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Heroin assisted treatment and research networks

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Abstract

Purpose – The purpose of this paper is to map research communities related to heroin-assisted treatment (HAT) and the scientific network they are part of to determine their structure and content.
Design/methodology/approach – Co-authorship as the basis for conducting social network analysis with regard to degree, weighted degree, betweenness centrality, and edge betweenness centrality.
Findings – A number of central researchers were identified on the basis of the number of their collaborative relations. Central actors were also identified on the basis of their position in the research network. In total, 11 research communities were constructed with different scientific content. HAT research communities are closely connected to medical, psychiatric, and epidemiological research and very loosely connected to social research.
Originality/value – The first mapping of the collaborative network HAT researchers using social network methodology.

Keywords Research, Collaboration, Networks, Co-authorhip, Evidence base, Heroin-assisted treatment
Paper type Research paper

Introduction

This paper is part of the "Addictions and Lifestyle in Contemporary Europe: Reframing Addiction Project" (Alice Rap), work package 2, which works with stakeholder analysis within the addiction field. The work package has conducted a number of case studies of addiction policy and treatment (e.g. Substance Use and Misuse 2013, Vol. 48, No. 11, special issue; Hellman *et al.*, 2015), and the present paper is part of a study of stakeholder activities at the supranational level with regard to heroin-assisted treatment (HAT). This case study seeks to investigate epistemic or knowledge communities at the supranational level on the basis of the premise that such communities may attain an authoritative voice in particular policy areas, in this case, policy with regard to HAT. Haas (1989) and Adler and Haas (1992) defines epistemic communities as a network of professionals with recognized expertise and competence within a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue area. This paper uses co-authorship analysis to present a supranational mapping of networks of professionals who have been involved in HAT research. The analysis will not be capable of determining whether the professionals have an authoritative claim to relevant knowledge about HAT, but it will be able to show the forms of knowledge that dominate research on HAT and the extent to which knowledge concerning HAT is based on multi-disciplinary collaboration. In the co-author analysis, we employ community-detection algorithms that construct communities or clusters of collaborations solely on the basis of the topological characteristics of the analyzed network. These structural communities or community structures are composed of groups of authors who are highly connected with one another and poorly connected with others (Girvan and Newman, 2002; Rodriguez and Pepe, 2008). The clustering of authors may

be seen as footprints of the collective units of knowledge production with regard to HAT. Mapping the clustering of knowledge production is particularly relevant within an epistemologically challenging research field that attracts numerous scientific disciplines. The mapping of knowledge production with regard to HAT may indicate the extent to which HAT policy is informed by multiple forms of knowledge.

HAT, where heroin is prescribed for supervised medical treatment of opioid dependence, is a relatively new and controversial treatment modality (McKeaganey, 2008; Rehm and Fischer, 2008; Small and Drucker, 2006). HAT is controversial primarily because it prescribes a hitherto-illegal drug – heroin – to drug users and because heroin lacks the stabilizing properties of other substitution drugs. Because of its controversial nature, it has been important to demonstrate that HAT provides effective treatment for particular groups of opioid-dependent people (Uchtenhagen, 2010). Research – particularly randomized controlled trials (RCTs) – that can determine the effectiveness of the treatment modality has therefore played an important role in policy debates surrounding this issue. Trials have thus been conducted in Switzerland, the Netherlands, Germany, Spain, the UK, Belgium, and Canada. Even in countries like Denmark, which have introduced HAT without conducting a national trial, the international evidence base has played an important role in the policy-making process (Strang *et al.*, 2012). Many researchers and politicians regard evidence constructed through RCTs as highly reliable and fundamental for introducing new treatment methods. RCTs are, however, also a particular means of creating evidence, one which is itself open to controversy, not so much because of doubts concerning the knowledge that RCTs can create but more because of the knowledge that RCTs cannot create and the blind spots that they may thus entail (Dehue, 2004; Houborg, 2012). On this basis, we have found it relevant to investigate the particular kinds of research communities and research networks that encompass international research concerning HAT. We conducted a co-author analysis of the research networks of which HAT research projects and programs are a part. This analysis has focussed on relationships between authors and to some extent the knowledge content of the research.

