographic predictors of collaboration were age, population of the surgery's location, distance to the pharmacy, specialty. *Conclusion* The results provide evidence for the factor structure of both measures in measuring attitudes toward and frequency of collaboration. A model of collaboration in which behaviour and extent of collaboration are directly influenced by individual and context characteristics is supported.

Keywords Attitude · General practitioners · Germany · Pharmacists · Statistical factor analysis · Surveys and questionnaires

Impacts on practice

- The current status of interprofessional collaboration in Germany is expandable.
- Analysis of possible reasons and backgrounds for discrepancies in role perception between practitioners and pharmacists is needed and must be used for the development of new strategies and guidelines to foster collaboration and thereby improve patient care
- Indicators for successful implementation of recent and future interprofessional collaboration projects can be measured.

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Introduction

All over the world, pharmacists and general practitioners are the health professionals most trusted by patients [1]. In today's world, responsible professional practice and co-operation between health care professionals will determine the future of medication use and health care costs, especially in light of an ageing multi-morbid population. Polypharmacy challenges patients, their physicians and pharmacists. Effective collaboration between all these stakeholders is pivotal to optimising health care outcomes from the use

of medications, reducing medication related problems and downstream costs of their management.

Research has highlighted the benefits of practitioner-pharmacist collaboration on (1) clinical outcomes of patients with dyslipidaemia, hypertension and diabetes [2–14] and (2) humanistic outcomes of patients with mental illnesses and dyslipidaemia [15, 16]. While collaboration was found to increase costs in the short term, it was shown to improve prescribing appropriateness, foster medication changes and resolution of drug-related problems. One important strategy to optimise collaboration is to engage practitioners and pharmacists in the co-design of new services/roles which may then be implemented as pilot programs testing feasibility and efficacy [17]. This has already started in some countries e.g. the Netherlands, United Kingdom, United States of America, Australia and Germany [18–20].

Strategies to achieve higher stages of collaboration were proposed by McDonough, Doucette [21]. These include open face-to-face communication, high quality recommendations to the physicians with subsequent feedback, consistent provision of high-quality care to patients and practitioners and the communication of patient outcomes related to the collaboration.

While collaborative working relationships between general practitioners and community pharmacists have been investigated in Australia, to date there has been limited research in Germany. Only few studies have investigated inter-professional collaboration in Germany [22]. There is no validated measure for practitioner-pharmacist collaboration.

Aim of the study

The objectives of this study were to provide evidence for the factor structure of two previously validated instruments of physician-pharmacist collaboration in measuring attitudes toward and frequency of collaboration as perceived from the general practitioner's perspective and to develop an explanatory model which illustrates factors influencing general practitioner-pharmacist collaboration.

Ethics approval

In Germany, studies need ethics approval if they're conducted by health practitioners, on patients, with drugs/radioactive material/human material or using sensitive personal data. Ethics approval for this research project therefore was not needed because it was a questionnaire implemented by a pharmacy institute, included pharmacist and practitioners and was not using any sensitive personal data.

Method

Development of the existing measures

The development and validation of the instrument measuring frequency (Frequency of Inter-professional Collaboration Instrument (FICI-GP)), using an Australian practitioner cohort was reported by Van [23]. Eleven Likert-type items addressed collaboration (communication, information sharing, shared decision making). For each item respondents were asked to indicate the frequency of interaction occurring in the past month between themselves and the pharmacist with whom they had most dealings. The possible responses were 'nil', '1–2 times', '3–4 times', '5–6 times' and '7 or more times'.

Following principal components analysis and Rasch analysis, the refined 10-item instrument measuring frequency was shown to be unidimensional, fit the Rasch model, have good internal consistency and criterion validity [23]. Higher scores, that is more frequent collaboration, correlated with co-location of practitioner surgery and the collaborating pharmacy and with frequent contact of the respondents with pharmacists during their formative years. Concurrent validity was demonstrated by a strong correlation with the physician–pharmacist collaboration instrument-relationship initiation subscale, a previously validated three-item scale based on the collaborative working relationship model [24].

