Abstract. *The factors of knowledge transfer through teamwork in hospitals from developing medical systems have not been thoroughly studied. We explored physicians' assessment of knowledge sharing in teams in order to better define and understand these factors. We questioned 1615 physicians in 323 clinics, who returned 898 valid questionnaires. The physicians were asked to reflect on their learning experiences, as members in various teams, and on the value of these situations for their overall learning outcomes. We have used principal component analysis and OLS regression to outline the relations between the perceived quality of overall learning outcomes and the learning situations encountered in teamwork. We have obtained a model of teamwork learning, to which stability is central: a constant group of physicians, alternating in teams. The learning opportunities in the clinic include learning from one's own errors, learning from colleagues (role models), learning from patients, learning from case discussions, learning from clinical report discussions. Some are retained and some others are dropped, based on the physicians' attitude to them. While learning from one's own errors is preferred, role models seem to be rather controversial. Physicians' own judgments and evaluations of learning sources influence team knowledge transfer and its perceived quality.*

Keywords: knowledge transfer, inter-professional learning, medical teamwork

KNOWLEDGE TRANSFER IN MEDICAL EDUCATION FROM A TEAMWORK PERSPECTIVE

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1. Introduction

Teamwork is currently recognized as being Achilles' heel in medical practice and education (Burford, 2012; Curran et al., 2007; Wilkinson, 2002). It is a sensitive issue impacting largely on the quality of care. In fact, the two processes of the medical profession, *learning* and *doing*, can hardly be set apart, in the 'learning together to work together' paradigm (Thistlethwaite, 2012). This paradigm also considers the prepositions of learning, *with*, *from*, and *about*, which include the classical triad of *knowing what*, *knowing how*, and *knowing whom*, but go beyond it, in stressing the blending of collaborative, peer-to-peer learning with learning from models.

Medical education has at least two important particularities. First, it mainly takes place in a clinical context or, as it is commonly said, by the bedside. The variety of information, the pressure to learn and the costs of error differ largely from any other educational setting. Second, it is a continuous learning, blended with the professional activity itself. The natural question arising is to what extend this specific of medical education enables or hinders knowledge transfer, which is at the core of every learning process?

Teamwork is an intuition-based, personalized knowledge management (Sheffield, 2008). Healthcare organizations tend to prefer the codified approach, based on rigorous and rigid routines and procedures. Although this standardization is widely popular in healthcare nowadays, in the form of evidence-based medicine (Bossuyt and Kortenray, 2001), we claim that standardization may benefit from teamwork learning, because knowledge, in medical practice, is not always explicit. Initiatives like "clinical excellence" (Wailoo et al., 2004) should take into account the role of tacit knowledge diffusion in medical practice. Our discussion on learning and knowledge sharing will be an integrative approach to the types of knowledge and conversion from tacit to explicit, and to intergenerational transfer.

Knowledge dynamics is a soft organizational learning process taking place in a knowledge intensive workplace (Brătianu and Orzea, 2011; Brătianu et al., 2011; Kyndt et al., 2009; Liveng, 2010; Mayer, 2010; Morgan et al., 2005; Nissen, 2006; Pawlowsky, 2001; Prugsamatz, 2010; Roos et al., 2005). Knowledge dynamics can be described as a continuous restructuring of the field forces acting within an organization. It comprises processes like knowledge creation, knowledge acquisition, knowledge dissemination, knowledge diffusion, knowledge exchange, knowledge sharing, knowledge storing and retrieving, knowledge transformation, and knowledge loss. Knowledge dynamics can be better understood using the field concept for knowledge (Brătianu and Andriessen, 2008; Brătianu, 2010; Brătianu and Orzea, 2010a, Bratianu and Orzea 2010b), and the dynamic theory of organizational knowledge creation (Nonaka, 1994; Nonaka and Takeuchi, 1995; Ichijo and Nonaka, 2007). Knowledge dynamics became in the last years a challenge for knowledge management research due to its multidimensional implications in enhancing organizational performance and achieving the competitive advantage (Brătianu, 2009; Geisler and Wickramasinghe, 2009; Prusak and Weiss, 2007; Teece, 2009; Warren, 2008; Ryu, 2003). Some organizations have knowledge embedded in their processes and the knowledge that is in a format between passive and explicit. The challenge for

every organization is to transform passive knowledge into active knowledge and to transform individual, tacit knowledge into group, organizational knowledge. Organizations have to put processes in place and think of knowledge initiatives to bring about this transformation (Mândruleanu and Ivanovici, 2008). In our research we will concentrate only on knowledge transfer modes and knowledge transformation from tacit to explicit.