Approach

Duke (2015) has conducted an in-depth qualitative analysis of the knowledge network that has developed around HAT in Europe since the mid-1990s. Central to this network are the relationships between researchers and research groups in the countries that have conducted scientific trials into HAT's feasibility and effectiveness, particularly the trials in Switzerland, the Netherlands, and Germany. Duke provides a detailed analysis of the different kinds of interaction and relationships between HAT researchers and how researchers came to see themselves as belonging to something akin to a community with common epistemic as well as policy-relevant ideas.

In the present paper, we are also – like Duke – interested in relationships between researchers and research communities. Our point of departure is research into HAT. Our analysis is based on one particular kind of collaboration between researchers, namely co-authorship, identified using data from a bibliographic database. We are therefore unable to say anything about the quality of the collaboration and relationships between researchers or about the meaning they attribute to such collaboration. Rather than providing this kind of in-depth qualitative analysis of the research network like Duke, we will undertake a comprehensive mapping of relationships between researchers.

We base our investigation on the idea that it is possible to map research networks through co-author analysis (Newman, 2004a, b). Co-authorship is when two or more authors write a paper together and therefore indicate collaboration. By mapping co-authorship through bibliographic databases (in our case, the Web of Science), we therefore have an opportunity to demonstrate how researchers are connected and to map a particular scientific network and possible clusters or communities within this network.

Methods and data

Using the Thomson-Reuters Web of Science service, we collected information on authorship of 609 publications related to HAT and written by 20 seed authors, who were identified as central

HAT researchers through a short literature review and consultation with partners in the Alice Rap research program. Seed authors are the authors who represent the starting points for the network mapping. The overall case study of supranational research networks on HAT should ideally include researchers from the various countries in which HAT research has been conducted. The selection criteria for seeds thus involved including both highly cited researchers on HAT from different countries (on the basis that they would be productive starting points for mapping research networks) and researchers from specific countries with HAT research in order to include different countries. The latter aim was particularly important since selection on the basis of citations alone tends to privilege countries with a tradition of writing in English. The publications were inspected and structured using the Sci^2 Tool. The data set was imported into R, in which the network was analyzed and visualized using the igraph library (Csardi and Nepusz, 2006). Visual inspection was conducted using Gephi (Bastian *et al.*, 2009). Given the data-collection method of gathering co-authorship relationships based on a number of seed actors, it is likely that some researchers will be left out: The data set represents the collaboration networks of the 20 seed authors, thereby excluding researchers who have never collaborated with them. An undirected and weighted co-authorship network was constructed based on the 609 publications, containing 333 authors who had co-authored at least two articles and 1,634 relationships. Any two authors in the network are thus considered connected if they have co-authored a paper with the weight of the relationship determined by the number of co-authored papers. After the network analysis and the construction of communities, the content of the articles from the different communities was analyzed on the basis of coding of abstracts and keywords. The material was coded independently, first by a research assistant and then by one of the authors with regard to the journals within which the articles were published, the topics of the articles, and the countries in which the research was located. When abstracts were missing, articles were coded solely on the basis of title and keywords.

Results

The network was subjected to four network analyses: relationships (degree[1]); weighted relationships (degree); betweenness centrality; and edge betweenness centrality. These are different analyses of the network's relationships and how the actors are situated within the network, including how actors cluster into particular communities. The first analysis consisted of a mapping of all actors and their number of relationships to other actors in the network. We also mapped the weighted relationships of each actor in the network. This calculates not only the number of relationships to other actors but also an actor's number of co-authorships. A researcher may thus have relationships with a few other researchers with whom he or she has written a large number of articles, which then adds to the researcher's weighted relationships. The third analysis was betweenness centrality (Girvan and Newman, 2002). This is an analysis of the position of the actors in the network with regard to their connections to other actors. An actor may, for example, have few relationships and a small measure of weighted relationships but still be a very important actor in the network because he or she represents a "bridge" between different parts of the network, without which parts of the network would become disconnected. The fourth analysis was edge betweenness centrality. This is the method by which structural communities have been constructed. This is done by gradually removing relationships from the network until a structure of communities or clusters of particularly intense relationships emerges.

