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Knowledge integration, teamwork and performance in health care

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Abstract

Purpose – Knowledge integration is the process of building shared mental models. The integration of the diverse knowledge of the health professions in shared mental models is a precondition for effective teamwork and team performance. As it is known that different groups of health care professionals often tend to work in isolation, the authors compared the perceptions of knowledge integration. It can be expected that based on this isolation, knowledge integration is assessed differently. The purpose of this paper is to test these differences in the perception of knowledge integration between the professional groups and to identify to what extent knowledge integration predicts perceptions of teamwork and team performance and to determine if teamwork has a mediating effect.

Design/methodology/approach – The study is a multi-center cross-sectional study with a descriptive-explorative design. Data were collected by means of a staff questionnaire for all health care professionals working in the rehabilitation clinics.

Findings – The results showed that there are significant differences in knowledge integration within interprofessional health care teams. Furthermore, it could be shown that knowledge integration is significantly related to patient-centered teamwork as well as to team performance. Mediation analysis revealed partial mediation of the effect of knowledge integration on team performance through teamwork.

Practical/implications – In practice, the results of the study provide a valuable starting point for team development interventions.

Originality/value – This is the first study that explored knowledge integration in medical rehabilitation teams and its relation to patient-centered teamwork and team performance.

Keywords Performance, Knowledge sharing, Teamwork, Health care, Teams, Questionnaires, Knowledge integration, Shared mental model

Paper type Research paper

Introduction

Interprofessional teamwork is one of the most important quality criteria for health care organizations (Antoni, 2010; Kuhlmey, 2011; Gibbon *et al.*, 2002; O'Leary *et al.*, 2012; Ezziane *et al.*, 2012). The complexity of the health care system together with the changing demands in health care call for effective and efficient collaboration among different groups of health care professionals. The need for collaboration in interprofessional teams is further intensified by the changing spectrum of diseases with a growing number of elderly, multimorbid and chronic patients, as well as by the

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modified roles of patients, exemplified by the wish for more participation in treatment planning and decision making. A further reason for the growing significance of interprofessional teams is the rising importance of economic activities and the efficiency of health care organizations, coupled with the specialization and differentiation (increase of functional diversity) of health care professionals (Fitzgerald and Davison, 2008).

Health care and especially chronic care require a team including several different health professions working together in order to improve the patients' health status. The resulting treatment is based on the integration of medical, individual and social perspectives. This biopsychosocial approach is the theoretical basis of the International Classification of Functioning, Disability and Health, (World Health Organization, 2005), which provides a conceptual model for treatment in medical rehabilitation. The model of chronic care (Stock *et al.*, 2004; Schaefer and Davis, 2004) states that effective treatment requires productive interactions between the interprofessional teams and informed, active patients. The majority of medical rehabilitation in Germany takes place in in-patient rehabilitation clinics (Gerdes *et al.*, 2006), where many different health care professions work directly together in interprofessional teams. These health professions have to integrate their different perspectives on patients' needs, preferences and health status (Körner, 2009, 2010). This calls for a knowledge integration process as well as for good communication, coordination and cooperation within a rehabilitation team (Körner, 2013; Körner *et al.*, 2013).

Collaborative care achieved through high-functioning patient-centered interprofessional teamwork can enhance the effectiveness and efficiency of the organization and the health care system (Arevian, 2005; Newman *et al.*, 2005; Schouten *et al.*, 2008). In its report on *Cooperation and Responsibility Prerequisites for Target-oriented Health Care*, the German Advisory Council on the Assessment of Developments in the Health Care System (Sachverständigenrat zur Begutachtung der Entwicklung im Gesundheitswesen, 2007) called for ongoing efforts to develop effective and efficient patient-centered interprofessional teams. Several factors contribute to the development of successful patient-centered interprofessional teams. The present study focusses on the knowledge integration of different health professional groups and its influence on patient-centered teamwork and team performance. Below, we will therefore describe the relevant constructs of patient-centered teamwork, team performance, knowledge integration and mental models and aggregate them in an input-process-output (IPO) model, which then is used as the conceptual model of the study.

Theoretical background

Patient-centered teamwork and team performance

Patient-centered teamwork in medical care is defined as two or more different health care professionals working together toward a common goal in order to provide comprehensive services to patients and to produce the best outcome for them (Sinclair *et al.*, 2013; Braithwaite, 2010; Salas *et al.*, 2005; Canadian Interprofessional Health Collaborative, 2010; Xyrichis and Lowton, 2008; Körner and Wirtz, 2013).

