PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (**http://bmjopen.bmj.com/site/about/resources/checklist.pdf**) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	The diffusion of knowledge and behaviours among trainee doctors in an acute medical unit and implications for quality improvement work. A mixed methods social network analysis.
AUTHORS	Sullivan, Paul; Saatchi, Ghazal; Younis, Izaba; Harris, Mary

VERSION 1 - REVIEW

REVIEWER	Dr Veena Patel University Hospitals of Leicester NHS Trust, Leicester, UK
REVIEW RETURNED	12-Nov-2018

GENERAL COMMENTS	I have read your submission with great interest. The manuscript deals with a novel perspective to the social network analysis in healthcare and will interest the readers of this journal. I have few major concerns and advice for revision of the paper improving the soundness of the methodology, analysis and reporting. 1. Regarding the introduction, research question and study objective: The background information explaining the current context of the study and available evidence on current delivery of knowledge in these 3 domains of healthcare provision, available network structure supporting learning is not clear in the introduction. The conceptual framework leading to the research question is also lacking. Socila networking in study is via interaction only, were they communication on mails, what'sup, facebook; role of superviors/managers in the team is clear. 2. Abstract: the objectives in the abstract and the main article differ. And the conclusion does not answer the research question raised. 3. questions regarding the study design : Survey and interviews are 2 methods used to answer the research question in the study. The study lacks description of the reason for choosing this method and its advantages. The survey questions and its analysis is not mentioned in the paper. The questions used in the interview are not illustrated. Is this open interview or structured or semi-structured interview? Please provide concise details of your analysis to show scientific rigour and reliability Here are some excellent and current reference books: o Corbin, J., & Strauss, A. (2014). Basics of qualitative research: Techniques and procedures for developing grounded theory: Sage publications.

	Patton, M. Q. (2015). Qualitative research & evaluation methods: Integrating theory and practice. Thousand Oaks: Sage Publications. Also from the survey and interviews how were themes identified? Where there different reiterative coding stages? How were the conflicting views resolved during coding? 4. Critical thoughts are missing, like: • These teams having supervisors/ management roles and its impact on the learning? Role of senior nurse/ managers/rota/ shift patters/ culture of the team are not addressed or taken into account for. • Study does not give clear information about the work-organisation domain of the study? Consultant conducted the interview who invited participants for study ..which raises the question of sampling bias; and it is interesting to note all the participants who were invited were willing to participate !! this could influence the results Overall description of the methodology is weak: Reflexivity is not addressed. 4. Results: descriptions on the participants –male, female ; ethinic background ; survey participants ? 5. survey results is lacking and who this information was transcribed to SNA is not clear. Only few quotations are listed and shows lack of transparency. 5. Reference: are not upto date; further critical revision is needed. Young A J Research topics and trends in medical education by social network analysis BMC Medical education 2018 18: 222 “Social network analysis in medical education” Isba et al Med Educ. 2017 6. Discussion: lacks critical references comparing the current available evidences supporting the study results. The 3 domains in study are complex and has various other factors which influence the learning and also social networking factors. Clarity on the what sort of social networking /networks will be helpful for the readers to understand the influence. 7. Limitation: sampling bias is the major flaw; author says inductive-deductive approach is used and themes emerged were 3 domains as pretermined in the study…were they no new concept emerged during the interview …? Questions the validitiy of the study.

REVIEWER	Alison Fox The Open University. UK
REVIEW RETURNED	25-Nov-2018

GENERAL COMMENTS	Dear Paul and co-authors I really enjoyed reading this paper as it connects with themes from my parallel research with beginning teachers and because I agree with you that it is important to recognise and examine the power of relationships to affect professional practice development and learning, as you do in this paper.

	I have offered the detail of my comments on an annotated copy of the pdf version of your paper. I hope you find these constructive, as they were intended. In summary I recommend two main areas for development, which I believe would benefit a reader. The first is in the clarity of the research design as communicated. Most of the information about the parts of the design is included but the reader would benefit from an overview of this and also a rationale for the use of QUAN and then QUAL data collection, including its integration. This sequential explanatory study can be connected with wider methodological writing about Mixed Methods research and I have recommended some references in my annotated copy which I hope will be of interest/use. I also recommend bringing all the comments relating to the ethical dimension to the study together under the one heading and have I posed some questions which might inspire some further reflections in this area, which could benefit other researchers. The second area is making a stronger connection between the presentation of the results and the claims made in the discussion and I have offered some suggestions on the annotated copy of the paper. To this end, I think that more use could be made of the network diagrams included to illustrate certain claims. I also wondered whether some conceptual links could be made to thinking about the way those within close practice settings learn from one another. I have pointed you to Etienne Wenger's work on communities of practice, in case you are not already familiar with this, which seems to add some useful ideas about participation in communities which seem to match well with the teams within the medical unit you were studying. This work doesn't refer specifically to networks (as it uses language of community rather than network) but might cover all the teams in the unit if conceptualised together as a community of practice. I think the paper reflects a worthwhile, well thought through and systematically carried out study and I am grateful to have had the opportunity to review it. In my final comments on the annotated copy I have offered a suggestion for further study which could follow on from this. I think the paper and the data you have revealed has potential to affect future support for trainee medical professionals. With best wishes, Alison The reviewer provided a marked copy with additional comments. Please contact the publisher for full details.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Reviewer Name: Dr Veena Patel

The manuscript deals with a novel perspective to the social network analysis in healthcare and will interest the readers of this journal. I have few major concerns and advice for revision of the paper improving the soundness of the methodology, analysis and reporting.