Relationships

In our analysis, we first looked at the number of relationships (or in technical terms, "degrees") that each person had to other researchers on the basis of co-authorship. If Researcher A has worked with Researcher B on one article and Researcher C on another article, then Researcher A has two relationships and Researcher B and C each have one relationship. This allowed us to identify the researchers with the greatest number of relationships. Table I presents the 30 researchers with the greatest number of relationships in our material. Unsurprisingly, the table shows that a number of the researchers with the greatest number of relationships are our seed authors, but they also correspond very well with the lead researchers in the national HAT trials (cf. Duke, 2015).

Table I	Actors ranked by degree				
Rank	Actor	Degrees	Rank	Actor	Degrees
1	Rehm, J. (Seed)	70	16	Gossop, M.	26
2	Strang, J. (Seed)	67	17	Brissette, S.	25
3	Stimson, G.V. (Seed)	59	18	Reimer, J.	25
4	Fischer, B.	54	19	Soyka, M.	24
5	van den Brink, W. (Seed)	47	20	Oviedo-Joekes, E. (Seed)	24
6	Uchtenhagen, A. (Seed)	47	21	Ferri, M. (Seed)	24
7	Krausz, M.	38	22	Verthein, U.	23
8	Haasen, C. (Seed)	34	23	Reggers, J.	23
9	Metrebian, N. (Seed)	34	24	Blanken, P. (Seed)	23
10	Hickman, M.	30	25	Amato, L.	23
11	Davoli, M. (Seed)	30	26	Perucci, C.A.	22
12	Naber, D. (Seed)	29	27	McSweeney, T.	21
13	Ansseau, M. (Seed)	28	28	Frick, U.	21
14	Rhodes, T.	27	29	Turnbull, P.	20
15	van Ree, J.M.	26	30	Mayet, S.	20

On this basis, we see that Rehm is the researcher in our material who has relationships to the greatest number of researchers through co-authorship. It is unsurprising that our seed authors and central researchers in the HAT trials should have the most relationships as we have taken our point of departure from established senior researchers with many publications.

Weighted relationships

In order to provide another measure for the network of relationships between researchers, we also analyzed the intensity of their relationships. This means that we counted each researcher's number of co-authorship relationships in the material. To explain, if Researcher A has co-authored one article with Researcher B and three articles with Researcher C, then Researcher A would have two relationships and four weighted relationships. Whereas the mapping of relationships only showed how researchers were connected through co-authorships, the mapping of weighted relationships showed the intensity of collaboration or connectedness of the various authors by showing how much they collaborated with other authors. Undertaking this analysis altered our image of the network slightly but not significantly. The top five researchers for weighted relationships included the same top five researchers when counting number of relationships, but they changed ranking. This indicates that some had more collaborators than others (counting relationships) but that these others in some cases had more intense collaborations. While Rehm had the most relationships with other authors, Stimson had the largest number of weighted relationships. In other words, Stimson had co-authored with fewer researchers but had worked more intensely/written more papers with these researchers, adding to his weighted relationships. More significantly, some of the researchers moved up the list when measuring weighted degree compared with when measuring degree alone (Table II).

This may have to do with the fact that, when analyzing research networks using the measures of degree and weighted degree, it is important to bear in mind that different disciplines publish in different ways. In medicine, for example, it is common to write publications with a large number of co-authors while in the humanities and social sciences it more common to have single authors or just one or two co-authors. It is also important to bear in mind that, in some disciplines, it is common practice for an entire research team to be registered as co-authors on publications from a research project or trial (Newman, 2004a, b). This means that researchers who work in particular disciplines and/or are part of large research programs are likely to receive many weighted relationships.

Betweenness centrality

Researchers who have relationships with many other researchers and who collaborate intensely with other researchers of course play an important role in the research network. But a