Our paper is structured as follows. First, we perform an analysis of the main factors influencing knowledge transfer in medical organizations, and of the issue of knowledge sharing in groups and teams. Second, we present the methodology and the design of our empirical research. Third, we present the most relevant of our quantitative research results. Finally, we interpret and discuss our findings, showing their importance for improving the performance of medical education.

2. Context

Knowledge transfer within professional groups, especially physicians, is a highly researched topic, recently. In our research, the focus is rather on the organizational culture components influencing the working of teams and the inter- and intra-team knowledge sharing processes. We show that organizational values and organizational climate are key contextual factors in enabling or disabling knowledge sharing processes (Willem and Scarbrough, 2006; Wang and Noe, 2010). One of the major ingredients of teams promoting knowledge sharing is trust. Bontin-Foster et al. (2008) have distinguished trust as a major ingredient of teams promoting knowledge sharing. This *willingness to be vulnerable* (Lencioni, 2002) makes people cooperate, in order to balance their strengths and weaknesses, rather than compete. In highly competitive environments, as medical teams (Porter and Teisberg, 2007), cooperation is an important lesson to be learnt.

The medical system, especially in teaching and research hospitals, which are the focus of our research, is mainly vertically structured, with a significant emphasis placed on hierarchy, on formal relations, while knowledge sharing is largely horizontal: "Knowledge sharing is a more subtle concept, and is seen as a dual process of enquiring and contributing to knowledge through activities such as learning-by-observation, listening and asking, sharing ideas, giving advice, recognizing cues, and adopting patterns of behavior." (Bosua and Scheepers, 2007, p. 99). Thus, knowledge sharing becomes possible in environments where individuals are categorized based on their respective knowledge levels, not on any other types of hierarchies. A knowledge level is given by the integrative result of tacit and explicit knowledge (Brătianu and Orzea, 2010a; Brătianu and Vasilache, 2010).

One of the prerequisites of knowledge transfer in teams is team stability. Medical migration used to be an issue of the post-colonial world, involving physicians migrating from the African countries, or India, to Europe or US (Astor et al., 2005; Hagopian et al., 2004). Recently, physicians from less prosperous European countries, with low budgets allocated to healthcare, migrate to the West, creating nearly insurmountable problems to the system. Presently, Romania only has 1.9 physicians

per 1000 inhabitants, as compared to 3.3 physicians per 1000 inhabitants, the European average. Migration is more intense at the entry-level, of recent graduates starting their medical training in teaching and research hospitals. Their presence in these large hospitals, confronted with very diverse and complex medical cases, removed some of the burden of ordinary, routine work, allowing professionals to focus on performance in research and healthcare. Thus, their migration not only diminishes the replacement rate, in professional teams, but also forces older and more skilled doctors to take over routine tasks, and reduce the time allocated to learning and sharing knowledge. The quality of the knowledge intensive processes is consequently lower, and so is the quality of the medical act. As far as teams are concerned, in the context of medical migration they tend to be more unstable, exhibiting lower levels of enthusiasm and a general climate of transition. Knowledge transfer, as a basic mechanism for learning, under these circumstances, is expected to be less systematic, depending more on nuclei of good practice and less on procedures that can be traced at the scale of an entire medical section, or hospital. Given that national professional record and recommendations are little or not taken into account in international recruitment procedures, physicians aiming to leave are not interested in building a strong reputation inside their present teams.

Considering the context above, we advance the following research hypotheses:

- The learning process in medical interprofessional learning is based mostly on the knowledge conversion from tacit to explicit knowledge;
- Knowledge sharing is practiced mostly by younger physicians;
- Intergenerational and inter-teams knowledge transfer are relatively less important in the medical learning process.

Based on these hypotheses, we have investigated the learning processes, intra- and inter-teams, in Romanian teaching and research hospitals. The methodology of the research, as well as the results and discussions, are expanded in the next sections.

