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Networked Health Cooperation in the European Union: Horizontal or Hierarchical?

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Abstract
During the COVID-19 crisis, European Union (EU) health policy has become high politics. Key parts of EU health cooperation have, however, long developed more discretely in European administrative networks (EANs) and become core building blocks in the institutional architecture of an EU health policy. In these networks, health experts interact regularly and, by doing so, pool key resources and develop common standards. However, are some network members more influential than others in defining the way forward, and if so, why? In this paper, we examine the structure of networked health cooperation in the case of health technology assessment (HTA), by means of unique survey data and social network analysis, employing exponential random graph models (ERGMs) for different types of interaction. A horizontal structure of interaction fosters cooperation by and for all, whereas a hierarchical structure allows certain members to set agendas and place themselves in a powerful position. We find that the network structure is indeed hierarchical, with some members constituting the core of the network based on their national HTA experience as well as external contact relations.

Keywords: European administrative networks; health technology assessment; EUnetHTA; network structure; social network analysis

Introduction
At first glance, European Union (EU) health policy integration remains limited. EU member states have repeatedly opposed delegation of health care competences to the supranational level, the EU budget is modest concerning health, and the treaty specifies that member states are responsible for the organization and delivery of health services and medical care (TFEU article 168 (7)) (Greer, 2006; Martinsen & Vrangbaek, 2008; Böhm & Landwehr, 2014). However, EU health policy cooperation is quite advanced. For a long time, the EU has coordinated the free movement of health professionals and patients, regulated safety and quality of medical devices, built agencies to control and approve pharmaceuticals, gathered reliable information on emerging threats to human health, and regulated food safety and health at work, among other regulatory tasks (Newdick, 2006; Permanand & Vos, 2010; Vollaard et al., 2013, 2016; Hervey & McHale, 2015; Martinsen & Schrama, 2021).

With the COVID-19 crisis, EU health policy has even become high politics, bringing together heads of state, health ministers and experts to confront the pandemic through joint actions (Brooks and Geyer, 2020; Greer & de Ruijter, 2020; Greer et al., 2021). Furthermore, new initiatives are on the table. In November 2020, the European Commission proposed a European Health Union with strengthened mandates for both the European Medicines Agency (EMA) and the European Centre for Disease Prevention and Control.
(ECDC), and in spring 2021, it launched a public consultation on a new Health Emergency Preparedness and Response Authority (HERA). These recent developments demonstrate how a transboundary crisis such as the COVID-19 pandemic can rapidly prepare the ground for extended EU health cooperation.

However, behind the scenes of high politics, expert-driven health cooperation has long been at work. In European administrative networks (EANs), civil servants and experts meet regularly to share information, develop and diffuse common standards for health quality and security and improve national implementation and enforcement (Eberlein & Newman, 2008; Vollaard et al., 2013; Maggetti & Gilardi, 2014; Martinsen & Schrama, 2021). Although hardly known to the public, such networks can be extremely important in developing new health measures as well as reviewing existing ones; think, for example, of the Pharmacovigilance Risk Assessment Committee (PRAC), a safety committee under the EMA, which was responsible for reviewing the AstraZeneca COVID-19 vaccine (see EMA press release, 18 March 2021 and press briefing, 7 April 2021). Over time, a considerable number of EANs have been established within the field of health, covering a wide range of issues, such as orphan medicinal products, health security, human tissues and cells, adverse effects of medicines, medical devices and cross-border health care (see Table S1 in the Supporting Information for EANs in the health policy area).

One of the EANs in public health is the Health Technology Assessment Network (EUnetHTA), established in 2006 (Böhm & Landwehr, 2014; Greer & Löblová, 2016; Boers, 2021). Its background and development demonstrate how an EAN can be key in progressing EU standards towards a pan-European model of shared assessments. Health technology assessment (HTA) is a multidisciplinary approach that evaluates dimensions of health technologies, including their medical and economic effectiveness. HTAs provide scientific advice to health policy-makers regarding whether a new drug or a medical device should be publicly funded (Greer and Löblová, 2016). HTAs thus focus on both the quality of new pharmaceuticals and technologies entering the market and their effectiveness, that is, their ‘value for money’. EU cooperation on HTA is potentially very important. Pooling resources on HTA means pooling information, knowledge, evidence, methods and practices concerning which medicine or medical devices on the market provide the best quality and most value for money. In times of fiscal stress, limited health budgets and growing demands, pooling resources at a larger European scale can be crucial. This is because it allows health authorities wider and shared ground for making evidence-based decisions on the pricing or reimbursement of health technologies. Thus, by cooperating rather than competing, health policy-makers share the same evidence-based ground for dealing with the pharma industry, prioritizing between medicines and devices on the market and developing public health.