Comment 1: The conceptual framework leading to the research question is .. lacking.

We have included a description of the conceptual framework, and the established framework that it is based on (Institute for Healthcare Improvement's triple aim framework), adapted into a framework to classify domains of work – clinical/technical behaviours link with the IHI domain of health, outcomes patient centred behaviours that link to experience, and self organising/ prioritising, that link with efficiency. PAGE 4 LINE 55 ff

Social networking in study is via interaction only, were they communication on mails, what'sup, facebook;

We aimed to concentrate only on near real time, as required' knowledge transfer in the workplace, when trainees either observe behaviours that they will emulate, or when they ask for advice and receive teaching in relation to their own patients. These would be interactions that occurred with physical proximity.

This is explained in introduction, PAGE 5 LINES 24-31

role of supervisors/managers in the team is not clear.

The aim of this research was to explore learning between peers i.e. among trainees, albeit at different levels of seniority. The way these large teams are structured means there are no direct lines of hierarchy, so, for example, while FY doctors interact with registrars, they do not have allocated supervisors. We do delineate different grades of trainees in the network maps. We did not include knowledge transfer from consultants as we specifically wanted to explore horizontal spread from trainee to trainee.

Abstract: the objectives in the abstract and the main article differ. And the conclusion does not answer the research question raised.

Abstract aim has been adapted;

Reviewer 1 Comment 5 questions regarding the study design: Survey and interviews are 2 methods used to answer the research question in the study. The study lacks description of the reason for choosing this method and its advantages.

We aimed to research encounters that involved physical proximity, and occurred on near real time during patient care. This can be achieved through recall based methods, such as surveys and interviews. Another available method would be ethnography, but this would require considerable resource to capture the ad hoc encounters over a period of months and we were unable to use this approach. There are methods to capture non face to face encounters such as mapping of emails, but we did not intend to research email communication. We refer to this in introduction, PAGE 5 LINES 24-31

Reviewer 1 Comment 7 The questions used in the interview are not illustrated.

The initial interview guide is included as supplementary material.

Is this open interview or structured or semi-structured interview? Please provide concise details of your analysis to show scientific rigour and reliability

Interviews were semi structured. The initial interview guide consisted of prompts to ensure domains were covered, along with example scenarios to illustrate the concepts. This is now explained in the paper; methods, interviews section. PAGE 7 LINES 34-40

Reviewer 1 Comment 8. Also from the survey and interviews how were themes identified? Where there different reiterative coding stages? How were the conflicting views resolved during coding?

Coding was done after every 2-4 interviews. Themes that developed were incorporated as prompts into subsequent interviews. At the end of the project coding was repeated for all interviews by 2 coders. When items were coded differently the coders discussed these and reached consensus. This is included in methods, interviews section. PAGE 7 LINES 43-50

Critical thoughts are missing, like:

- These teams having supervisors/ management roles and its impact on the learning? Role of senior nurse/ managers/rota/ shift patters/ culture of the team are not addressed or taken into account for.

The goal was to explore relationships between trainee doctors. We suggest this research should be extended to include other professions.

Study does not give clear information about the work-organisation domain of the study?

We include examples to illustrate the domains in an additional text box.

Consultant conducted the interview who invited participants for study ..which raises the question of sampling bias; and it is interesting to note all the participants who were invited were willing to participate !! this could influence the results

We believe the relationship of the consultant with the trainees was not such that they would feel compelled to take part and it was made very clear that they could decline. We believe the high acceptance rate was due to the fact that participation was made easy. Interviewees were asked if they would take part at a time when they were not busy, and interviewers delayed interviews if the trainees became busy at the appointed time.

For the surveys, trainees were asked to complete a short questionnaire on their own mobile devices during a routine meeting and told that the survey takes on average 2 minutes. Again, we made it very clear that participation voluntary, and that only a non-clinical research fellow would know who did and didn't take part, and all data that was available to the consultant researcher would be anonymised.

Re bias: the authors' feel that the fact that all invited participants agreed to take part actually can be seen as reducing bias, since there can be no characteristics over-represented in the 'decline' group etc. In the surveys this meant we were able to sample the entire group and get a complete sociocentric SNA graph. In the interviews, we sought a maximum diversity sample, and the high rate of acceptance meant we were able to select from the mix of different subgroups; again, the fact that none declined, in our own view, reduces response bias.