The scale measuring attitudes (Attitudes Toward Collaboration Instrument (ATCI-GP)) was developed and validated in an Australian sample of 376 physicians. It comprised 15 items on a five-point Likert-scale ('strongly disagree', 'disagree', 'neither', 'agree', 'strongly agree') which reflected three determinants of collaboration (interactional, practitioner, environmental) [25].

The questionnaire

The instruments (Appendix 1) were translated into the German language, verified by a bilingual native English speaking person and reviewed by one of the original authors. For the instrument measuring frequency, participant general practitioners were asked to rate the frequency of interaction with the pharmacy with which they had most interaction and no financial relationship, during the last three months on the following scale: 'nil', '1–2 times', '3–4 times', 'more than 4 times'. The five-point ATCI-scale required responses as described in the previous section.

Study sample

A cross sectional survey of practitioners in Mecklenburg-Western Pomerania was conducted between January and April 2015. The study sample was sourced from different registries to contact every physician (specialised in internal medicine, general medicine, paediatrics, dermatology).

Data collection

The survey was administered via mail. It consisted of a cover letter, the 10-item FICI-GP, the 15-item ATCI-GP and demographic questions about themselves and their surgery based on the German health care system. Each survey was marked with an identification code to coordinate follow-up mailings. A reminder letter and another copy of the survey was sent twice (at four weeks intervals) to the non-responders. After the first analysis a non-responder survey was conducted. No prepaid return envelope was provided. There was no financial incentive to the participants.

Statistical analysis

Double entry was used for data verification. Preliminary analysis was conducted to determine baseline descriptive statistics. In this context demographics were considered and compared to official statistical data of Germany. Then, cases with > 50% of questions not answered were removed.

The factor structures of the instruments were examined separately using exploratory factor analysis in Mplus v7, using the mean- and variance-adjusted weighted least squares estimation method to handle the ordinal item responses, and the geomin rotation method. Originally, principal components analysis was used but subsequently exploratory factor analysis was selected because, although the two methods typically produce similar results, exploratory factor analysis is more appropriate for identifying factors rather than mere data reduction. To determine the number of factors, we used parallel analysis and a scree plot [26]. Inclusion of items in aggregate scores for each factor was based on factor loadings. Internal consistency of the scales, was assessed with Cronbach's alpha and McDonald's omega coefficients, values > 0.7 were considered acceptable [27].

An empirically testable model was developed to examine the influence of different variables on inter-professional general practitioner-community pharmacist collaboration. The model was analysed using structural equation modelling in Mplus v7, using maximum likelihood estimation with robust standard errors to handle non-normality, and following the guidelines of Schreiber [28]. Any case with missing data in the instruments was removed from the databases to standardise computation and accomplish comparability. First a series of univariate models was run to determine which of the demographic and surgery variables predicted at least one of the three endogenous variables (i.e., the instruments' scores); any variable that satisfied this criterion was included in the final structural model. Scores representing the factors obtained using exploratory factor analysis were included as observed variables. To ensure adequate degrees of freedom given the sample size, all predictors were coded as binary (Fig. 1). The tested model included demographic and surgery variables as predictors of ATCI-GP scores, which in turn were predictors