HTA was picked up by some European states in the early 1980s. Meanwhile, the European Commission started to fund initiatives enhancing EU HTA cooperation (Böhm & Landwehr, 2014). More than two decades later, EUnetHTA saw the light of day. The members of the EUnetHTA are expert civil servants, acting as representatives from national health technology authorities at both the national and regional levels. The aim of the network is to provide systematic, robust and evidence-based information to health policy-makers for health policies to become both safe and
effective (Kristensen et al., 2008, p. 32). Currently, a permanent EU HTA network is being negotiated by EU legislators, as proposed by the European Commission in 2018.

Existing literature on regulatory networks has acknowledged the capacity of EANs to share information, produce common standards and engender convergence (Maggetti & Gilardi, 2011). The question, however, remains whether interaction between network members is primarily horizontal or hierarchical. That is, are network members equally influential in defining the way forward or do some members control and influence the process more than others, and if so, why? When network members interact, they bring national resources to the table – information, practices and experience – and by doing so, they may push their ways of doing things as the common denominator towards convergence. Recent research shows that regulators use EANs as opportunity structures to push through their preferences and approaches (Vantaggiato et al., 2021). Some network members may occupy a more central position in the network than others, and by their central position, they take greater control of the flow of information, decision-making and ultimately the decision outcomes of the network (Leifeld & Schneider, 2012; Christopoulos & Ingold, 2015; Ingold & Leifeld 2016). The question of whether interaction is horizontal or hierarchical is important in the case of HTA, as in most other networks. In the case of HTA, it concerns whether some members are more influential than others in deciding which methods, evidence and procedures become the joint and common HTA approach. The position to influence the final outcome produced by the network is currently particularly important in the case of EU HTA because a permanent network is under negotiation by EU legislators. As stated by a key actor in the network, ‘the reason to take a larger role in Joint Action 3 [current EU HTA program] was because of the knowledge it was going to work towards the permanent HTA cooperation and our desire to influence the permanent mechanism of HTA cooperation’ (interview quote, Boers, 2021, p. 265).

This article aims to contribute to both the study of EU health policy by researching the specific case of EUnetHTA and how EANs may constitute key venues for health cooperation, as well as the more general study of the role of EANs in the governance and application of EU law. We thus examine both the importance and structure of the EUnetHTA, and we investigate whether all member state representatives are equally important when key resources are being exchanged, namely, information, best practices, the preparation of joint assessments and the provision of advice. And if not, which factors do then explain why? Is it experience, capacity or external contact relations that explain who become core actors in a network defining common standards?

To examine these questions, we gathered unique survey data among the members of the EUnetHTA network with an 83 per cent response rate. We employ social network analysis and develop exponential random graph models (ERGMs) to examine the different types of interaction.

This article is organized as follows. In Section I, we present the background and development of HTA cooperation in the EU. We present the theory from which we examine network interaction and develop our hypotheses in Section II. Section III lays out the data collected and the methods employed. The results section follows in Section IV. Finally, we discuss and conclude on our findings.
I. Background and Development