Table II Actors ranked by weighted degree

Rank	Actor	Weighted degree	Rank	Actor	Weighted degree
1	Stimson, G.V. (Seed)	270	16	Krausz, M.	105
2	Strang, J. (Seed)	238	17	Reimer, J.	104
3	Rehm, J. (Seed)	235	18	Perucci, C.A.	102
4	van den Brink, W. (Seed)	213	19	Naber, D. (Seed)	97
5	Fischer, B.	185	20	Ansseau, M. (Seed)	91
6	Davoli, M. (Seed)	163	21	Guh, D.	90
7	Brissette, S.	155	22	Metrebian, N. (Seed)	90
8	Haasen, C. (Seed)	153	23	Anis, A.H.	88
9	Uchtenhagen, A. (Seed)	152	24	Rhodes, T.	84
10	Oviedo-Joekes, E. (Seed)	143	25	Donoghoe, M.C.	83
11	van Ree, J.M.	129	26	Amato, L.	82
12	Schechter, M.T.	115	27	Hendriks, V.	81
13	Marsh, D.C. (Seed)	111	28	Blanken, P. (Seed)	80
14	Verthein, U.	111	29	Hickman, M.	74
15	Gossop, M.	108	30	Ferri, M. (Seed)	68

researcher's importance does not necessarily rest upon these qualities. The importance of a researcher for the research network may also rest upon his or her position within it. The presence of one strategically central researcher who connects a great number of other researchers may thus have a significant effect on the collaborative network. To identify central actors in the network, we analyzed the researchers' betweenness centrality, which is a measure of the number of shortest paths in the network that pass through the node, in this case the researcher. If these central actors were to disappear from the network, the network might split into subgroups or lose connectivity. Such researchers may therefore be said to function as bridges connecting different parts of the network. As such, information flows with a particularly high intensity through these actors or nodes in the network.

Table III lists the 30 actors in the network with the highest betweenness centrality (and also includes their relationships and weighted relationships). We find that the seeds, as expected, take central positions in the network. However, we also uncover several new actors in central positions. While many of the central actors have written a large number of articles (for example, Stimson has authored 116 articles in the data set), other central actors have produced far fewer. The centrality of researchers in the network is thus not only dependent on the number of articles authored but can also be based on their collaborators.

The importance of betweenness centrality and how it may alter our identification of the central actors in the network can be illustrated by looking at the position of W. Hall in the network. Hall has a relatively low number of relationships and weighted relationships compared with researchers like Rehm and Strang. The reason for his high betweenness centrality is that he connects a great number of researchers in the network who would become disconnected if he disappeared. In this way, Hall's relatively few co-authorships may be seen as strategically important from a network perspective.

Edge betweenness centrality: research communities

We applied the community-detection model based on edge[2] betweenness centrality proposed by Girvan and Newman (2002). The model identifies community structure by progressively removing the relationships with the highest betweenness centrality. Girvan and Newman (2002, p. 7825) showed a successful application of the model on a network of researchers based on co-authorship. As relationships connecting communities will have a high edge (relationship) betweenness centrality, this will reveal the community structure (Girvan and Newman, 2002, p. 7822). The model revealed 11 communities in our research network, seen in Figure 1.

Table III Actors ranked by betweenness centrality

Rank	Actor	Degree	Weighted degree	Betweenness centrality	Number of articles	Rank	Actor	Degree	Weighted degree	Betweenness centrality	Number of articles
1	Rehm, J. (Seed)	70	235	89,977,292	66	16	Ferri, M. (Seed)	24	68	3,008,352	25
2	Reggers, J.	23	43	88,321,391	8	17	Haasen, C. (Seed)	34	153	2,175,983	50
3	Strang, J. (Seed)	67	238	83,397,979	89	18	Ansseau, M. (Seed)	28	91	26,406,667	28
4	Krausz, M.	38	105	76,964,389	20	19	Blanken, P. (Seed)	23	80	25,508,988	21
5	Hall, W.	17	18	76,097,537	3	20	Van ree, J.M.	26	129	22,749,129	34
6	Van den brink, W. (Seed)	47	213	61,057,533	80	21	Legros, J.J.	11	24	20,943	7
7	Fischer, B.	54	185	58,557,155	48	22	McKeganey, N.	10	10	2,068,052	2
8	Naber, D. (Seed)	29	97	51,373,442	34	23	Gossop, M.	26	108	19,873,512	36
9	Hickman, M.	30	74	51,264,293	16	24	Raschke, P.	5	6	18,006,671	2
10	Wiessing, L.	13	13	43,240,882	3	25	REIMER, J.	25	104	17,789,852	27
11	Metrebian, N. (Seed)	34	90	36,125,915	21	26	Romero, M. (Seed)	11	33	17,550,253	19
12	Stimson, G.V. (Seed)	59	270	35,472,286	116	27	Schulte, B.	13	15	15,962,841	3
13	Uchtenhagen, A. (Seed)	47	152	3,514,036	64	28	Soyka, M.	24	50	14,610,116	11
14	Scantamburlo, G.	7	9	32,505,667	2	29	Mattick, R.P.	14	22	14,237,361	5
15	Turnbull, P.	20	29	30,488,503	8	30	Mayet, S.	20	30	13,887,037	6