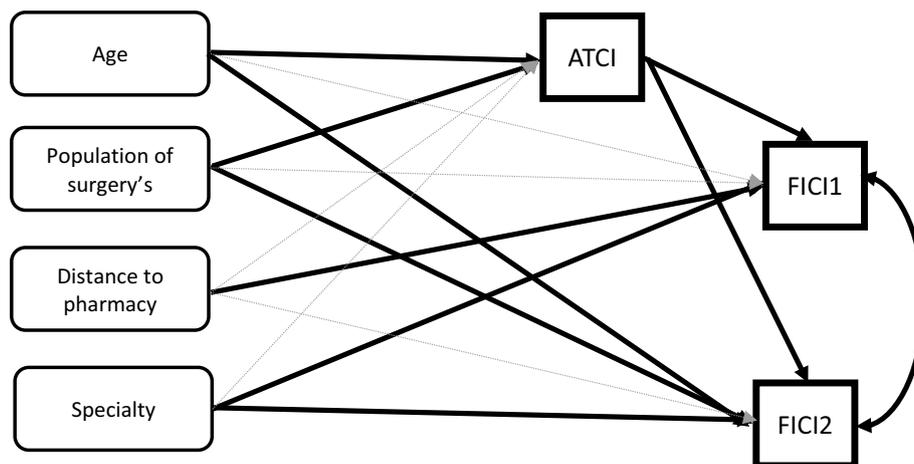**Fig. 1** Structural model showing predictors of FICI- and ATCI-GP scores. Statistically significant ($p < .05$) paths are shown in bold. Statistically not significant ($p > .05$) paths are shown grey. Factors are shown on the right (FICI1, FICI2, ATCI). FICI1 and FICI2 are correlated. Predictors are shown on the left site (binary code: age (< 51 vs. ≥ 51), population of the surgery's location (rural/provincial vs. metropolitan), distance to the pharmacy with most interactions (co-located/< 5 min vs. > 5 min), direct patient hours worked per week (≤ 40 vs. > 40), speciality (general medicine vs. dermatology/paediatrics/internal medicine))

of FICI-GP scores (Fig. 1). As this structural model is a path analysis and therefore just-identified, model fit is perfect and therefore not reported.

Results

Of the 1438 practitioners invited to complete the survey, 516 usable surveys were returned. The achieved response rate (35.9%) is comparable to studies previously conducted in Australia and Mecklenburg-Western Pomerania, Germany [22, 23, 25, 29, 30]. The gender and age distributions were comparable to statistics of the federal health monitoring system and federal chamber of German general practitioners [31] (Table 1). Additionally, 72 non-responder surveys were returned. Analysis showed that overall non-responders were similar in characteristics to responders (Table 1).

Behaviours and attitudes to general practitioner–pharmacist collaboration

More than four contacts in the previous three months were reported by half of the respondents for only two of the items; general communication and communication to clarify scripts (FICI 1 and FICI 5). All other activities were infrequent (i.e., < two contacts in the previous three months). Nevertheless, overall, respondents expressed favourable attitudes to collaboration with the pharmacist. (Tables 2, 3). No outliers were identified.

Exploratory factor analysis

Parallel analysis and scree plot suggested extraction of two FICI-GP factors. The first factor, composed of items one to five, nine and 10, represents 'Communication and collaboration' (Cronbach's alpha 0.81, McDonald's omega 0.81). The second factor was composed of items six, seven, eight, representing 'Pharmacist medication management' (Cronbach's alpha 0.80, McDonald's omega 0.81). The correlation between the factors was 0.52. For the instrument measuring attitudes, parallel analysis and scree plot supported a one-factor solution (Cronbach's alpha 0.94; McDonald's omega 0.94). Variance accounted for ATCI 4.0%, FICI1 34.3% and FICI2 16.6%. Factor loadings are shown in Tables 4 and 5.

Structural equation modelling

After list wise deletion 395 usable surveys were used for structural equation modelling (response rate 27.5%). In univariate tests, age, population of the surgery's location, distance to the pharmacy with the most interactions, and specialty, exhibited significant associations the instruments' scores. The structural model and estimates are illustrated in Fig. 1 and Appendix 2. A higher ATCI score was associated with higher FICI1 and FICI2 scores i.e. positive attitudes to collaboration with pharmacists was associated with more frequent self-reported actual collaboration. More frequent communication toward collaboration with pharmacists (i.e. higher FICI1 scores) was associated with shorter distance to pharmacy and specialty in general medicine. Older respondents with surgeries located in rural/provincial areas, specialised in general medicine collaborated with pharmacists more frequently in medication management. More positive attitudes toward collaboration (i.e. higher scores) were associated with those located in rural/provincial areas and specialty in general medicine. There were indirect effects on FICI1 and FICI2 of both age and metropolitan versus rural/provincial via ATCI. The correlation between FICI1 and FICI2 was 0.51, $p < .001$.