3. Methods

The paper identifies the modes of knowledge transfer and knowledge conversion inside the teams, and between the teams in medical practice, in large university hospitals (LUHs) in Romania. Also, our research focuses on the contextual factors influencing the learning process, both at the team level and at the clinic level.

A university hospital is a learning environment where teaching, learning and research integrate in a complex dynamics (Mennin, 2010). In order to ensure a better methodological focus of the paper, we took as a structural unit of analysis the clinic which, in the Romanian healthcare system, is a section where not only healthcare services are provided, but also teaching and research, to undergraduate and post-graduate medical students. Thus, the medical clinic has a complex culture, which combines a hospital environment with an academic environment, at the simplest structural level. For these reasons, the medical clinic was set as the survey unit in our research. We focused on the perceptions of physicians on knowledge transfers, based on the following criteria:

- physicians have the leading role in teams, and they initiate knowledge transfers;
- they mediate between the individual and the organizational level of knowledge transfer, as considered in our study;
- their professional culture is homogenous, allowing for a good replication of the results of the study.

Thus, we consider that our option for physicians, exclusively, preserves the relevance of the study, while diminishing the pool of respondents, which turns it into a methodological advantage. Still, an analysis extended towards all the categories involved in hospital knowledge transfers can further refine the results of the present research.

The research question is identifying how learning becomes possible through knowledge transfer in medical teams. We selected the variables based on a literature review, choosing a fixed research design (quantitative study). We measured a fixed range of variables, by means of a questionnaire. The questionnaire was suited for this research because it was inexpensive, it saved time, and it was anonymous. It comprised 65 items and 10 classification questions, and was applied to physicians in Romanian LUHs.

The hospitals were selected based on simple random sampling without replacement. Knowing the population of Romanian LUHs, according to the Romanian Healthcare Statistics Department, we applied the formula of the standard error, for a 95% confidence interval (z = 1.96):

$$\sigma_p = \frac{p - \pi}{z} = \frac{D}{z} \tag{1}$$

By replacing p in the formula, we have computed n, the number of clinics to be included in the sample:

$$n = \frac{\pi(1-\pi)z^2}{D^2} \tag{2}$$

By rounding n to the next integer, the sample size was set to 323 clinics. Secondly, the physicians were selected, by applying stratified probabilistic sampling in each of the clinics. The strata used were interns, physicians and senior physicians. The final sample included 1615 physicians, who returned 898 valid questionnaires. The returning quota of 55% was considered acceptable for the analysis, given the difficulty of access to data, in the circumstances of the study.

The surveyed physicians took part in 142 teams, over the last year, the average participation per physician being of about six teams. The frequency analysis revealed that 135 physicians took part in more than 10 teams; 572 physicians took part in 5 to 10 teams; 191 physicians took part in less than 5 teams.

By teams, we understand surgical teams, as well as complex medical care teams. 37% of the sample considered were surgeons (332), 16% (144) were anesthesiologists – considered as parts of the surgical teams, as well, while the rest of the physicians (422) were internists of various specialties, radiologists, pathologists.

The surgical team was defined as the assembly of physicians doing surgery together, in one surgical instance, while the medical team was defined as the assembly of physicians contributing to the resolution of a medical case. Physician learning was quantified by the variables:

- errlrn (learning from one's own errors);
- clglrn (learning from colleagues);
- ptlrn (learning from patients);
- ltmdsc (learning from team case discussing);
- lcldsc (learning from clinic report discussing).

We have used explanatory variables of our learning model:

- age (age of the physicians);
- spec (specialization);
- teamm (team membership);
- tsize (team size);
- tsko (task orientation);
- rmdlt (role models in the team);
- voclr (clear vision and objectives of the clinic);
- clpspp (clinic performance support);
- clldr (clinic leadership).

The variables which were not expressed as frequencies were recorded on Likert scales from 1 to 7. Cronbach's alpha for the first set of variables was 0.714, which was considered acceptable for the analysis, while Cronbach's alpha for the second set was 0.787, which was also considered acceptable.