Xyrichis and Ream (2008) emphasized that the health professionals "have complementary backgrounds and skills, sharing common health goals and exercising concerted physical and mental effort in assessing, planning, or evaluating patient care" (Xyrichis and Ream, 2008, p. 232). They also stated that "this is accomplished through interdependent collaboration, open communication and shared decision making"

(Xyrichis and Ream, 2008, p. 232). Further factors that contribute to the development of successful patient-centered interprofessional teams in medical rehabilitation are regular and effective team meetings, information sharing, type of leadership-model (based on the purpose of the team), active participation/engagement of team members, a common framework for different professions, professional education, joint protocols and work practices, composition and size of the team (team structure), team culture, clear tasks roles and responsibilities, trust, respecting each other, cooperation, support, availability of necessary resources, preparation and training of the team members and patient/family involvement (Hammick *et al.*, 2009; Körner, 2013; Müller *et al.*, 2014 Nijhuis *et al.*, 2007; Reeves *et al.*, 2010). The main barriers to interprofessional teamwork are heavy workload, inadequate pay, stereotypes and insufficient time corridors to consult within the interprofessional team (Körner *et al.*, 2014, Müller *et al.*, 2014).

Effective teamwork is associated with high team performance as well as better patient-related outcomes (e.g. higher treatment quality, better clinical outcomes and improved patient safety), staff-related outcomes (e.g. higher job satisfaction, greater well-being, improved mental health, better team climate and increased team efficiency) and organization-related outcomes (e.g. cost savings, workforce retention and reduced turnover) (Ezziane *et al.*, 2012; Körner *et al.*, 2016; O'Leary *et al.*, 2012).

Reviews indicate that teamwork influences the performance of medical teams (e.g. Mathieu *et al.*, 2000; Schmutz and Manser, 2013). Performance measures are classified as process performance measures, such as deviations, case delays, length of stay, and operating time, vs outcome performance, e.g. complications, fall rates, and morbidity. High performance achieved through patient-centered teamwork requires an interdisciplinary team approach. The interdisciplinary approach is interactive and participative, with the health care professionals agreeing upon a common treatment goal and adapting their discipline-specific goals to this common goal. The physician involves the other health care professionals in treatment decisions within a multilateral interaction process and coordinates the treatment in interprofessional team meetings (Körner, 2010; Thylefors *et al.*, 2005). In multidisciplinary teamwork, in contrast, the different disciplines work separately, each with its own treatment goals. The physician determines and delegates the treatment options to the other health care professionals in a one-way, mostly bilateral interaction process between the professionals. Interdisciplinary team approaches have been shown to result in better teamwork and team performance than multidisciplinary approaches (Körner, 2010; Thylefors *et al.*, 2005). Gittell *et al.* (2009) showed that distinct work practices (e.g. cross-functional conflict resolution, interprofessional performance measurement and cross-functional rewards) strengthen the relational coordination among team members with different professional backgrounds (i.e. doctors, nurses, physical therapists, social workers and case managers). Relational coordination is based on team members' shared goals, shared knowledge and mutual respect. Further aspects are frequent, timely, accurate, and problem-solving communication. The enhancement of relational coordination among team members in turn leads to higher patient-perceived quality of care and reduced length of stay. Relational coordination mediates the effects between high performance work practices, quality and efficiency outcomes in health care (Gittell *et al.*, 2009).

Knowledge integration and shared mental models

One coordinating mechanism for establishing patient-centered interprofessional teamwork is a shared mental model (Mathieu *et al.*, 2000; Salas *et al.*, 2005). The integration of the diverse knowledge of the health professions in shared mental models