Health technology assessment was initiated in the United States in the 1970s to inform health policy decisions. With the rapid increase in new health diagnostics and technologies, research-based assessments of their quality, security and effectiveness are needed. As a result, the first national HTA office was set up in the United States in 1972. Europe followed suit more than a decade later. As a consequence of increasing pressure on national health budgets, the need for evaluation of the cost-effectiveness of new technologies has only grown since then. In 1987, the first European HTA agency was established in Sweden, followed by Finland in 1995, Denmark in 1997 and the United Kingdom in 1999 (Löblová, 2016). Additionally, Spain was among the European forerunners, setting up regional HTA offices from 1991 onwards. Around the mid-2000s, HTA had become a more mainstream part of health policies, and more EU member states established HTA agencies. However, a majority of Central and Eastern European EU member states as well as Greece, Portugal, Malta, Luxembourg and Cyprus were late to adopt HTA bodies or procedures (Löblová, 2016). These countries were considerable steps behind in developing evidence-based practices and decision-making. In 2011, EU legislators adopted the Patients’ Rights Directive (Directive 2011/24). Article 15 of the directive details that a voluntary network shall support member states in the provision of objective, reliable and comparable information on health technologies. Thus, the patient rights directive provided new incentives for the implementation of national HTA in EU member states, which had not yet established an HTA procedure or institution (Scintee & Ciutan, 2017; Zawada & Mäkelä, 2017).

The European Commission has long supported HTA cooperation between EU member states and been a key driver of EU development (Böhm & Landwehr, 2014; Boers, 2021). From the early 1980s, the Commission funded HTA-related studies. From 1993 to 2002, three projects specifically aiming to enhance HTA cooperation between EU members were carried out. However, the network established as part of the projects was discontinued after the completion of the third project (Kristensen, 2012). In 2002, a process for more sustainable network formation was initiated, and in 2006, the EUnetHTA network was finally established.

Since its inception, the network has developed by means of Commission-funded, fixed-term projects, more specifically by means of three Joint Action programs.¹ From the outset, the purpose of the EUnetHTA network has been to bring together national HTA institutions to facilitate the exchange of reliable, timely and transferable information and thereby support politicians and health authorities in their health technology decisions (Guegan et al., 2014). The aim of the network has developed from reducing the differences in national HTA to applying a joint and common approach, with the purpose of converging HTA methods and conducting joint assessments. One of the key tools to do so is the adoption of the HTA core model, which establishes a standard procedure for what a qualified and effective HTA shall contain (Kristensen, 2012). However, national health technology assessments differ in key parameters, making convergence and joint actions slow and cumbersome (Chamova, 2017). National practices vary in terms of scope. Some

member states only conduct HTA on pharmaceuticals, others include medical devices, and some assess the economic effectiveness of technologies, while still others conduct full HTAs, including ethical and social aspects. National practices also differ in terms of methods and quality. They differ in how data and evidence for the assessments are provided, by assessments carried out by the HTA authority or by the company producing the technology. They also differ in which stakeholders – industry, patient experts, payers and/or clinical experts – are involved in the process and to what degree (Chamova, 2017). Finding common ground means selecting between different national practices.

The network today consists of representatives from 81 national, regional and not-for-profit agencies or health authorities, which all produce or contribute to HTAs. The members are not limited to EU member states but also include Norway, the United Kingdom and Ukraine. The network has an executive board and a secretariat. The secretariat is based in the Netherlands, and its team assists the network administratively, as well as in the creation and dissemination of HTA scientific knowledge. The network currently operates according to seven work packages with different tasks. Each work package has a lead organization, primarily responsible for realizing the defined objectives, deliverables and milestones (Boers, 2021).

In this article, we survey the members of work package 4 (WP4). The primary objective of WP4 is to produce joint HTA assessments and develop a common framework for this. WP4 is thus occupied with one of the key objectives of EUnetHTA. The WP is led by the Norwegian Institute of Public Health and includes 51 institutional members at the national and regional levels. WP4 is set to deliver approximately 50 joint HTA assessments and approximately 30 collaborative assessments on pharmaceuticals and other technologies. WP7 follows up and reports on how often joint assessments are being used back in member states. WP7 reports that, thus far, there have been 220 national take-ups of joint assessments produced under Joint Action 3 and 97 under the previous Joint Action 2 program. The production and use of joint assessments show that health technology has come far into actual HTA coproduction of methods and standards. However, the critique is that national duplication is still prevalent and that the take-up of joint assessment should spread (Boers, 2021).