Discussion

The results of the study provide evidence for the factor structure of both previously validated instruments in the context of primary care in Germany. The explanatory model illustrates factors influencing the scope, the nature and extent of collaboration.

Mecklenburg-Western Pomerania is prototypical of rural areas in Germany for the purposes of exploring practitioner-pharmacist interactions in the context of an ageing multi-morbid population using polypharmacy. This cross-sectional study provided a snapshot of the current attitudes and behaviours of general practitioners toward collaboration with pharmacists. Whilst respondents expressed generally positive attitudes to the value of collaboration, the current level of collaboration was very limited.

Communication is an influential facilitator of collaboration [32, 33]. By openly communicating with pharmacists, general practitioners fulfil the important requirement of working together in the best interest of the patient. The nature of the communication however is key. For example, the frequency of item five (The pharmacist contacted me to clarify scripts.) relates to the fact that German pharmacies are reimbursed for prescriptions from statutory health insurance accounts which demand rigorous conformity to prescription laws and regulations. If any detail is missing the pharmacy will not be paid, even if the patient has already received their medication. Such communication is purely administrative and unrelated to patient care.

Indeed, in recent years pharmacists have been dispensers of medicines rather than health care professionals. The implementation of the discipline of clinical pharmacy in university education 15 years ago generated a new awareness of patient relevant care and drug therapy related problems (ATCI-GP items 3, 4, 7, 8, 14). With the young, educated

Table 1 Demographic statistics of practitioner respondents and their surgeries (frequency, percentage, non-responder survey percentage)

	Frequency	Percentage	Non-responder survey percentage
About the practitioner			
Gender			
Male	214	41.5	38.0
Female	302	58.5	62.0
Age			
< 35 years	3	0.6	–
35–50 years	188	36.4	42.3
> 51 years	315	61.0	57.8
Unspecified	10	1.9	–
Years in general practice			
< 10	129	25.0	29.6
10–30	314	60.9	55.7
> 30	56	10.9	14.1
Unspecified	17	3.3	1.4
Direct patient hours worked per week			
< 20	22	4.3	1.4
20–40	270	52.3	60.0
> 40	214	41.5	38.6
Unspecified	10	1.9	1.4
Hours spend in continuing education in the past 12 months			
< 20	23	4.5	2.8
20–50	220	42.6	59.2
> 50	261	50.6	36.6
Unspecified	12	2.3	1.4
Specialty			
General practice	288	55.8	63.4
Dermatology	25	4.8	1.4
Paediatrics	51	9.9	8.5
Internal medicine	152	29.5	26.8
About the surgery			
Type of practice			
Solo practice	378	73.3	70.4
Group practice	88	17.1	22.5
Medical care centre	38	7.4	7.0
Unspecified	12	2.3	–
Total population of the surgery's location			
Rural: < 5000	109	21.1	19.7
Provincial: 5000–20,000	194	37.6	35.2
Metropolitan: > 20,000	204	39.5	43.7
Unspecified	9	1.7	1.4
Number of different pharmacists with whom you have interactions			
1–3	321	62.2	73.2
3–6	145	28.1	19.7
> 6	39	7.6	7.0
Unspecified	11	2.1	–
Distance to pharmacy with whom you have the most interactions			
Co-located/next door	156	30.2	40.9
Less than 5 min walk away	175	33.9	29.6
More than 5 min walk away	170	32.9	28.6