is a precondition for effective teamwork and team performance (Gibson, 2001; DeChurch and Mesmer-Magnus, 2010; Salas *et al.*, 2005; Steinheider *et al.*, 2009; Xiao *et al.*, 2013). Developing a shared mental model for cooperation within an interprofessional team is very important for accomplishing complex tasks such as biopsychosocial treatment in medical rehabilitation. In this field, the task can only be successfully completed by integrating the knowledge and resources of the different health care professionals within the rehabilitation team (Steinheider *et al.*, 2009). The process of building shared mental models is called knowledge integration, whereas the resulting multidisciplinary knowledge base is designated as shared mental models (Mohammed *et al.*, 2000; Steinheider *et al.*, 2009). Therefore, knowledge integration can be considered an indirect measure of shared mental models. The main aspects are a shared and organized understanding of relevant knowledge of the task (e.g. aim, work process, division of work, methods and tools) and of the team (e.g. team members' characteristics, such as skills and expertise, roles and responsibilities) (Burtscher and Manser, 2012; Cannon-Bowers *et al.*, 1993; DeChurch and Mesmer-Magnus, 2010; Mohammed *et al.*, 2000; Steinheider *et al.*, 2009). For health care, Evans and Baker (2012) developed the "Mental Model of Integrated Care," which emphasizes the convergence and divergence of knowledge and beliefs and which may help to explain the effectiveness of integration initiatives, diagnose integration problems and develop interventions in order to improve integration and the delivery of care. Based on different educational and socialization experiences, it is likely that the different groups of health professionals do not share the same mental model (Hall, 2005; Mickan and Rodger, 2005). International studies have pointed out a fragmentation of health care (Fitzgerald and Davison, 2008; Hall, 2005; Pecukonis *et al.*, 2008; Reeves *et al.*, 2010) and the need for integrating the different groups of health care professionals. "Differing roles, value systems, experiences, expectations, and power relationships influence perceptions" of health care professionals (Evans and Baker, 2012, p. 715), as does working within their own professional group (building professional silos) rather than collaborating with colleagues in other disciplines (Hall, 2005; Pecukonis *et al.*, 2008; World Health Organization, 2010). Previous studies have shown that team processes and team performance are rated differently by different professional groups within interprofessional health care teams (Hall, 2005; Pecukonis *et al.*, 2008; Körner *et al.*, 2014). Whereas physicians tend to evaluate team processes rather positively, other team members, e.g. nurses, are more critical and often evaluate these variables more negatively (Körner *et al.*, 2014). Hence, it can be assumed that the differences in the perceptions of teamwork are an indicator for professional silos. This could be due to a lack of knowledge integration and result in bad team performance.

Aim and framework of the study

The aim of the study is to investigate perceptions of knowledge integration by different groups of health care professionals in a rehabilitation setting and its impact on perceptions of patient-centered teamwork and team performance. As previous studies found differences among health professions in the evaluation of teamwork and team performance (Hall, 2005; Körner *et al.*, 2014; Pecukonis *et al.*, 2008), we hypothesized that this also applies to the evaluation of knowledge integration within interprofessional teams in medical rehabilitation clinics:

H1. Perceived knowledge integration is assed differently by different health care professional groups in medical rehabilitation.

IPO models (McGrath, 1964) are widely accepted as a framework for team research in healthcare (Gibbon *et al.*, 2002; Lemieux-Charles and McGuire, 2006; Xyrichis and Ream, 2008; Körner *et al.*, 2016). The input factors (e.g. ability and personality of team members, team composition, organizational context, task characteristics) are the precondition for successful team work and team effectiveness (Lemieux-Charles and McGuire, 2006). These input factors influence the patient-centered team process (teamwork) within the health care teams which consists of communication, coordination, cooperation, climate and respect (Körner and Wirtz, 2013). Performance in the IPO model is conceptualized as an output influenced directly by teamwork (process) (Schmutz and Manser, 2013). It can be assessed through the team members' perceived team performance/effectiveness (subjective outcome) or through patient, staff and organizational outcomes (objective outcome) (Körner *et al.*, 2016; Lemieux-Charles and McGuire, 2006). Shared mental models resulting from knowledge integration are also positively related to team performance; therefore, according to the IPO model, the impact of shared mental models on team performance can be either direct or mediated by teamwork (Mathieu *et al.*, 2000; Turner *et al.*, 2014). Furthermore, successful team processes (patient-centered teamwork) significantly enhance team performance (Schmutz and Manser, 2013). Based on the depicted findings, an influence of knowledge integration on patient-centered teamwork and team performance is expected. Furthermore, it can be assumed that patient-centered teamwork serves as a mediator. Figure 1 presents the conceptual model of the study.

Based on the conceptual model of the study, the following are our hypotheses:

H2. Perceived knowledge integration is positively related to perceived patient-centered teamwork.

H3. Perceived knowledge integration is positively related to perceived team performance.

H4. Perceived patient-centered teamwork mediates the impact of perceived knowledge integration on perceived team performance.