Overall description of the methodology is weak: Reflexivity is not addressed.

We have expanded the methods section and included a section on reflexivity. PAGE 7 LINES 10-17

Results: descriptions on the participants –male, female ; ethinic background ; survey participants ?

We include a breakdown by gender and role. We did not record ethnicity. PAGE 8 LINES 50-53

Survey results lacking and who this information was transcribed to SNA is not clear.

Survey results are represented by network maps and metrics that describe those maps, these are now included in the results/surveys section.

We have included description of the data entry into SocNetV software. In methods, surveys section. PAGE 6 LINE 34

Only few quotations are listed and shows lack of transparency.

We have included more quotations to provide richer illustration of theories

Reference: are not up to date; further critical revision is needed.

Young A J Research topics and trends in medical education by social network analysis BMC Medical education 2018 18: 222

We feel that the social networks referred to in this paper describe linkages between researchers rather than clinical practitioners or teachers, and after careful reflection, do not feel that this would add to the narrative of our paper.

"Social network analysis in medical education" Isba et al Med Educ. 2017

We are grateful for the pointer to this paper, and have included references to it. PAGE 8 LINE 34; PAGE 13 LINE 27

6. Discussion: lacks critical references comparing the current available evidences supporting the study results.

We have added evidence supporting our finding of high influencers and their characterisitcs.(references 21-22) We have been unable to find literature regarding the different network structures that are at play for the different domains of information, and believe this is the first study to report on this.

7. Limitation: sampling bias is the major flaw;

As discussed above, the authors suggest that sampling was not associated with significant bias, either in terms of the actual sample that was invited (all team members for surveys and a maximum

diversity sample (in terms of job roles) for interviews. We believe that he high uptake actually reduces responder bias

author says inductive-deductive approach is used and themes emerged were 3 domains as pretermined in the study…were they no new concept emerged during the interview …? Questions the validitiy of the study.

The domains were used as a framework to structure the interviews. The interim analyses allowed emergent theories to develop within and across the pre-defined domains, and, while thematic analysis was done with the framework in mind, it was intended to develop theories that transcend to basic domain framework. This is included in methods, interview section.

Reviewer: 2

Reviewer Name: Alison Fox

Institution and Country: The Open University. UK

Please state any competing interests or state ‘None declared’: None declared.

Please leave your comments for the authors below

Dear Paul and co-authors

I really enjoyed reading this paper as it connects with themes from my parallel research with beginning teachers and because I agree with you that it is important to recognise and examine the power of relationships to affect professional practice development and learning, as you do in this paper.

I have offered the detail of my comments on an annotated copy of the pdf version of your paper. I hope you find these constructive, as they were intended. In summary I recommend two main areas for development, which I believe would benefit a reader.

The first is in the clarity of the research design as communicated. Most of the information about the parts of the design is included but the reader would benefit from an overview of this and also a rationale for the use of QUAN and then QUAL data collection, including its integration. This sequential explanatory study can be connected with wider methodological writing about Mixed Methods research and I have recommended some references in my annotated copy which I hope will be of interest/use.

This is added at the end of the introduction. PAGE 5 LINES 27-30

I also recommend bringing all the comments relating to the ethical dimension to the study together under the one heading and have I posed some questions which might inspire some further reflections in this area, which could benefit other researchers.

This has been done PAGE 5 LINE 34 and ff

The second area is making a stronger connection between the presentation of the results and the claims made in the discussion and I have offered some suggestions on the annotated copy of the paper. To this end, I think that more use could be made of the network diagrams included to illustrate certain claims. I also wondered whether some conceptual links could be made to thinking about the way those within close practice settings learn from one another. I have pointed you to Etienne Wenger's work on communities of practice, in case you are not already familiar with this, which seems to add some useful ideas about participation in communities which seem to match well with the teams within the medical unit you were studying. This work doesn't refer specifically to networks (as it uses language of community rather than network) but might cover all the teams in the unit if conceptualised together as a community of practice.

We have included reference to Wenger's work on communities of practice as well as Lingard's theory of collaborative competence

I think the paper reflects a worthwhile, well thought through and systematically carried out study and I am grateful to have had the opportunity to review it. In my final comments on the annotated copy I have offered a suggestion for further study which could follow on from this. I think the paper and the data you have revealed has potential to affect future support for trainee medical professionals.

With best wishes, Alison

Main text:

Comment 1: The reference (1) should be part of the first sentence and hence have the full stop/point after the number I believe. This applies throughout the paper.

We have checked this and think the system used by BMJ Open specifies that the reference follows the full stop.

Comment 3: These aims seem to be potentially closed questions, when phrased as 'whether'. It would be more powerful if open ended questions could be generated. The paper does more than answer whether X or Y happens or not.