To pool resources and further develop health technology cooperation, the Commission has pushed for mandatory take-up of joint assessments. The idea of an independent EU HTA agency was dropped as unrealistic (Löblová, 2021, p. 127) and instead the Commission worked for a permanent and powerful European Administrative Network on HTA. Anticipating the end of Joint Action 3 in late 2020, the Commission developed a proposal for a regulation on health technology assessment in January 2018, including mandatory joint HTAs. The Commission presented three main objectives and reasons for its proposal. The first reason relates to the internal market. Different national HTA processes, methodologies and requested evidence impede and distort market access for health technology developers. Second, HTAs are still being conducted in parallel in different member states with duplication of work as a result. Third, with its proposal the Commission aims to ensure a long-term sustainability of EU HTA cooperation instead of fixed-term projects. A core part of the Commission’s proposal thus concerns the establishment of

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a permanent EAN structure, called the coordination group which will be in charge of pan-European HTAs. According to the Commission, the coordination group shall consist of representatives from the member states, in particular from health technology assessment authorities and bodies. Designated expert subgroups shall again be responsible for producing joint clinical assessments and joint scientific consultations for medical products and certain types of medical devices, which, after a transitional period, would be mandatory to participate in and make use of. The Commission’s proposal on mandatory joint actions was initially regarded by most observers as bold and too soon for policy-makers to agree on (Boers, 2021, pp. 370–3). In a joint letter, a potential blocking Council minority consisting of Bulgaria, the Czech Republic, France, Germany and Spain took position against mandatory uptake of joint clinical assessments and too strong a role for the Commission (Löblová, 2021). The European Parliament was, on the other hand, in favour of the proposal from early on (Löblová, 2021). However, in line with the more general push for a European health policy in the midst of COVID-19, the Council changed position. On 24 March 2021, the Council agreed on a common position on mandatory joint HTA actions (Council of the European Union, document 7310/21). On 21 June 2021, the Council and the European Parliament finally agreed on an overall compromise package and on 9 November 2021, the Council held its vote on the proposal with 25 member states voting in favour and only Bulgaria and Poland abstaining from the vote (Council of the European Union, document 10531/21 and 13691/21). No member state voted against. The forthcoming regulation hereby establishes a permanent EAN structure, called the ‘Member State Coordination Group on Health Technology Assessment’, which will be the governing body for joint HTA work and assessments. Joint assessments will be carried out by expert subgroups as envisioned by the Commission. The take-up of the joint reports will, however, not be mandatory for the member states, but if carrying out national HTA where a joint clinical assessment has been published, the latter shall be given due consideration. The Commission will act as secretariat for the coordination group and support its work, but does not have a voting right on joint clinical assessments, will not act as co-chair for the coordination group and cannot comment on the content of joint clinical assessment reports. Thus, a powerful member state-led coordination group will soon establish a permanent EAN for the governance of pan-European HTA.

In sum, the development of HTA in Europe has come far over time. From being limited to a few states, health technology is now assessed across the Union. In parallel to national developments, EU cooperation has been enhanced. By means of the EUnetHTA network, common methods and joint assessment are now produced and currently negotiated as mandatory and permanent for the future.

II. Theory

Established through EU legislation, the EUnetHTA network brings together representatives of national HTA institutions across Europe to implement common HTA policy and carry out joint assessments. As such, it can be defined as a European administrative network. The explicit aim of EUnetHTA is to develop European collaboration on HTA, and they do so by interacting with one another to produce joint assessments and pool information, practices and expertise. These are all key features of European administrative networks, an increasingly popular governance tool for addressing a structural deficiency.
in the European executive order: the gap between joint decision-making and national implementation (Trondal, 2010; Mastenbroek & Martinsen, 2018; Martinsen et al., 2021). Despite being the EU core executive, the European Commission has limited resources and competences to develop and enforce the administration of EU policies when compared to the national level (Majone, 2000; Olsen, 2003; Trondal, 2010). To carry out its tasks, the Commission depends on cooperation with national administrations. EANs bring together national civil servants to foster cooperation, pool the resources of expertise and ensure a more consistent and effective application of EU rules (Börzel and Heard-Lauréote, 2009). When network members interact, mutual learning and common understandings of best practices and shared problems are set to occur (Börzel & Buzogány, 2019). They can constitute important instruments to improve the application of EU law (Hobolth & Martinsen, 2013; Börzel, 2021).

The structure and ways in which network members interact are key to the success of a network. If members interact closely and share valuable information, best practices and advice, cooperation and integration are more likely to be produced as a result. Interaction forms the structure of the network and constitutes an important unit of analysis. Interaction directs knowledge, information, practices and experiences. By examining interaction, that is, the internal structure of a network, the route of exchange and coordination can be uncovered (Vestlund, 2017).