Table 1 (continued)

	Frequency	Percentage	Non-responder survey percentage
Unspecified	15	2.9	1.4
Location of the pharmacy with whom you have the most interactions			
Medical centre/medical care unit	130	25.2	25.4
Shopping centre	66	12.8	14.0
Unattached	285	55.2	56.3
Unspecified	35	6.8	4.2

Table 2 Item response frequencies (and percentages) and descriptive statistics for the FICI-GP

FICI items[a]	1	2	3	4	Unspecified	Median score	IQR
FICI 1	18 (3.5%)	123 (23.8%)	107 (20.7%)	259 (50.2%)	9 (1.7%)	4.00	2.00–4.00
FICI 2	297 (57.6%)	157 (30.4%)	28 (5.4%)	22 (4.3%)	12 (2.3%)	1.00	1.00–2.00
FICI 3	80 (15.5%)	251 (48.6%)	79 (15.3%)	102 (19.8%)	4 (0.8%)	2.00	2.00–3.00
FICI 4	297 (57.6%)	152 (29.5%)	30 (5.8%)	26 (5.0%)	11 (2.1%)	1.00	1.00–2.00
FICI 5	10 (1.9%)	96 (18.6%)	120 (23.3%)	282 (54.7%)	8 (1.6%)	4.00	3.00–4.00
FICI 6	205 (39.7%)	196 (38.0%)	51 (9.9%)	54 (10.5%)	10 (1.9%)	2.00	1.00–2.00
FICI 7	198 (38.4%)	219 (42.4%)	53 (10.3%)	41 (8.0%)	5 (1.0%)	2.00	1.00–2.00
FICI 8	170 (33.0%)	263 (51.0%)	47 (9.1%)	26 (5.0%)	10 (1.9%)	2.00	1.00–2.00
FICI 9	251 (48.6%)	171 (33.1%)	42 (8.1%)	38 (7.4%)	14 (2.7%)	2.00	1.00–2.00
FICI 10	298 (57.8%)	162 (31.4%)	24 (4.7%)	25 (4.8%)	7 (1.4%)	1.00	1.00–2.00

[a]FICI scores: 1-'nil'; 2-'1−2 times'; 3-'3−4 times'; 4-'>4 times'

Table 3 Item response frequencies (and percentages) and descriptive statistics for the ATCI-GP

ATCI items[a]	1	2	3	4	5	Unspecified	Median score	IQR
ATCI 1	4 (0.8%)	8 (1.6%)	27 (5.2%)	272 (52.7%)	199 (38.6%)	6 (1.2%)	4.00	4.00–5.00
ATCI 2	6 (1.2%)	17 (3.3%)	92 (17.8%)	252 (48.8%)	139 (27.0%)	10 (1.9%)	4.00	4.00–5.00
ATCI 3	11 (2.1%)	28 (5.4%)	96 (18.6%)	281 (54.5%)	90 (17.4%)	10 (1.9%)	4.00	3.00–4.00
ATCI 4	12 (2.3%)	32 (6.2%)	103 (20.0%)	256 (49.6%)	106 (20.5%)	7 (1.4%)	4.00	3.00–4.00
ATCI 5	6 (1.2%)	25 (4.8%)	53 (10.3%)	301 (58.3%)	124 (24.0%)	7 (1.4%)	4.00	4.00–5.00
ATCI 6	3 (0.6%)	24 (4.7%)	57 (11.1%)	304 (58.9%)	118 (22.9%)	10 (1.9%)	4.00	4.00–5.00
ATCI 7	6 (1.2%)	56 (10.9%)	166 (32.2%)	218 (42.3%)	51 (9.9%)	19 (3.7%)	4.00	3.00–4.00
ATCI 8	14 (2.7%)	48 (9.3%)	122 (23.6%)	226 (43.8%)	97 (18.8%)	9 (1.7%)	4.00	3.00–4.00
ATCI 9	3 (0.6%)	3 (0.6%)	20 (3.9%)	262 (50.8%)	218 (42.3%)	10 (1.9%)	4.00	4.00–5.00
ATCI 10	5 (1.0%)	18 (3.5%)	45 (8.7%)	268 (51.9%)	174 (33.7%)	6 (1.2%)	4.00	4.00–5.00
ATCI 11	4 (0.8%)	23 (4.5%)	37 (7.2%)	280 (54.3%)	165 (32.0%)	7 (1.4%)	4.00	4.00–5.00
ATCI 12	1 (0.2%)	19 (3.7%)	41 (8.0%)	282 (54.7%)	166 (32.2%)	7 (1.4%)	4.00	4.00–5.00
ATCI 13	2 (0.4%)	23 (4.5%)	39 (7.6%)	285 (55.2%)	159 (30.8%)	8 (1.6%)	4.00	4.00–5.00
ATCI 14	13 (2.5%)	49 (9.5%)	110 (21.3%)	253 (49.0%)	82 (15.9%)	9 (1.7%)	4.00	3.00–4.00
ATCI 15	2 (0.4%)	1 (0.2%)	38 (7.4%)	284 (55.0%)	184 (35.7%)	7 (1.4%)	4.00	4.00–5.00