We have altered the aim to:

The aim of this research was to explore how knowledge, attitudes and behaviours diffuse between individuals through different network structures within similar bounded teams of trainee doctors in a particular organisational setting.

PAGE 4 LINE 47 and ff

Comment 4: This is where you can explain that your study, unlike some of the others published worldwide, are looking at what we assume are within-organisational teams, rather than a broader network which extends beyond an organisation (if this is the case). It would be helpful to a reader to clarify the location and scale of the team/network to set up a reader for the fact that not one team but multiple within-organisation teams were looked at. Suggest this could read something like 'different network structures represented by different teams in a particular organisational setting'

Response: As above

Comment 5

A reader is expecting one network map of one team. As it appears now that there are six teams, this would be helpful to set up on the previous page. Perhaps these could be called team-networks?

We have included additional text. :

The research was conducted in five consecutive teams, each of approximately 20 trainee doctors, over a total period of 24 months. Individuals mostly spent either 4 or 6 months on the team. PAGE 6 LINE 11 and ff.

Comment 6

It would be useful to have a comment about whether participants had any questions about this ie. commenting on one another or whether you think there are any special considerations you had to take into account to ensure this felt safe for them to do so (as advice which would help others), even if this is contained within your application and approval with the REC.

We have included:

We reassured participants that confidentiality would be maintained and survey data would be anonymized by an external research associate prior to analysis.

Comment 7: On what basis did they decide which method to engage with? Could they participate in both? What was your rationale for having two methods? This seems to be a sequential design and so this could be highlighted.

We have included:

The first two teams completed electronic surveys, and the members of the following four teams participated in interviews. PAGE 5 LINE 50

Comment 8:

Did the survey data therefore inform what was asked of the interviewees? Was it an iterative design where the interviews were being used to generate QUAL data to help explain the patterns and possible factors affecting the patterns found in the QUAN data?

We have included:

Interviews guides included questions about which colleagues were particularly influential, and what their characteristics were, in order to explore the finding of high influencers in the initial survey phase of the study. PAGE 7 LINE 22

Comment 9: Here we get clarity about the bounds of the networks available to them? Is it possible that the trainees were approaching people beyond their unit? This might be worth reflecting on as a limitation of the study and an area for further research ie. allowing for a more porous/extended network of influence. This is increasingly the case in the age of social media and the opportunity to learn from others/take advice well beyond those known to them.

We have included a comment on the fact that we did not include links to others outside the team in discussion, limitations. We have included a comment on the fact that we excluded electronic communication PAGE 16 LINES 18-33

Comment 10: Was it important that no-one saw one anothers's survey results in case of feeling safe to answer?

See response to comment 6

Comment 11: Therefore was it important that the participants didn't get to find out one anothers' responses to feel safe to respond and also that the interview transcripts were confidential? How did you move from this QUAL data to mapping team networks of these trainees? Did you? It is important to explain how you integrated data from the two phases.

The anonymization of data precluded any release of specific data from the survey phase.

Comment 12: Could examples of these be cited here for readers who would be interested in following these ideas up?

Examples of scenarios that were used to illustrate the domains in interviews are included in box.

Comment 13: Assume appendices should be numbered.

This has now been added.

Comment 14: Suggest this could be included in the ethical section earlier as this is strong validation that you did indeed take your ethical responsibilities seriously and minimised any possible issues to the satisfaction of participants.

Now included in ethics section

Comment 16: Patient and Public involvement

This is a mandatory section heading for the journal, we have shortened the text. PAGE 7 LINE 55

Comment 17: Was there anything to say about this particular team? Why was this one chosen to be illustrated? Was it 'typical' or showed interesting features?

We include the following in results, surveys section.

Figures 1-3 shows the network graphs for the three domains for team one; the graphs for team two showed similar topography.

Comment 19: You have included equivalents, which is really helpful, but do HO, SHO and ST still need including in full.

This has been done.

Comment 20: I was wondering about the evidence from your data of a more negative dimension ie. lack of respect? You do refer to this in a few paragraphs time. Is there something to say from your

data about whether networking is defined more by positive or negative decision-making/responses towards peers? (You just refer to 'some' being put off from approaching others p10 lines 17-22).

We have included an illustrative quote:

Conversely,

“even if they’re, say, a brilliant diagnostician or surgeon, if I see someone behaving badly with a patient, I struggle to learn from them” PAGE 10 LINE 10

Comment 21: I just wondered whether it was worth making a concluding comment here about the importance of the observable to impact on peers ie. behaviours, as well as access to be able to observe these behaviours (which, as they include word of mouth about past behaviours, also something about the visibility of these behaviours).