Method

The present study is cross-sectional with a descriptive-explorative design. Data were collected by means of a staff questionnaire for all health care professionals working at the medical rehabilitation clinics and treating patients. The survey was anonymous and participation was optional for everyone. On completion, the questionnaire could be sent directly to our research team in a pre-paid addressed envelope. The study is part of the grant program "Design and evaluation of a patient-centered team development

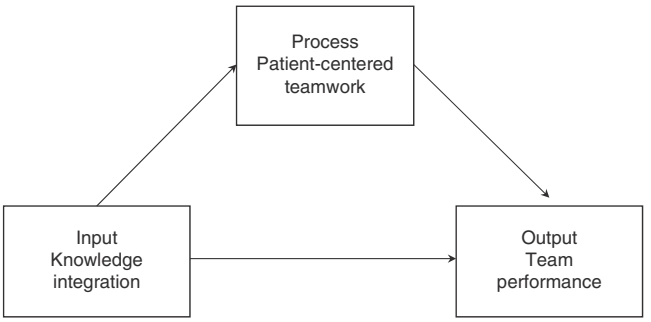


Figure 1.
Conceptual model of the study

program for medical rehabilitation" funded by the German Federal Ministry of Research and Education and the German Statutory Pension Insurance Scheme (Grant number: 01GX1024). It was approved by the Ethics Committee of the University of Freiburg (Official approval number: 190/12). A positive ethics committee vote is available.

Sample/participants

Based on the overall aim of the above-mentioned grant program to develop a team development program for all specializations, team sizes and clinic sizes, heterogeneous clinics were asked to participate. The clinics have different specializations – neurology (two clinics), orthopedics (six clinics) and oncology (two clinics) – as well as different sizes (90 to 210 beds). However, they are all somatic rehabilitation clinics with interprofessional health care teams and pursue a holistic treatment approach. We randomly selected 114 rehabilitation clinics with different specializations and asked them to participate; 23 of them were interested in the study. After the study was presented in more detail, 12 clinics in South Germany initially confirmed their participation in the study. Two of these clinics opted out before the data collection process began, while the remaining ten participated throughout the study. The surveys ($n = 890$) were sent to the designated study coordinator, who distributed them to all health care professionals in their clinic rehabilitation teams. The study coordinators received between 35 and 144 questionnaires, depending on the number of health care professionals at their rehabilitation clinics. Of the 890 staff questionnaires, 317 (response rate: 35.6 percent) were returned to the research team. Clinic 5 was eliminated from the analysis because of a response rate below 20 percent, leaving a final total of nine clinics and 306 staff members.

The sample consisted of nearly two-thirds women, with the percentage of female participants ranging between 57.1 percent and 82.9 percent at the nine individual clinics. Approximately 70 percent of all participants were between 40 and 59 years old. More than half (54 percent) had been working at their respective clinics for more than ten years, and more than half (54.7 percent) worked full time. The majority were physical therapists (29.6 percent) and nurses (26.9 percent), followed by physicians (17.6 percent), psychologists and social workers (9.6 percent), and dieticians, speech therapists and occupational therapists, who were combined in the category "others" (16.3 percent).

Measures

In order to assess knowledge integration, the modified "scale of knowledge integration problems" (KIP Scale; in German: *WIP-Skala)* (Steinheider *et al.*, 2009) was applied. The scale was adapted by using task instead of project. Furthermore, we eliminated the first item of the original questionnaire ("the team members are not prepared to consider other points of view") in order to shorten the questionnaire and adapt it to the present research context. This left a total of seven Likert-scaled items (KIP 1 to KIP 7; see the list below). The scales ranged from 0 (= does not apply at all) to 4 (= fully applies). Internal consistency in our study was identical with the original scale and can be evaluated as good (Cronbach's $\alpha = 0.87$). Factor analysis also revealed one dimension (explained variance: 56 percent), like the original questionnaire (Steinheider *et al.*, 2009). The scale value was calculated as the mean of the seven items, where one missing item was accepted. If more than one item was missing, no total score was calculated. Lower total scores indicate better knowledge integration. The items of the scale of knowledge integration problems (KIP) are:

- *KIP 1*. Team members cannot adequately express their own point of view to the other participants.

- *KIP 2* Too little time and effort is devoted to developing a common understanding of the task.
- *KIP 3* Team members do not put enough effort into understanding the ways of thinking or the procedures and methodologies of the other disciplines.
- *KIP 4* Team members have different objectives regarding the accomplishment of their tasks.
- *KIP 5* The interprofessional team composition makes it difficult to develop a common understanding of the task.
- *KIP 6* The discipline-centered thinking of individual team members makes it difficult to develop a common basis for task accomplishment.
- *KIP 7* The methodologies of the other disciplines remain unclear.