[a]ATCI scores: 1-'strongly disagree'; 2-'disagree'; 3-'neither agree nor disagree'; 4-'agree'; 5-'strongly agree'

pharmacists awareness of patient-centred pharmaceutical care and the new specialty has progressively diffused into community pharmacy and into practice [34].

A statistical model of factors influencing the level of collaboration highlights the influence of age of the practitioner, type of medical specialty and distance of surgery from the pharmacy on the both frequency of and attitudes toward collaboration.

Among the analysed sample of German practitioners there was general disagreement with item seven, 'The

Table 4 Detailed factor loadings of the FICI factors (FICI1, FICI2) in relation to the FICI items

FICI items	Factor loadings	
	FICI1	FICI2
FICI 1	0.71	0.08
FICI 2	0.63	0.16
FICI 3	0.86	− 0.13
FICI 4	0.75	− 0.05
FICI 5	0.53	0.20
FICI 6	0.28	0.47
FICI 7	− 0.01	0.91
FICI 8	0.11	0.84
FICI 9	0.48	0.34
FICI 10	0.54	0.29

Table 5 Detailed factor loadings of the ATCI factor in relation to the ATCI items

ATCI items	Factor loadings
ATCI 1	0.80
ATCI 2	0.79
ATCI 3	0.81
ATCI 4	0.72
ATCI 5	0.88
ATCI 6	0.90
ATCI 7	0.61
ATCI 8	0.70
ATCI 9	0.86
ATCI 10	0.84
ATCI 11	0.76
ATCI 12	0.87
ATCI 13	0.69
ATCI 14	0.63
ATCI 15	0.86

pharmacist actively addresses patients' medical concerns'. Possible reasons are that physicians believe that addressing medical concerns is outside the scope of a community pharmacist's practice [35]. It is noteworthy, however, that practitioners reported strong mutual respect for pharmacists as fellow health professionals. This is promising, as it is an essential pillar of collaboration and a good collaborative working relationships [33, 36–38]. However, it is also the case that an active role in patient care for pharmacists is underdeveloped in Germany. A change to a more active role had just begun [22, 38].

In the German data, ATCI-GP was a single interpretable factor 'Attitudes to collaboration with pharmacists' and the FICI-GP was interpreted as 'Communication and collaboration' and 'Pharmacist's medication management'. This suggests that in Germany, physician-pharmacist collaboration is at an early stage of development. While attitudes of German physicians fell on a single continuum, they made a distinction between their general communication with pharmacists

and communication reflecting actual participation of pharmacists in medication management. This may indicate that involvement of German pharmacists in medication management is not part of routine practice.