Figure 1 Heroin-assisted-treatment epistemic community
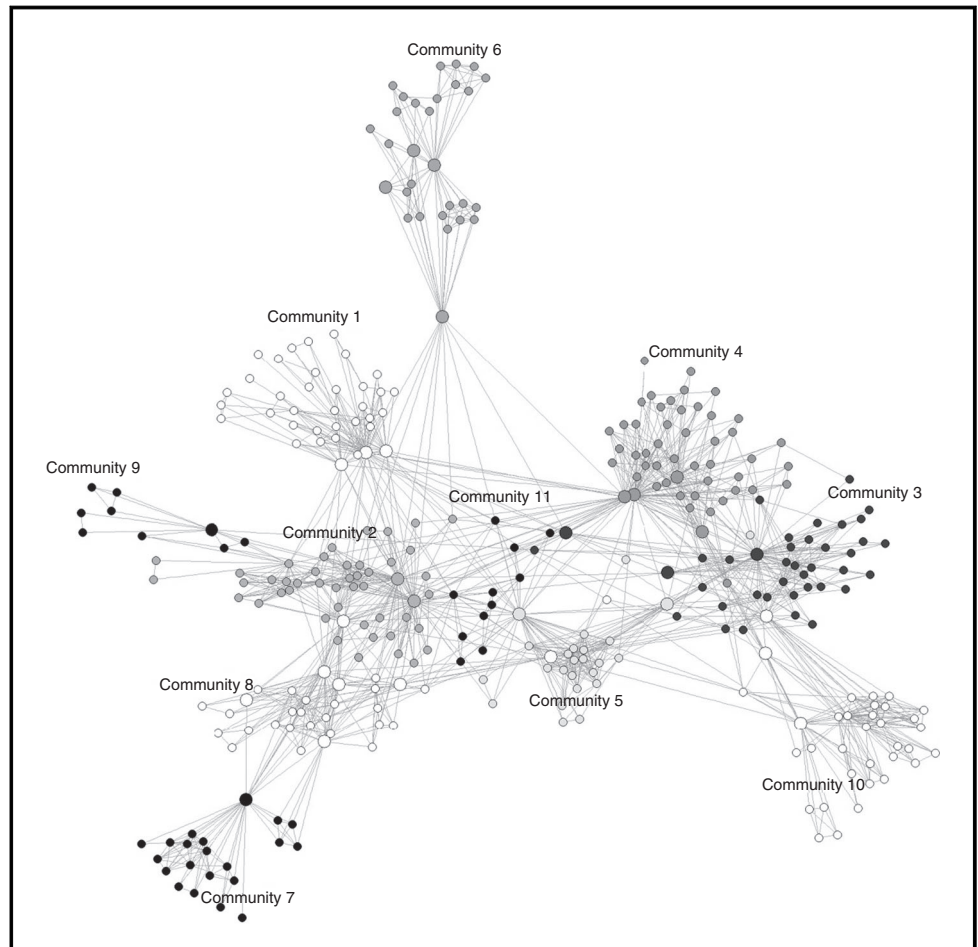
To define the communities, we reviewed the articles written by members of each community. Table IV shows the number of articles and community members.

We find that the core of most of the communities tends to be large research projects involving a number of researchers who tend to co-author a great deal of articles with one another, including the various national HAT trials. It is, however, important to note that the communities do not

Table IV Overview of research communities

Community	Number of members	Number of articles	Citations of articles	Citations per article
1	37	80	1,445	18.5
2	47	96	1,349	14.1
3	39	102	2,449	24
4	50	102	2,550	24
5	25	66	651	9.9
6	29	21	333	15.9
7	21	28	661	23.6
8	31	72	675	8.4
9	9	19	160	8.4
10	34	67	1,608	24
11	11	19	371	19.5

exclusively correlate with such trials and research projects as they also include relationships that are unrelated to these projects. Furthermore, there is some difference between the communities with regard to the disciplines and research topic represented as well as with regard to homogeneity and heterogeneity of disciplines and topics. Finally, the communities vary significantly in terms of size. We will discuss these issues in the following.