As for the size of the team, we distinguished between small teams, with less than 5 members; medium teams, 5 to 7 members; large teams, with more than 7 members; the sizes were established based on the average team size in the considered hospitals, and on similar studies methodologies (Kalisch and Begeny, 2005; Ratto et al., 2002). The descriptive statistics for the two sets of variables considered are shown in Tables 1 and 2 below:

Table 1

Descriptive statistics for team learning variables

	N	Minimum	Maximum	Mean	Std. Deviation
errlrn	142	2	6	3.43	.985
clglrn	142	1	3	1.70	.781
ptlrn	142	1	2	1.66	.475
ltmdsc	142	1	5	2.29	.912
lcldsc	142	1	4	1.66	.858
Valid N (listwise)	142				

It can be seen that learning from one's own errors prevails over learning from colleagues. Our sample is, consequently, more inclined towards individualism, than towards cooperation. This is actually a conversion process from tacit knowledge (own experience, unstructured) into explicit knowledge (lessons learned, structured) which is significant for the medical practice environment. Also, learning from patients is not

significantly valued, which accounts for prejudices still embedded in the system. A separate test on the sample of young doctors revealed a value of 3.14 for learning from patients, with a standard deviation of .801, showing that the dynamics of the sources of learning and their order of preference are age-dependent. Our second hypothesis is confirmed.

Table 2

Descriptive statistics for explanatory variables

	N	Minimum	Maximum	Mean	Std. Deviation
age	142	31	52	34.97	13.111
teamm	142	1	5	2.20	.979
tsko	142	1	4	3.41	.719
rmdlt	142	1	4	2.35	.961
cblns	142	1	3	1.71	.818
clpspp	142	1	2	1.63	.486
clldr	142	1	5	2.39	.952
Valid N (listwise)	142				

The age of the teams (average of 35 years) indicates a population of physicians having passed their specialty exam and having become independent in their profession (without a tutor). Team membership was recorded as a sense of belonging to the team they are currently working in. The team was defined as the people currently contributing to the solving of a medical case, from a surgical or medical point of view. The attachment to a team is rather low, which constitutes a risk for team cohesion, but also an opportunity to learn from more diverse teams. The task orientation – that is, focusing on what you have to do, rather than on relations – is rather high, suggesting that physicians are more involved in the content, than in the context of their work. The role models in the teams (people whom physicians would like to resemble) are not so well individualized. Clinic leadership, as well as clarity of vision and objectives, is moderately well represented. We haven't focused, here, on the vision of the clinic as it publicly expressed (for instance, on the hospital website), but rather on the way in which it is perceived (internalized) by the physicians in the clinic.

The descriptive statistics for *team size* presented in Table 3 below:

Table 3

Descriptive statistics for team size

		Freq	Percent	Valid Percent	Cumulative Percent
Valid	1	73	39.9	51.4	51.4
	2	60	32.8	42.3	93.7
	3	9	4.9	6.3	100.0
	Total	142	77.6	100.0	
Missing	System	41	22.4		
Total		183	100.0		

Small teams (1) are prevailing, while large teams account for only 6.3% of the total, due to the contextual influences presented above. This can be hypothesized as enabling knowledge transfer.

4. Results and discussions

We have run Pearson correlations, 2-tailed, at the 0.01 level, between the learning and explanatory variables. We found out a negative correlation of -.360 between *error learning* and *clinical support*, suggesting that the less clinical support, the more focus on one's own errors (*you're on your own, learn*). There is also a negative correlation of -.297 between *colleagues learning* and *patient learning*, suggesting that the two seem to exclude each other. As learning from colleagues correlates positively to team membership (.279), while learning from patients correlates negatively with team membership (-.256), it may be inferred that doctors which activate more easily in teams are more oriented towards learning from their colleagues and vice-versa, while the others would rather prefer a one-to-one learning relationship with their patients.

The age correlates negatively with the clarity of the vision and the objectives (-.316), meaning that the younger the doctor, the clearer these should be, to provide him with an initial guidance. Clinic leadership correlates well with learning through case discussions (.312), implying that the leadership creates the context for these discussions and makes them efficient, from the point of view of learning. The role models are negatively correlated with clinic support (.-213), meaning that the two compensate each other: either it is a learning context at the team level, either encouragement at the clinic level. If together, they are perceived as redundant (see Table 4).

Table 4

Factorial analysis of learning

	1	2	3
ptlrn	.790	-.278	.083
clglrn	.621	-.214	.022
ltmdcs	-.087	.748	.048
errlrn	.044	-.330	.292
lcldsc	-.052	-.540	.516
a. Extraction method: Principal component analysis b. 3 components extracted.			