The relationship between attitudes, other exogenous variables and actual collaboration is illustrated in Fig. 1. Attitudes were related to both FICI-GP factors. A possible explanation is that as a first step positive attitudes may ease initial contact between physicians and pharmacists. Positive experiences in terms of co-operation has fuelled continued work with pharmacists. This accords with the collaborative working relationship model [21].

The only variable that was directly associated with frequency of both inter-professional 'Communication and collaboration' and 'Pharmacist medication management' was specialty of physician. In general medicine, physicians look after people of all ages and with many different medical conditions. Although they have broad expertise, their patients do not necessarily tell them about their other medications and co-morbidities. It is often in conversation with the pharmacist that this information is revealed, necessitating further communication between the practitioner and the pharmacist to clarify appropriateness of some medications or doses, thus explaining the higher frequency of interaction. An explanation of the significantly lower frequency of collaboration between internists and pharmacies compared to the other specialities could be a result of their more advanced training and qualifications, i.e., internists may be more skilled in management of polypharmacy and drug interactions in multi-morbid patients resulting in fewer queries and interactions with the pharmacy.

The distance from the pharmacy only directly influenced the frequency of 'Communication and collaboration'. The greater the physical distance, the less frequent the communication. Co-location of the professions facilitates collaboration [32, 33, 39, 40]. It is easier to collaborate if professions work in close proximity. Thus a spontaneous face-to-face meeting is more likely to occur [41–44]. However, it was unrelated to 'Pharmacist medication management'.

Age and location of the physician's surgery were associated with both attitudes and collaborative behaviours. The older the physician, the more work experience, the more positive their attitudes to collaboration, which in turn indirectly influenced their frequency of communication [45]. There was however a direct relationship between age and frequency of 'Pharmacists medication management' suggesting the older the physicians the more likely they were to engage the pharmacist in medication management related collaboration. This finding is surprising and contrasts with previous reports that the older the physicians the less likely they are to hold positive views about an expanded pharmacists' role in medication management. In contrast, in line with previous research, if the surgery was located in a rural/

regional area the physician expressed more positive attitudes and greater frequency of engagement of pharmacists in medication management collaboration than their urban counterparts [33]. This may relate to more opportunities to meet and develop relationships.

Strengths and limitations

Response rates were modest but comparable to rates of the Australian surveys [23, 25]. Methods used to increase response included design of a cover letter and follow-up reminders. Additionally a non-responder survey was conducted to support the results and conclusions. Only a 'snapshot' description of the collaboration status is produced. The items will have to be adapted to account for future developments. Another strength of the study was the large sample size.

Because the participants were asked to think about the last three months of collaboration when answering the instrument measuring the frequency, recall bias may have occurred. Prejudices regarding their own experiences may have influenced the participants when answering the questions. Problems of comprehension may have biased the results, e.g. if the participants skipped the introduction or they didn't respond relative to the community pharmacist with whom they had most interaction.

Conclusion

The results of the study provide evidence for the factor structure of both instruments in measuring attitudes toward and frequency of collaboration between German general practitioners and community pharmacists. A model of collaboration in which behaviour and extent of collaboration is directly influenced by individual and contextual characteristics is supported.

To date, there has been limited research exploring practitioner-pharmacist collaboration in Germany. This cross-sectional study gives an insight into common German physician-pharmacist relationships and their determinants. It may provide a better understanding of barriers and how they can be broken down—as well as facilitators—which can foster collaboration. In addition, given the changes taking place in Germany and the developments in practice i.e. more widespread adoption of pharmaceutical care, the instruments may serve to track changes in interprofessional collaboration over time or as a measure of impact for intervention designed to improve interprofessional care between general practitioners and pharmacists.