In presenting the 11 communities, we first present (whenever possible) the top five journals of the communities with regard to number of articles published and the top five research topics as they are registered in Web of Science.

Community 1

Journals: *European Neuropharmacology; Drug and Alcohol Dependence; Addiction; British Medical Journal; Addictive Behaviors*.

Topics: psychiatry; substance abuse; pharmacology and pharmacy; neuroscience and neurology; general and internal medicine.

The core of Community 1 is the Dutch HAT trials. The scientific content is mainly medical, pharmacological, and psychiatric in relation to testing various drugs for addiction treatment, clinical research, outcome of trials, and comorbidity of treatment populations. There are also a few HAT literature reviews, methodological articles mainly relating to heroin trials, epidemiological articles about different ailments of drug users, and articles about the relationship between HAT science and politics.

Community 2

Journals: *Drug and Alcohol Dependence; European Addiction Research; Canadian Journal of Public Health; Addiction; Drug and Alcohol Review*.

Topics: substance abuse; psychiatry; general and internal medicine; public, environmental, and occupational health; psychology.

The core of community 2 is the Canadian HAT trials and, to a lesser extent, the Spanish trials. The reason for this is mainly that one researcher – Oviedo-Jokes – participated in both the Canadian and Spanish trials, thereby connecting them. There are also a few articles concerning the Swiss trials. In fact, we see that articles reporting from the Swiss trials can be found in several communities, indicating a wide range of collaborations by researchers from these trials. This can also be seen from Figure 1 (the core content of Community 5 and 11 is comprised of articles about the Swiss trials). The content is dominated by clinical research concerning the outcome of the heroin trials through measures of physiological and mental health, illicit drug use, crime, and social conditions. There are also a number of epidemiological articles about the population of drug users who are the target group for the trials. The articles referring to research from Spain also focus on social problems and social exclusion of drug users. Finally, there are a few articles that debate HAT. This community appears much more heterogeneous than Community 1 in terms of the countries from which research is reported and with regard to the research's scientific content. The research is nevertheless dominated by medical (including psychiatric) and epidemiological perspectives, though with a perspective that is less biological than in Community 1.

Community 3

Journals: *Addiction; Aids; British Medical Journal; Drug and Alcohol Review; the Lancet. Topics*: substance abuse; psychiatry; general and internal medicine; infectious diseases; virology.

The core of Community 3 is British epidemiological research into infectious diseases among drug users, particularly HIV and risk behavior among drug users. Related to these topics, there are also a number of articles concerning harm reduction, both as an idea/movement and as specific services, mainly needle-exchange programs. Not all articles refer research in the UK; some articles refer to epidemiological issues related to drug use in Eastern Europe and Africa. There are only a few articles concerning HAT that review the literature and research in the area. This

community contains some of the very few social science-based articles in the network that use sociological theory and qualitative methods (three articles). This community, like Community 1, is rather homogeneous, with the main body of articles concerning infectious diseases among drug users from an epidemiological perspective.

Community 4

Journals: *Addiction; British Medical Journal; Drug and Alcohol Review; Addictive Behavior; Addiction Research; British Journal of Psychiatry*.

Topics: substance abuse; psychiatry; general and internal medicine; psychology; social issues.

The core of this community is also British research, but the research in this community is much more heterogeneous than in Community 3. With regard to HAT, the community contains a few articles reporting from the British heroin trials, review articles, and debate about HAT. Related to this, there are also a number of articles that present and/or evaluate the traditional British system of opiate prescription. However, a number of other topics and types of research is also presented. As in the previous community, there are a large number of articles about risk behavior, the epidemiology of infectious diseases among drug user, and harm reduction measures, particularly a number of articles about Naloxone. There are also a large number of articles that present clinical research on various treatment measures for substance abuse, including in- and out-patient detoxification, psychosocial interventions, methadone maintenance treatment, and relapse prevention. Finally, this community also contains a few articles about harm reduction from a global perspective. This community could thus be said to be a mainly British community of substance abuse research that contains a number of different topics related to interventions.