Patient-centered interprofessional teamwork was assessed via the Internal Participation Scale (Körner and Wirtz, 2013), consisting of six four-point Likert items ranging from 1 (does not apply at all), to 4 (fully applies), with the further option "I can't judge this." The items of the scale are: overall there is a friendly climate in the clinic; the health care professionals work hand-in-hand; agreements are made amongst health care professionals; the different types of treatment are well coordinated; communication in the team is efficient; and the health care professionals respect each other. When calculating the total score, one missing item was accepted. At a value of 0.77, the internal consistency (Cronbach's α) was lower than in the original study (0.87). High total scores indicate good teamwork.

Team performance in general was measured with the self-compiled global item "Overall, I evaluate the interprofessional team performance in our clinic as […]." The scale ranged from 1 (= very good) to 6 (= insufficient).

Data analysis

The quality of data entry was tested by taking random samples and checking the items for plausibility and performing missing data analysis. Furthermore the intra-class correlation coefficients (ICC) were calculated for the scales "perceived knowledge integration" and "patient-centered interprofessional teamwork" and the global item measure "perceived team performance" in order to determine the variance which is located on the clinic level (Wirtz and Caspar, 2002). The ICCs for knowledge integration (0.06), teamwork (0.08) and team performance (0.04) are very low. Therefore it is justified not to differentiate between the clinics and to aggregate the data for the analysis. To test *H1*, multivariate (item level) and univariate (scale level) variance analyses were carried out to compare the perception of knowledge integration by the different groups of health professionals. In order to test the association between knowledge integration and patient-centered teamwork (*H2*) as well as team performance (*H3*), regression analyses were calculated. The proposed mediation model (*H4*) was tested with classic mediation analysis (Baron and Kenny, 1986). IBM SPSS (version 21) for Windows was used for all data analyses.

Results

The assessment of knowledge integration revealed significant differences between health care professional groups (F (4, 285) $= 7.87$, $p < 0.001$, $\eta^2 = 0.099$). Physicians rated it most favorably ($M = 1.01$), whereas physical therapists ($M = 1.68$) and the other

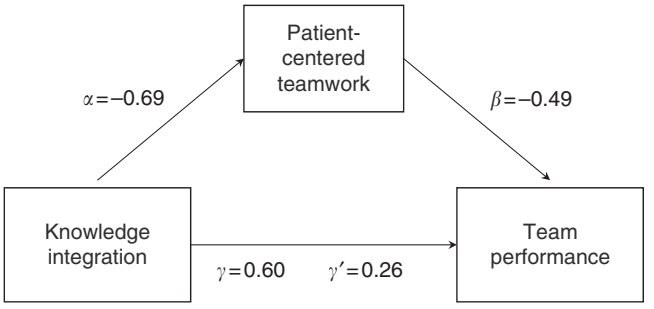
health professionals (e.g. dieticians, occupational and speech therapists) ($M = 1.68$) perceived knowledge integration as poorer. All items of perceived knowledge integration were rated significantly differently by the different health care professional groups except for item 5 ("the interprofessional team composition makes it difficult to develop a common understanding of the task"). Table I summarizes the results.

The results show that knowledge integration is positively associated with team performance (*H3*, $\gamma = 0.60$) and patient-centered teamwork (*H2*, $\alpha = -0.69$). Some of the standardized β weights are negative because of the opposite polarity of the scales. Results of the regression analyses testing the postulated mediation model (*H4*) are depicted in Figure 2 (see also Table II). All regression coefficients are significant at the