Appendix 1

Frequency of Interprofessional Collaboration Instrument for general practitioners (FICI-GP)

1. The pharmacist and I openly communicated with each other.
2. The pharmacist informed me of new products/services that are available/that they provide.
3. I contacted the pharmacist for specific drug information.
4. I contacted the pharmacist for specific patient information.
5. The pharmacist contacted me to clarify scripts.
6. The pharmacist contacted me to discuss dosage adjustments.
7. The pharmacist contacted me to recommend an alternative medication (e.g., due to an adverse reaction, contraindication etc.).
8. I adjusted patient medication after the pharmacist's recommendation.
9. I shared patient information with the pharmacist.
10. I involved the pharmacist in decisions regarding medication management.

Attitudes Toward Collaboration Instrument for general practitioners (ATCI-GP)

1. The professional communication between myself and the pharmacist is open and honest.
2. The pharmacist is open to working together with me on patients' medication management.
3. The pharmacist delivers high quality healthcare to patients.
4. The pharmacist has time to discuss with me matters relating to patients' medication regimens.
5. The pharmacist meets the professional expectations I have of him/her.
6. I can trust the pharmacist's professional decisions.
7. The pharmacist actively addresses patients' medical concerns.
8. Discussions with the pharmacist help me provide better patient care.
9. The pharmacist and I have mutual respect for one another on a professional level.
10. The pharmacist and I share common goals and objectives when caring for the patient.

11. My role and the pharmacist's role in patient care are clear.
12. I have confidence in the pharmacist's expertise in medicines and therapeutics.
13. The pharmacist has a role in assuring medication safety (for example, to identify drug interactions, adverse reactions, contraindications etc.).
14. The pharmacist has a role in assuring medication effectiveness (for example, to ensure the patient receives the optimal drug at the optimal dose etc.).
15. My working together with the pharmacist benefits the patient.

Note: In answering both the FICI-GP and ATCI-GP items, respondents were asked to 'think of the pharmacist with whom you have most dealings and no financial relationship.' In answering the FICI-GP items, respondents were asked to 'estimate the number of times following has occurred in the last 3 months' on a four-point response scale, where 1 = 'nil', 2 = '1–2 times', 3 = '3–4 times', 4 = 'more than 4 times'. In answering the ATCI-GP items, respondents were asked to 'indicate the extent to which you agree or disagree with the following statements' on a five-point response scale, where 1 = 'strongly disagree', 2 = 'disagree', 3 = 'neither agree nor disagree', 4 = 'agree' and 5 = 'strongly agree'.

Appendix 2

See Table 6.

Table 6 Estimates from path analysis

	Direct effects			Indirect effects		
		Standardised	p	Unstandardised	Standardised	p
Dependent: FICI1	Rsquared = .34					
ATCI	0.50	0.48	0.00			
Age	0.03	0.02	0.56	0.07	0.05	0.02
Population of surgery's location	−0.06	−0.05	0.19	−0.07	−0.06	0.01
Distance to pharmacy	−0.19	−0.15	0.00	−0.04	−0.03	0.14
Direct patient hours per week	0.06	0.05	0.22	0.01	0.01	0.79
Specialty	−0.25	−0.21	0.00	−0.04	−0.03	0.18
Dependent: FICI2	Rsquared = .17					
ATCI	0.40	0.31	0.00			
Age	−0.13	−0.09	0.04	0.05	0.03	0.02
Population of surgery's location	−0.13	−0.09	0.04	−0.06	−0.04	0.01
Distance to pharmacy	−0.09	−0.06	0.19	−0.03	−0.02	0.15
Direct patient hours per week	0.09	0.06	0.18	0.01	0.00	0.79
Specialty	−0.26	−0.18	0.00	−0.03	−0.02	0.20
Dependent: ATCI	Rsquared = .04					
Age	0.13	0.11	0.02			
Population of surgery's location	−0.15	−0.13	0.01			
Distance to pharmacy	−0.08	−0.07	0.13			
Direct patient hours per week	0.02	0.01	0.79			
Specialty	−0.07	−0.06	0.17			

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