Community 5

Journals: *European Addiction Research; Addiction; Sozial- und Pravent.; Drug and Alcohol Review; Suchttherapie*.

Topics: substance abuse; psychiatry; public, environmental, and occupational health; general and internal medicine; pharmacology and pharmacy.

As the journal titles indicate, the Swiss heroin trials represent the core of this community. The community contains a number of articles reporting outcomes of the Swiss heroin trials as well as articles on HAT research and treatment methods. There are also a few articles concerning HAT policy in Switzerland. But the community also contains a large number of articles that are unrelated to the Swiss trials, including articles discussing treatment methods (such as maintenance treatment and compulsory treatment) from a European or global perspective and articles on risk behavior, epidemiology, and harm reduction. A single article discusses addiction as a cultural phenomenon, but otherwise the articles focus on intervention.

Community 6

Journals: *European Neuropsychopharmacology; Acta Clin. Belg.; Biological Psychiatry; British Journal of Psychiatry; Drug and Alcohol Dependence*.

Topics: psychiatry; neurosciences and neurology; pharmacology and pharmacy; endocrinology and metabolism; internal and general medicine.

As the research topics suggest, this community is fairly homogeneous and centered around medical issues concerning biological psychiatry and neurology. The community contains three articles on HAT: one review article on HAT research, one article on staff concerns when delivering HAT, and one article on recruiting drug users for HAT.

Community 7

Journals: *Nervenheilkunde; American Journal of Psychiatry; Internist; Pain*.

Topics: psychiatry; neurosciences and neurology; pharmacology and pharmacy; general and internal medicine.

Again we see a rather homogeneous community, this time with neurology and psychopharmacology as the main areas of research. The community does not contain articles on HAT, but it does contain a few articles about research into methadone maintenance treatment.

Community 8

Journals: *Drug and Alcohol Dependence; Addiction; European Psychiatry; European Addiction Research; Suchttherapie.*

Topics: psychiatry; substance abuse; public, environmental, and occupational health; general and internal medicine; psychology.

As the journals and research topics indicate, this community returns us to the field of substance abuse research. The main body of articles in this community report on German heroin and substitution treatment trials and to a lesser extent on the Canadian heroin trials, but the community also contains articles on the Swiss trials and reviews of heroin trials in Europe. There are also articles concerning drug treatment in Cyprus and developing/transitional countries. Furthermore, the community contains a few epidemiological and pharmacological articles. While the community is geographically dispersed, it is fairly homogeneous with regard to research area, which is clinical substance abuse treatment outcome research.

Community 9

Journals: *Gac. Sanit.; Ann. Oncol.; Drugs: Education, Prevention, and Policy; Drug and Alcohol Review; enferm. Emerg.*

Topics: substance abuse; pharmacology and pharmacy; public, environmental, and occupational health; general and internal medicine; infectious diseases.

This is a small and rather heterogeneous community with articles from Latin America, Spain, and USA. The largest proportion of articles concern risk behavior and epidemiology, but there are also articles reporting on laboratory research with different drugs. The community contains two articles on the Spanish heroin trials.

Community 10

Journals: *Cochrane Database Systematic Reviews; Addiction; Aids; British Medical Journal; American Journal of Public Health.*

Topics: substance abuse; general and internal medicine; psychiatry; infectious diseases; public, environmental, and occupational health.

This community is rather heterogeneous with regard to geography and content. The majority of articles are epidemiological; treatment outcome research from Italy and the UK; and reviews of international drug treatment research, including HAT and MMT. The community also contains WHO publications on the epidemiology and prevention of HIV and substitution treatment.

Community 11

Journals: *European Addiction Research; Sozial – und Pravent.; Drug and Alcohol Dependence; The Lancet; Psychiatr. Prax.*

Topics: psychiatry; substance abuse; public, environmental, and occupational health; general and internal medicine; science and technology – other topics.

This community almost exclusively contains articles from the Swiss HAT trials, reporting on outcomes, economy, treatment methods, and debates involving HAT. This is a homogeneous community.