However, in the existing literature, the internal structure of networks is foremost presented as either horizontal interaction between member states or supranational: interaction as vertically steered by the Commission (Hobolth & Martinsen, 2013). In a horizontally organized network, member-state representatives interact without much steering or involvement from the Commission or without certain members being more central than others (Slaughter & Hale, 2010). In a horizontal network, members participate and contribute to the network on equal terms in a non-hierarchical manner that allows for coproduction by and for all (Schout & Jordan, 2005; Lavenex, 2008; Slaughter & Hale, 2010; Heidbreder, 2015). Networks are presented as an alternative form of governance to hierarchy and markets, producing a specific form of interaction based on non-hierarchical coordination (Börzel, 1998).

Nevertheless, the absence of supranational steering does not mean that network interactions are free from hierarchy in effect. Internal network structures can differ in the extent to which network members are able to interact horizontally, that is, on equal terms. The recent work by Vantaggiato, Kassim and Wright points to the importance of uncovering the internal network structure because it forms an opportunity structure, allowing members to set agendas and decide with whom to share resources (Vantaggiato et al., 2021). Although foundational rules for EANs acknowledge members as equals, in practice, representatives from national authorities ‘command very different levels of expertise, experience and resources’ (Vantaggiato et al., 2021, p. 575). Interaction implies transaction costs, which actors will try to reduce by selecting whom they team up with (Leifeld & Schneider, 2012). Time is scarce, and not all actors are equally relevant. Contact serves different purposes depending on the direction of who contacts whom. For outgoing contact, the purpose is to gather information and learn from others. For incoming contact, the contacted obtains an opportunity to disseminate information and thus influence others (Leifeld & Schneider, 2012). When members team up with other members selectively, some members become more central than others, and a hierarchy may be
established between them. Hierarchy in that sense means that some members partake in an unequally large share of interactions.

Whether network interaction forms a horizontal or hierarchical structure is, however, an empirical question. We therefore present two contrasting hypotheses, assuming either that members interact to the same extent in the network, that is, in a horizontal manner, or that members interact more with some members than with others, that is, in a hierarchical manner.

\textbf{H1a}: National HTA bodies tend to be involved in the same share of EUnetHTA interactions, leading to a horizontal network structure.

\textbf{H1b}: National HTA bodies tend to be involved in an unequal share of EUnetHTA interactions, leading to a hierarchical network structure.

If we identify a hierarchical pattern of interaction, the important follow-up question becomes what can explain why some members are more central than others in a network. Inquiring into network centrality is important because previous research has shown that actors who occupy a central position in a network also have positions closer to the final outcome produced by the network (Leifeld & Schneider, 2012, p. 732). The actors at the centre of a network have a higher likelihood of influencing decision-making and outcomes (Christopoulos & Ingold, 2015, p. 480). In other words, they are more powerful. By their positions, central actors can route decision-making in certain directions, making some choices more likely than others and uploading their preferences and scientific views into this process (Vestlund, 2017; Vantaggiato et al., 2021). Resource pooling within networks is thus not a neutral process. Resources are not simply added together, but rather the resources of some members weigh more than others. In our case, where the purpose of the network is to bring expertise and evidence into the policy-making process of health technologies, it is crucial to identify if and why some members occupy more central positions in defining the way forward.

Why do some actors occupy central and entrepreneurial positions in a network through which they have the opportunity to set the agenda (Christopoulos & Ingold, 2015; Vantaggiato et al., 2021)? We present three explanatory hypotheses.

First, centrality may be explained by experience, on the assumption that members in a network will contact those members with greater experience in the field. Those with experience have more knowledge of how to handle the issue in question. Experienced members display a higher command of knowledge and will thus be more relevant for other members to seek contact with (Leifeld & Schneider, 2012; Lőblová, 2016). We thus hypothesize:

\textbf{H2}: More experienced national HTA bodies tend to be involved in a greater share of EUnetHTA interactions.