We labeled the three components extracted as follows: *human factor* (colleagues and patients); *relational factor* (team discussions); *individual-institutional interaction* (clinical discussions and learning from one's own errors). As the first component accounts for the largest part of the variance (approx. 22%), motivations for intra-team knowledge transfer are still exterior to the team, the transfer being rather pulled, than pushed. Our first hypothesis is confirmed. We considered the perceived quality of overall knowledge sharing on the 1 to 5 Likert scale. The OLS analysis for overall knowledge sharing quality is presented in Table 5 below:

Table 5

Regression coefficients

	Model 1	Model 2	Model 3	Model 4
Constant	6.011	7.172	6.439	3.432
Models	- 0.072	- 0.036	- 0.012	0.044
Patients	0.138	0.014	0.102	0.031
Team bonuses	-0.027	- 0.049	- 0.070	- 0.022
Team support		- 0.034	- 0.050	0.031
Task orientation		0.081	0.061	0.029
Team leadership		-0.251	- 0.230	- 0.073
Learning from errors		- 0.232	- 0.224	- 0.086
Clinic vision			0.018	0.013
Clinic support			0.359	0.114
Clinic bonuses			0.019	0.027
Team shifts				0.542
New members				- 0.258
R^2 adjusted	1.3%	2.5%	7.3%	11.1%
Change in R^2		1.2%	4.8%	2.9%

The overall perceived quality of knowledge transfer is correlated with team shifts, but not with the presence of new team members, as they may create a feeling of insecurity and distrust. The ideal knowledge sharing situation is that of a stable pool of physicians, alternating in teams. Support in teams is also seen as correlating positively with knowledge sharing, as it promotes trust and cooperation.

As R^2 does not decrease, all the regression variables in the final model are well chosen, contributing to the perceived overall quality of knowledge sharing processes. The first group of variables includes extrinsic motivators, showing that a good relation with the patients tends to influence knowledge sharing more than models or bonuses. The second group of variables refer to the relationship between the individual and the team, which seems to influence little the quality of knowledge sharing. Our third hypothesis is confirmed.

Overall, the variables in the third group, referring to the relationship between the clinic and the team, are more influential, being responsible for both inter-team knowledge sharing processes, and intra-team knowledge sharing.

The focus should be on the clinic, as essential entity of knowledge transfer, on its culture and integrative capacities, rather than on the team. Strategies to stimulate team shifts, by increasing the number of young team members, and by controlling the flux of inter-disciplinary cases, are beneficial for inter-teams knowledge transfers, at the level of the clinic. Also, the weighting of the team size, in favor of small and medium teams, enforces knowledge transfers in hospital clinic.

6. Conclusions

The paper was structured along two axes: the theoretical excurse, revising some of the most relevant models of knowledge transfer, and the applicative part, investigating how knowledge transfer takes place in medical practice, to select the

most suitable model. Our study identified the factors of teams knowledge transfer in medical clinics of large university hospitals, by checking several hypotheses, which linked these processes with the age and size of the teams. Practical recommendations regarding the selection and formation of the teams were, thus, formulated, as well as insights into the in-depth mechanisms of knowledge transfer, and its influencers.

It is of interest to mention also the fact that mixed-age teams may constitute a strategy to increase the intergenerational learning. The team knowledge level depends not only of how much knowledge each member of the team has got, but also of the knowledge transfer between the members of the team. If the team is composed of members belonging to different generations, then the intergenerational learning becomes the most important mechanism for increasing the knowledge level of the whole team, which could be a realistic clinic objective.

Smaller team size and younger physician age were found as positively correlated with knowledge transfer, inside, as well as between teams. Extrinsic factors of knowledge transfer appeared to be prevalent, pleading for a stronger focus on explicit knowledge transfer processes, aligned with standardization and routine in healthcare. An equilibration of the balance, in the sense of paying more attention to the tacit side of knowledge transfer would be, in our opinion, a sound recommendation, which will benefit organizational climate. However, tacit knowledge is strongly personal knowledge and it takes sometimes a significant effort to transform into explicit knowledge through externalization and only then to be transferred through specific mechanisms to the other members of the team. Also, it is necessary a certain degree of motivation that can be stimulated trough the organizational culture of the medical clinic.

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