		Physicians ($n = 51$)	Nurses ($n = 78$)	Physical therapists and sports teachers ($n = 82$)	Psychologists and social workers ($n = 27$)	Others ($n = 42$)	Total	$F_{(df1,df2)}$	η_p^2
KIP1	*M*	0.84	1.53	1.55	1.30	1.60	1.40	$6.20_{(4,275)}$	0.08***
($n = 292$)	SD	0.90	0.99	0.86	1.03	0.80	0.95		
KIP2	*M*	1.31	1.55	2.10	1.89	2.07	1.78	$5.48_{(4,275)}$	0.07***
($n = 292$)	SD	1.12	1.15	1.10	1.19	1.10	1.15		
KIP3	*M*	1.08	1.76	1.80	1.52	1.83	1.64	$4.65_{(4,275)}$	0.06**
($n = 292$)	SD	0.94	1.13	1.10	1.12	1.10	1.10		
KIP4	*M*	1.49	1.90	2.02	1.85	1.95	1.86	$2.45_{(4,275)}$	0.03**
($n = 291$)	SD	1.10	0.91	1.01	1.03	0.96	1.00		
KIP5	*M*	0.75	1.21	1.23	0.96	1.17	1.10	$2.38_{(4,275)}$	0.03
($n = 289$)	SD	1.11	0.95	0.95	1.02	1.01	1.00		
KIP6	*M*	0.92	1.50	1.45	1.11	1.55	1.35	$3.44_{(4,275)}$	0.05**
($n = 290$)	SD	0.96	1.07	1.02	1.12	1.13	1.07		
KIP7	*M*	0.75	1.42	1.63	1.48	1.45	1.37	$7.09_{(4,275)}$	0.09***
($n = 286$)	SD	0.82	1.01	1.03	1.01	0.89	1.01		
KIP scale									
($n = 290$)	*M*	1.01	1.55	1.68	1.45	1.68	1.50	$7.87_{(4,285)}$	0.01***
	SD	0.77	0.73	0.72	0.72	0.75	0.77		
	Min	0.00	0.14	0.14	0.29	0.29	0.00		
	Max	3.43	3.57	3.43	3.43	3.00	3.57		

Notes: **$p < 0.05$; ***$p < 0.001$

Table I.
Perception of knowledge integration by different health care professional groups



Note: All coefficients are significant at the level $p \leqslant 0.001$

Figure 2.
Mediation model of knowledge integration, patient-centered teamwork and team performance with respective regression coefficients (standardized β-coefficients, see also Table II)

Model	Predictors	B	SE_B	β	ΔR^2	R^2
Team performance						
1a	(constant)	1.33	0.11			0.35
	Knowledge integration problems (KIP scale)	0.80	0.06	0.60***		
1b	(constant)	1.27	0.13		0.01	0.37
	Knowledge integration problems (KIP scale)	0.77	0.07	0.57***		
	Physicians[a]	–	–	–		
	Nurses	0.00	0.15	0.00		
	Physical therapists and sports teachers	0.25	0.15	0.11		
	Psychologists and social workers	−0.04	0.20	−0.01		
	Others	0.21	0.17	0.07		
Patient-centered teamwork						
2a	(constant)	3.80	0.05			0.48
	Knowledge integration problems (KIP scale)	−0.44	0.03	−0.69***		
2b	(constant)	3.84	0.06		0.01	0.48
	Knowledge integration problems (KIP scale)	−0.43	0.03	−0.67***		
	Physicians[a]	–	–	–		
	Nurses	−0.10	0.06	−0.09		
	Physical therapists and sports teachers	−0.10	0.06	−0.09		
	Psychologists and social workers	−0.03	0.08	−0.02		
	Others	−0.03	0.07	−0.02		
Team performance						
3a	(constant)	5.25	0.48			0.48
	Knowledge integration problems (KIP scale)	0.35	0.08	0.26***		
	Patient-centered teamwork	−1.03	0.12	−0.49***		
3b	(constant)	5.24	0.49		0.10	0.49
	Knowledge integration problems (KIP scale)	0.33	0.08	0.24***		
	Patient-centered teamwork	−1.03	0.12	−0.49***		
	Physicians[a]	–	–	–		
	Nurses	−0.09	0.14	−0.04		
	Physical therapists and sports teachers	0.15	0.14	0.07		
	Psychologists and social workers	−0.06	0.18	−0.02		
	Others	0.17	0.16	0.06		

Notes: [a]Physicians are the reference category. ***$p < 0.001$

Table II.
Linear regression analyses in the context of the mediation analysis

level $p \leqslant 0.001$. Whereas γ represents the direct effect of knowledge integration on team performance, γ' represents the indirect effect under the additional inclusion of the mediator patient-centered teamwork. The model is supported by an increase of 13 percent in the percentage of explained variance of team performance if the mediator is included (see Table II). In general, the percentages of explained variance (35 percent; 48 percent) can be regarded as high. As the direct effect is diminished if the mediator is added to the model, it can be concluded that patient-centered teamwork mediates the effect of knowledge integration on team performance. Importantly, since both the direct effect under inclusion of the mediator and the total effect under exclusion of the mediator are significant, the model reflects a partial mediation: Where fewer KIP exist, patient-centered teamwork and team performance are more positive. All hypotheses can therefore be confirmed. Additionally, all reported regression analyses were performed including dummy variables for the different professional groups. Results indicate that the health occupations have no significant influence on results. This is

represented in the nonsignificant β weights as well as by the lack of explanation of incremental variance (see Table II).