We have included:

This emphasis the need for the teacher to ensure that the outcome of actions is visible, and the rationale made clear. PAGE 16 LINE 45

Comment 22: It would be interesting to know whether the trainees had been encouraged to do this as part of their training or was an organic and hence personal activity? If the latter, were they all doing this? Also, it might be worth thinking about whether they were more aware of doing this as a result of your interview questions were stimulating them to make these actions conscious as a strategy? This is where it is worth acknowledging that your interviews might be an intervention in part to recognise this and, actually, later to potentially suggest that the questions you asked might model possible mentoring/supervisory relationship conversations as part of induction/training.

Response; trainees generally are keen to learn about ‘difficult’ conversations, probably because these are uncomfortable and they desire hints on how to get through them. We are not able to determine whether the questions change attitudes or behaviors, but this is a very important point. Beyond the context of this paper, we have found that interviews about clinical pathways make people realise things about shortcomings that they had not made explicit previously.

Comment 23

This is still a focus on observable behaviours then, as in domain 1, but with a focus on the link between means and end. I really like the way you then go on to explore the personal dimension to this on p12. Does this mean that trainees then planned to adapt the means into their own way of working rather than simply adopting that of another without adaptation? Was there evidence for adaptation of practice from your data or would this be merely inference?

This would only be inference and so is not included in the text.

Or, do they only choose those with similar values, as you imply? If the latter this seems to conflict a little with the claim that personal characterstics did not have an impact on who they emulated? This discussion of values links back to your earlier comment in the first para p11 lines 13-15 about personal values being important.

Here, we intended to refer only to emulation of communication skills and approaches, not wider values. This has been clarified with the following:

In contrast to the clinical domain, when choosing whether to emulate approaches to doctor-patient communication, characteristics of the person who was being observed was described as unimportant. PAGE 12 LINE 14

Comment 24

This is interesting. Is there anything to say who was or was not this 'leader' in your data? Did it have anything to do with seniority or could it be values driven and therefore independent of formal status? This is important in terms of the aims of your study, if you have data or thoughts on this.

The term 'leadership' was not intended to refer to an individual in a position of authority, etc. The text has been amended as below.

"When local culture was contrary to good care, they could be inspired for the good by a single individual." PAGE 13 LINE 17

Comment 25

There is literature about how efficacious teams are depending on whether they are self-forming or set up by administration and, assuming this is the latter in this context, whether the administration have thought actively about mixing skills brought to the team. It would be interesting context to add a note here on what basis the teams were formed. There may be literature available in the medical context to connect with?

We have added text in the introduction section to clarify that teams are allocated. We are not aware of a literature on self forming teams, and by and large, all hospital medical teams are made up through central allocation.

Teams of doctors are allocated to rotate through the unit, the majority at four monthly intervals. They all are training in medicine, but they have different experiences and skills that they bring from previous roles. Methods, participants section. PAGE 6 LINE 8

Comment 26

This kind of evidence connects with the work by Etienne Wenger and colleagues about communities of practice, which I mentioned earlier, in which practices become developed by those working within the same practice setting and deciding how to respond to pressures/agendas for their work. There are many publications and youtube clips about this work, if you are not familiar with it, but this might be an interesting introduction: http://wenger-trayner.com/introduction-to-communities-of-practice/. This idea might be useful to lift this discussion to something more conceptual?

We thank the reviewer for this pointer toward a very interesting body of research. We have made reference to Wenger's work in the paper but unfortunately the restricted word limit precludes a more in depth discussion.

Comment 27

It would be useful to summarise here the different ways social network position manifested themselves in your study - ie. not to do with any formal role but rather associated with X, Y and/or Z?

This text has been added in the results section:

Some individuals showed network features of with high influencers. These were high degree centrality (the number of connections that an individual has) and betweeness centrality (the number of bridges an individual completes between others). PAGE 8 LINES 29-34

Comment 28

Are these memes the three domains you have identified? What a meme is and what you claim to be in your data could be more explicitly stated.

We have added text, as below, in the introduction to define memes.

We hypothesised that memes, (by which we mean a unit of knowledge, attitude or behaviour that can spread between individuals through communication or imitation) relating to the three domains of work may be conducted through different co-existing networks in a single team PAGE 5 LINE 8 and ff

Comment 29

This has not been explicitly stated yet. Could use of the network diagrams be used to illustrate what is meant by this?

Network diagrams are included, as figures 1-3

Comment 30

Would it be more accurate to use 'could' rather than 'can' as your data can be used to imply this but diffusion of particular innovations wasn't explicitly covered in this paper? This seems to be an extrapolation from your data.

We have removed texts referring to diffusion of innovations

Comment 31

RE narrative description of the network patterns.

This appears to be a new claim that extends beyond the data presented earlier. I would suggest this needs to be set up earlier and linking to the figures included would provide the basis for this. These figures could be used more substantively in the findings section.