We have briefly reviewed the papers written by researchers in the 11 communities we constructed. As mentioned above, the communities should not be seen as identical to particular research projects and research programs. The communities represent particularly dense co-authorship relationships between researchers. That being said, when we look at the papers emanating from the various communities, we see that these papers are sometimes connected to

particular research projects and research programs. In some cases, papers emanating from such programs were only or mainly associated with one particular community. This was, for example, the case with Community 1, which reported from the Dutch heroin trials. In other cases though, papers associated with particular research projects/programs could be found in different communities. This was, for instance, the case with the Swiss heroin trials and the British research on HIV. Papers from the Swiss trials can also be found in other communities, indicating collaboration across communities. The scientific content of the papers from the various communities can differ to a fairly large degree, with some communities (Communities 6 and 7) mainly involving laboratory research, others mainly involving epidemiological research (Community 3), and others mainly involving clinical research (Communities 1 and 11). In most cases, the communities are characterized by a mixture of epidemiological and clinical research, testing different forms of treatment, including HAT. Despite this relative diversity, much of the research was problem-oriented, aiming to describe social and health problems and evaluate interventions into these problems. There is a striking absence of research investigating drug issues from a non-problematizing perspective. There is also a noticeable (near) absence of qualitative research and research that is grounded in the social sciences – except for articles debating the relationship between science and policy. These characteristics of the scientific content of the communities and the network as a whole can, of course, largely be attributed to our sampling of central HAT researchers as our seeds. However, this in turn also indicates that social science and qualitative methods have played an insignificant role in HAT research. It furthermore shows where HAT research is situated within the wider research community, where there are relationships to communities of neuroscience, psychiatry, and pharmacology in areas other than drug research but no relationships to social science communities.

Conclusion

As mentioned in the introduction, the present article is part of the Alice Rap stakeholder work package. The purpose of the article has been to contribute to an understanding of the role of particular supranational knowledge communities as stakeholders in HAT policy. Knowledge communities are networks of researchers with particular kinds of expertise and an authoritative claim to policy-relevant knowledge. Within an area such as addiction, which is epistemologically challenging and thus attracts various scientific disciplines (the multi-disciplinary nature of the Alice Rap project is indicative of this), we have found it relevant to investigate the knowledge communities that dominate HAT. While we cannot show whether particular kinds of knowledge claims dominate HAT policy, the mapping of knowledge networks in the area indicates the kinds of knowledge that represent the main input into the policy process. Our analysis shows that clinical knowledge dominates knowledge production with regard to HAT. It is unsurprising that clinical knowledge plays an important role in HAT research since HAT is – in part – a medical intervention and since clinical methods in general dominate treatment research. It does, however, come as a surprise that the social sciences seem to play a very minor role in HAT research, considering the complex nature of the addiction area and particularly the sociological and criminological issues that may be expected to be important for clients in HAT. The dominance of clinical knowledge also indicates that a particularly individualistic conception of drug use and drug addiction may have come to dominate HAT policy and practice. Perhaps social science knowledge could add knowledge that could improve treatment?

In this paper, we have not just been concerned with mapping knowledge communities but also with analyzing the structure of the supranational network of researchers working on HAT. Our analysis shows that a relatively small number of researchers dominate the network, possessing many relationships with intense collaboration. However, our analysis also helped identify researchers who were quantitatively rather insignificant within the network but played a major qualitative role in the structure of the network. These were researchers who, because of their position within the network, functioned as bridges between different parts of the network.

The present paper has attempted to conduct a social network analysis on the basis of co-authorship within the field of HAT research. The paper has shown the applicability of the

method but also that further research is needed in order to interpret the results. Our analysis has thus been unable to conduct further analyses into how and why these particular collaborative relationships are made and others are not. This would require research into the reasons, rationales, and meanings – both epistemological and more instrumental – that HAT researchers articulate. Such analyses exist (Duke, 2015), and in relation to this research, the analyses presented in this paper may help contextualize more in-depth research into scientific collaboration.

Notes

1. We use the word "relationship" instead of the more technical term "degree", which is commonly used in the network literature.

2. "Edge" is the technical term for a link or relationship in network analysis.

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