Discussion

As assumed, the results showed significant differences in the various health occupations' perception of knowledge integration. Physicians rated it better than other health care professionals, which may be due to differences in experiences, expectations, values and power between health care professions (Hall, 2005; Pecukonis *et al.*, 2008; Reeves *et al.*, 2010). However, health professional groups had no effect in the regression and mediation analysis. This can be explained by consistent differences between the health care professional groups over all variables in the model. Previous studies (e.g. Körner *et al.*, 2014) show differences for teamwork between the health care professional groups and underpin this assumption. Furthermore, the study confirmed a positive effect of knowledge integration on patient-centered teamwork and on team performance, with patient-centered teamwork mediating the effect of knowledge integration on team performance. This finding is consistent with the results of studies on shared mental models (Mathieu *et al.*, 2000), which showed that shared mental models (task and team) have an influence on team processes and team performance and that the effect of such models on team performance is mediated by team processes (Mathieu *et al.*, 2000; Klimoski and Mohammed, 1994). As knowledge integration reflects the process of establishing shared mental models, the studies can be viewed as comparable. Other studies found a reciprocal association between shared knowledge and team processes (Mathieu *et al.*, 2000; Stout *et al.*, 1999; Kozlowski and Ilgen, 2006). This means that better patient-centered teamwork is associated with better knowledge integration. However, based on the IPO model (Gibbon *et al.*, 2002; Lemieux-Charles and McGuire, 2006; Xyrichis and Ream, 2008; Körner *et al.*, 2016) and the existing study results (Gibson, 2001; DeChurch and Mesmer-Magnus, 2010; Steinheider *et al.*, 2009; Salas *et al.*, 2005), we decided in this study to categorize perceived knowledge integration as an input variable and regarded it as a precondition for patient-centered teamwork and team performance. The applied IPO model is accepted and often used as a framework for research despite the fact that it is very simple and does not consider the reciprocal association. More complex models exist, such as the input-throughput-output model or input-mediator-output-input model (Ilgen *et al.*, 2005; Schmutz and Manser, 2013).

The integration of the diverse knowledge of health professionals is a precondition for effective teamwork and team performance (Gibson, 2001; DeChurch and Mesmer-Magnus, 2010; Salas *et al.*, 2005). However, it does not necessarily result in improved performance, because "to improve performance, a mental model should not only be shared but also has to be correct" (Burtscher *et al.*, 2011, p. 259). Burtscher *et al.* (2011) found that similarity and accuracy of shared mental models have to interact to predict team performance. Further studies should take these two aspects of mental models into account.

The differences between the health care professional groups were to be expected, in keeping with the so-called silo effect (Hall, 2005; Pecukonis *et al.*, 2008; World Health Organization, 2010; Margalit *et al.*, 2009), which is often mentioned in the literature as a barrier to effective teamwork. Interprofessional training and education is recommended for breaking down professional silos and establishing a shared mental model in interprofessional teams (Hall, 2005; World Health Organization, 2010); several initiatives to implement interprofessional education for health care professionals have already been set up in universities and for apprenticeships. The review by Thistlethwaite (2012) and the collected reviews in the WHO paper

(World Health Organization, 2010) provide a comprehensive overview of the different interprofessional education approaches. Training approaches exist for medical practices such as medical rehabilitation. However, none are available for supporting knowledge integration processes and establishing shared mental models (Körner *et al.*, 2016), although pooling diverse professional skills, sharing information and integrating knowledge are also seen as prerequisites for a "holistic" rather than a mere fragmented picture of the patient (Thylefors *et al.*, 2005). Future interprofessional team interventions should focus more on knowledge integration in order to develop a common perception of the team's tasks and goals because this is the fundamental basis of successful teamwork (Antoni, 2010). Although the investigation of knowledge integration and its relation to teamwork and team performance are known to potentially support team and organizational learning efforts and to reveal key issues in team training (Steinheider *et al.*, 2009), limited research exists in this field.