In order to remove these new claims, we have added to the findings section and have changed the section in the discussion:

“We found that learning and influence in the different domains studied flowed through very different social network topographies. Clinical-technical knowledge flowed through dense networks. In contrast, the team networks relating were sparse, with suggestion from interviews that there were important connections that went outside the team. Self orgnaisation showed little evidence of peer to peer spread. This suggests different strategies might be needed for different domains, and passive diffusion is unlikely to achieve change in practice for non-technical practices. This is is important information, as change and quality improvement initiatives frequently target patient experience and the detail of working routines and practices.” PAGE 14 LINE 49 and ff

Comment 32

Could this be more nuanced to say that there was resistance to change from external to the team relationships but that there might be changes in practice influenced by those within the team of peers in resisting or working within the agendas of those external, even though this would not be by any particular individuals. Perhaps I am going beyond the data, influenced by what I know of the

communities of practice and my own work? Do stick with what your data shows. In any case it might be worth noting the resistance to change unless needing to, which will relate to your last point.

This is a very interesting concept and intuitively is we feel it is probably happening, although the research for this paper did not explore this, and so we are not able to add any comment to the draft.

Comment 33

This does link to the average number of others influencing them in the survey data section but what has not been covered (earlier) and would be interesting has been whether in the subsets of peers the same individuals appear in your data ie there is an agreement about the influencers? Could network diagrams be used to illustrate this within one team, to show how they can be identified? Perhaps in another diagram than chosen so far?

Each team included a different set of individuals, as the entire teams ‘change over’ at regular intervals (doctors spend 4 or 6 month blocks in a job). There were no individuals common to both the surveyed teams. Therefore, it is not possible to comment on agreement.

Comment 35

(Normalisation process theory) This seems a little late to add here without any explanation.

The reference to NPT has been removed from the text.

Comment 36

Maybe something to say about adaption of practices as well if you accept my earlier comments and have data to say something about this?

The interview participants did not refer to adaptation of practice in this respect, although they did talk about testing out; this is an idea that would warrant further exploration in future research.

Comment 37

I would suggest that there are more studies to feed from this one, within the medical profession, including looking at bigger assemblages of medical professionals to look beyond bounded teams to the wider networks in which they learn. I think this is a very exciting area, especially in the age of social media.

We have added the idea of researching un bounded groups

Future research could explore how individuals from outside of the core team exert influence, and how electronic media provides wider peer to peer links. PAGE 16 LINE 27

Comment 38 and 39

Even having read the paper I am still not sure that this covers everything discussed. Suggest that a link is made at least to 'practice development' as you have mostly revealed observable practices and behaviors that are taken on and adopted/adapted by others.

Is there something to say about the importance of visible actions/behaviours as influencing others, which are only one manifestation of values and knowledge, which were only studied in the trainees being influenced? Also something to say about the visibility of these practices/behaviours to others, in order to be available to influence others?

This is added in the conclusion:

The characteristics and prevalence of highly influential individuals also differs between domains. This casts light on the way that practices develop across a team, informs those who wish to enhance their influencing, and emphasizes the importance of making desirable behaviors clearly visible to facilitate their spread. PAGE 16 LINE 40

VERSION 2 – REVIEW

REVIEWER	Dr Veena Patel University Hospitals of Leicester NHS Trust, Leicester
REVIEW RETURNED	20-May-2019

GENERAL COMMENTS	Thanks for asking me to review the revised version of the manuscript. having done the critically analysing of the paper, I have these comments to make: 1. Research question /study objectives clearly defined: Conceptual framework is a way ideas are organised after reviewing the gaps in the literature, to reach the aim/purpose of the study. (adding in the text does not explain the way idea evolved!) • The authors suggest IHI project triple aim was the framework, which has 3 aims. Namely: improving the patient experience of care, improving the health of the population and reducing the percapita cost of health care (ref 12) which are different to what is

	presented in the paper. this is different to what is illustrated in the manuscript. Page 7, line 34,35: “we were not aware of any existing literature on knowledge transfer and influence specifically relating to different aspects of practice” I fell, there are plenty of evidence on work place learning particularly on improving the patient experience of care may be from different analysis, which cannot be ignored. 2. Abstract accurate, balance and complete: complete 3. Study design: I feel the design of the study could be improved. The attached survey questions are ambiguous, closed questions and not reproducible. as does the interview questions. Self-organisaiton is different from organisation at work!!! this is used with similar meaning in the paper. This study design covers three vast topic only superficially. 4. Method is not reproducible as the survey and interview questions are not focusing the purpose of the study specifically. 5. Ethical approval was taken 6. Statistics: results are presented as a network graph could be elaborated giving more explanation on density, centrality, network influence ect to understand the benefits on the SAN aspects. (attached is the reference which gives good description on presenting the SAN report : Saqr M, Fors U, Tedre M, Nouri J (2018) How social network analysis can be used to monitor online collaborative learning and guide an informed intervention. PLoS ONE 13(3): e0194777. https://doi.org/10.1371/journal.pone.0194777) Reference : There are not many studies in the field of medical education using the SAN, however there are studies in other fields which could be used for discussion for debating. 7. Results address the research question : results are now better presented, thanks; page 8 line 58, says high level theories emerged details of which could be better presented. 8. Discussion: critical reflection is failing. Debate from previous studies would be good to consider when comparing and contrasting the findings. The clues/observational findings/team influence could also add to the findings of the study. 9. The study is innovative and we need such studies to understand the influence of the team members and learning at the work place. Three main topics taken are important and broad and we need more robust design and critical appraisal to reach conclusions. I do feel there is need for major revision addressing these issues.

REVIEWER	Alison Fox The Open University, UK
REVIEW RETURNED	13-May-2019

GENERAL COMMENTS	Thank you for your detailed consideration of the reviewer comments and for explaining not only where there was evidence of your responses to these in the paper but also your thinking about how you chose to respond. I particularly appreciated this as one or two of my comments (for example about the punctuation for citations and reference to self-forming teams) were evidently not appropriate to this medical context, with which I did not have direct experience. I respect the decision-making of the authors in what and how to respond to each point raised, including when there is a preference not to extrapolate beyond the data collected, guided no doubt in part by the SRQR self-evaluation of the paper, included in this revised version. Within the word limits of this paper, I consider my comments to have been addressed in the resubmitted version. The study's articulated aims are now more in line with the reported research - how it was designed and has been concluded. The paper is now more explicit about its methodological approach and has included reflexive comments which are clearer about samplying, the choice of methods and ethical considerations. The study as of a bounded network is now clearer, which helps a reader to appreciate what has (and has not been) covered, for example no electronic methods of networking were explicity covered and no evidence of beyond-team links considered. The study remains focused on identifying key features of impactful behaviours within these medical teams. Further illustration of the meaning of terms has been included and I welcome the inclusion of the 'box' which illustrates the meaning of domains, although I wasn't clear where this would be linked to the text. The qualitative data which illustrates the findings complements the quantitative representation of networks and its analysis is the strength of the paper.

VERSION 2 – AUTHOR RESPONSE

Reviewer: 1

Reviewer Name: Dr Veena Patel

Institution and Country: University Hospitals of Leicester NHS Trust, Leicester

“1. Research question /study objectives clearly defined:

Conceptual framework is a way ideas are organised after reviewing the gaps in the literature, to reach the aim/purpose of the study. (adding in the text does not explain the way idea evolved!) “

This study aims primarily to present a description of the social network structure that conducts different types of behaviour and information within a single team, along with the findings of interviews

relating to the phenomena that strengthen influence and promote dissemination. The paper has two sections. The first, using a standard SNA methodology to map social network topography in clinical teams, and the second, a series of interviews using a grounded theory approach to explore the social phenomena that cause the features of the SNA maps we found to emerge.

We believe that the 'SNA' part of the paper, based on surveys of team members, used an accepted and widely used SNA research methodology and that introduction of a formal conceptual framework, such as is used in certain schools of qualitative research, would be inappropriate. The second part of this research used interviews which were analysed using a grounded theory approach, which allows theory to emerge from the data, and does not use a conceptual framework to categorise themes etc for data analysis.

The inspiration for the second, interview, phase of this paper was the findings of the survey phase, rather than identification of gaps in the literature, as mentioned by the reviewer (above).

We therefore feel it is appropriate that we do not present a conceptual framework for this work.

We did have a schema for dividing knowledge and behaviours into into three domains, and this was used to design the SNA surveys and the subsequent interviews, although we believe this is not the same as a conceptual framework proper. The thinking behind this was inspired by the IHI triple aim framework, although we agree that the three domains that we selected were not exactly the same as the IHI categories, since the latter are intended to be applied at population level. We have removed reference to the IHI triple aim, as we feel that the domains we selected are intuitively a reasonable way to divide parts of practice, and do not require external reference.

We have removed the term conceptual framework as we feel this was used ambiguously and it is clearer for the reader if it is not invoked. The original submitted paper did not include the concept of a conceptual framework, and this was added into the first revision at the request of reviewer 1. In retrospect we consider is misleading to the reader.

(COMMENT B)

We removed the following text from the intoduction:

"The Institute for Healthcare Improvement promotes a widely accepted framework, the "triple aim" which divides healthcare outputs into population health, patient experience and per capita cost.[12] We adapted these three goals into what we considered to be their correlates in an acute inpatient setting: Clinical outcomes from the episode of care (which depends on clinical-technical knowledge), patient experience during the episode (requiring patient centred attitudes and behaviours) and per-patient cost (which depends in a large part on the way clinicians organise their work, for example, by

prioritising tasks to accelerate discharge). We used this triad the basis of a framework for different kinds of skills of trainee doctors”.

• The authors suggest IHI project triple aim was the framework, which has 3 aims. Namely: improving the patient experience of care, improving the health of the population and reducing the percapita cost of health care (ref 12) which are different to what is presented in the paper. this is different to what is illustrated in the manuscript.