Limitations

Our research is limited in several respects concerning methodology and sampling. First, the study was cross-sectional, which does not allow making any statements about causality links. Additionally, all measures were self-reported by the health care professionals in the clinics. This implies the risk of a common method bias as a result of using one questionnaire for all measures, where it can be assumed that the participating team members try to maintain consistency in their responses, or rather, tend to respond with a sweeping statement (Borg, 2003; Bortz and Döring, 2009). Furthermore, constructs may overlap because knowledge integration (shared knowledge, mental model) is sometimes used to operationalize teamwork (Xiao *et al.*, 2013) or relational coordination (Gittell *et al.*, 2009). Teamwork and team performance are also subjective measures and are not entirely distinct because both are assessed by the team members' self-perception at one point in time. Collecting data with a single method from a single respondent at one time is problematic for examining associations. Another major problem is the weak operationalization of team performance. Only a single item asked about the perception of performance. Although the use of a single item for the measurement of psychological constructs is regularly considered as a "fatal error" in research (Wanous and Reichers, 1996), assessing performance with a single-item measure "has a long history in organizational behavior research" (Wanous and Hudy, 2001, p. 368). "The main argument against using single-item measures is that internal consistency reliability cannot be estimated" (Wanous and Reichers, 1996, p. 631) and it is assumed that single items have "unacceptably low reliability" (Wanous *et al.*, 1997, p. 247). However, in the case of team performance it can be assumed that the psychological construct "is sufficiently narrow and unambiguous to the respondent" that a single item may be adequate in the study (Wanous and Reichers, 1996, p. 631). Further studies should ideally use objective, aggregated and longitudinal data. Furthermore, different assessment methods or different raters for predictor and criterion are needed to eliminate risks (Podsakoff *et al.*, 2003, 2012).

Second, the results cannot be simply generalized to all in-patient medical rehabilitation clinics in Germany as we were only able to include nine participating clinics in the study and the questionnaire return rate was lower (37.3 percent) than considered acceptable (50 percent) by Bungard and Jöns (1997). However, the figures are reasonable when compared with other studies in this field (Milch *et al.*,

1999; Körner, 2010). Participation was voluntary for the clinics as well as for the team members; therefore, we were only able to reach motivated clinics and staff. These may be the most powerful people or those with the most positive perceptions. This selection bias limits the representativeness and the generalizability of the results.

Third, there are also statistical limitations: although we have very small sample sizes for the health care professional groups, a multivariate analysis was performed. Moreover, we combined different health care professions into subgroups. It remains unclear whether significant differences in the perception of knowledge integration as well as team performance and patient-centered teamwork exist within these subgroups. Furthermore, group sizes differed strongly across professional groups (e.g. between physical therapists and sports teachers ($n = 82$) vs psychologists and social workers ($n = 24$). Regarding the mediation analysis, the perceptions of knowledge integration, patient-centered teamwork and team performance were combined for all different professional groups. This was done because the inclusion of these groups did not reveal significant effects within one of the regression analyses. However, the absence of these effects could also be explained by the small sample sizes of the different professional groups. Thus, future studies should aim to compare groups with greater and more homogenous group sizes.

Further research and practical implications

This study particularly confirmed the importance of team members sharing a common understanding of the task as well as of reflected team goals as stated in the definitions of teamwork (Manser, 2009; Kauffeld and Schulte, 2011; Salas *et al.*, 2005; Weaver *et al.*, 2010; Fitzgerald and Davison, 2008). It also showed that the perceptions of the health care professionals working in the team diverged concerning knowledge integration and the extent of the problems. The reasons for these differences (silo effects) should be investigated in further research. More research is also needed on the process of knowledge integration and the strategies for building shared mental models in health care teams. To the best of our knowledge, this is the first study to focus on knowledge integration in interprofessional health care teams in medical rehabilitation. Longitudinal studies with mixed-method designs should be conducted to verify the associations between knowledge integration, shared mental models, teamwork and team effectiveness.

In practice, the results of the study provide valuable starting points for team building, team development or team interventions. To provide best-practice patient-centered health care, however, more support for the teams should be provided, for example, through team development programs to pool the knowledge of the health care professionals. West and Lyubovnikova (2013) state that effectiveness of teamwork can be enhanced by providing team training in health care. In a review of interprofessional teamwork and team intervention in medical rehabilitation, Körner *et al.* (2016) identified positive evaluation results for most existing team interventions. These interventions spanned a wide range in content, method, duration, etc., and were heterogeneous in content and complexity. Most were complex interventions, which are rated as the best (O'Leary *et al.*, 2012). However, no existing team development program in Germany focusses on knowledge integration and on establishing a shared mental model of task and teamwork for interprofessional teams in medical rehabilitation.

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