We have removed reference to IHI triple aim.

“2. Abstract accurate, balance and complete: complete “

“3. Study design:

I feel the design of the study could be improved.

The attached survey questions are ambiguous, closed questions and not reproducible.”

The authors believe the design of the SNA survey and its analysis is appropriate, and in keeping with widely used SNA methods. Survey questions in SNA are generally closed (e.g. in the last month, who have you spoken with about XYZ?); The questions are also inherently ambiguous, for example, it is for the respondent to decide what degree of interaction should be reported with an affirmative answer. This is a common and recognised aspect of SNA surveys. The survey was in fact less ambiguous than many SNA surveys because it took the unusual step (at least in relation to medical SNA research) of using survey questions that differentiated communication about different types of information.

“as does the interview questions.”

We are unsure of the intended meaning here.

“Self-organisaiton is different from organisation at work!!! this is used with similar meaning in the paper.”

We accept that it is difficult to find the ideal phrase to describe this aspect of practice; we have attempted to make our intended meaning clearer in the introduction () and feel that the content of the box helps to communicate our intended meaning. We have harmonised the phrasing to read “organisation of work” throughout the paper.

COMMENT A

This study design covers three vast topic only superficially.

We agree, but feel that this was our intention, and that this is appropriate as is a novel study, introducing for the first time the concept of co-existing network structures for different domains of information within the clinical workplace. We anticipate that there is much more detailed work that can be done in the future, looking at larger, more multidisciplinary teams and more granular domains of information. We refer to this in the discussion. As a preliminary report on a newly described phenomenon, we feel that the depth of enquiry is appropriate and hope that further work will be inspired.

CONNENT X

4. Method is not reproducible as the survey and interview questions are not focusing the purpose of the study specifically.

We feel that the survey and interview questions do, in fact, focus on the purpose of the study, which is stated as: “To explore how knowledge, attitudes and behaviours diffuse between individuals through different network structures within similar bounded teams of trainee doctors in a particular workplace setting.”

We also feel that the method is reproducible. The survey questions can be used in any team; the interviews were largely unstructured, as is the norm for grounded theory work, but we supply a high level interview guide and illustrative examples that other researchers could use directly to reproduce this work.

“5. Ethical approval was taken”

“6. Statistics: results are presented as a network graph could be elaborated giving more explanation on density, centrality, network influence ect to understand the benefits on the SAN aspects. (attached is the reference which gives good description on presenting the SAN report : Saqr M, Fors U, Tedre M, Nouri J (2018) How social network analysis can be used to monitor online collaborative learning and guide an informed intervention. PLoS ONE 13(3): e0194777. https://doi.org/10.1371/journal.pone.0194777)”

We have calculated a large range of network metrics; however, the visual maps show stark differences between domains that carry their message to the reader. Quantitative network metrics are mostly intended for demonstrating subtle differences between networks, which are not obvious to the eye, and we decided to limit the presentation of numerical descriptors as we felt this only distracted

from the clear message shown in the visual maps. If it were felt to be helpful, we would be very happy to include further metrics.

COMMENT C

“Reference : There are not many studies in the field of medical education using the SAN, however there are studies in other fields which could be used for discussion for debating.”

“8. Discussion: critical reflection is failing. Debate from previous studies would be good to consider when comparing and contrasting the findings. The clues/observational findings/team influence could also add to the findings of the study.”

“Page 7, line 34,35: “we were not aware of any existing literature on knowledge transfer and influence specifically relating to different aspects of practice”

I fell, there are plenty of evidence on work place learning particularly on improving the patient experience of care may be from different analysis, which cannot be ignored.”

We are restricted by the word limit, particularly since the reviewers recommended that we include additional direct quotes from interviews. We would welcome the opportunity to expand the discussion to illustrate the breadth and richness of existing of SNA research in workplaces, but this is unfortunately not possible in the current paper. There are several excellent reviews on this topic, and we feel that our goal should be to present our findings, and to attempt to discuss their meaning rather than describe the existing literature. We also feel that it would not be possible to shorten the existing text by enough words to allow a meaningful discussion without losing the message of our work.

7. Results address the research question : results are now better presented, thanks;

“page 8 line 58, says high level theories emerged details of which could be better presented. “

We have removed the term “High Level Theories”; We feel that the theories that we developed are presented succinctly and clearly. We would welcome the opportunity to be more expansive in this section but feel that, given restrictions on word count, this would mean reducing other important parts of the text and reducing the strength of presentation of the message of the findings.

COMMENT D

“9. The study is innovative and we need such studies to understand the influence of the team members and learning at the work place. Three main topics taken are important and broad.”

We thank the reviewer for this kind appraisal.

“We need more robust design and critical appraisal to reach conclusions.”

The authors feel that the design was robust, in that an accepted SNA survey approach was used, and interviews were conducted and analysed in a rigorous way.

The authors strongly believe that the results of this research support the conclusions.