Second, centrality may be explained by capacity. This assumption relates to resource dependence theory, according to which members will establish contact with network members representing more well-resourced organizations (Leifeld & Schneider, 2012).
Members from organizations with greater resources will have a higher capacity to prepare and engage in the network. For example, staff size has been identified as a significant driver of interaction in networks (Beyers & Donas, 2014). We therefore hypothesize:

**H3:** National HTA bodies with a greater capacity tend to be involved in a greater share of EUnetHTA interactions.

Third, centrality may be explained by external contacts. The assumption here is that the centrality of members relates to whom outside the network they contact when addressing the issue at hand. EANs bring national administrators together, but at times, they will need to turn elsewhere for clarification or advice to make the network operate more smoothly (Egeberg et al., 2003; Egeberg & Trondal, 2009). External contact may occur for different purposes: clarification of EU law, solving disagreements with other network members, solving disagreements with national public authorities concerning the questions treated in the network, improving administrative capacity of network-related issues or training regarding network-related matters. When in need of clarification or advice, the network member has three ways to turn: to his or her counterparts back home in the national ministry or agency, to the network secretariat or to the Commission. In particular, external ties to supranational institutions provide an information advantage and embed members more into policy-making on a supranational level (Newman, 2008). In return, it is argued that the Commission fosters supranational interests among network members and institutionalizes EANs as their agents (Levi-Faur, 2011). This dynamic, where the Commission steers the strategic objectives of network members, has also been found to be present in the field of HTA (Böhm & Landwehr, 2014; Boers, 2021, p. 462). Here, we assume that the more Europeanized a network member is, that is, turning to the Commission rather than back home, the more likely that member is to occupy a central position in the network. The underlying assumption is that Europeanized members interact more impartially from national interests and turn primarily to their EU principal in cases of disagreements or when in need of clarification. We hypothesize:

**H4:** More Europeanized national HTA bodies tend to be involved in a greater share of EUnetHTA interactions.

### III. Method and Data Collection

**Research Design**

We take a network approach to test our hypotheses on the network structure and drivers of interaction in EUnetHTA. By taking bilateral interactions as the unit of analysis, we can ascertain what patterns of interactions emerge when national HTA bodies exchange resources, such as advice and best practice information, and collaborate in joint assessments. Social network analysis also allows us to gain insight into which national HTA bodies members of EUnetHTA turn to most and for what reason.
To infer what drives network interaction in EU netHTA, we developed exponential random graph models (ERGMs) for each type of interaction. ERGMs are appropriate statistical models to take into account the inherently relational structure of networks (Handcock et al., 2008). ERGMs are based on the assumption of statistical dependence and allow us to model certain configuration types of network ties (such as clustered or hierarchical configurations of ties). The observed configuration of network ties can be explained by simultaneously testing theoretically relevant variables and dependency structures. In essence, ERGMs enable you to simulate a distribution of random graphs and find the best model fit through the estimation of parameters based on the observed network configuration. These models are developed to infer whether there are certain structural tendencies of interaction and allow you to test what drives the formation of network ties (Robins & Lusher, 2012).

The testing of our hypotheses is a two-step process. First, we develop a set of ERGMs including only network structural characteristics to infer whether interactions in EU netHTA take place on a horizontal or hierarchical level. Second, we develop another set of ERGMs, including both network structural characteristics and the relevant characteristics of the network members, to determine what leads some EU netHTA members to be involved in a greater share of interactions than others.

Data Collection

Dependent Variable

We collected the data on the interactions among national HTA bodies through an online survey distributed and collected between 2019 and 2020. We distributed the survey among all national HTA bodies involved in WP4, where the main objective is to produce joint HTA assessments and develop a common framework for this. The response rate across the member states partaking in EU netHTA was 83 per cent. This is a very high response rate and considered sufficient to accurately represent and model the network structure as if it was complete (Borgatti et al., 2006). While some member states have multiple HTA bodies, we selected one national HTA body per member state. In those cases where we received multiple responses per member state, we preferred HTA bodies that (a) operated on a national level (as opposed to regional), (b) fulfilled a lead role in EU netHTA (as opposed to an associate role) and (c) had the most complete response to our survey. We asked respondents with which HTA bodies from other member states they were most frequently in contact for (1) advice, (2) best practices, (3) information and (4) joint assessments. They were free to name as few or as many as they saw fit. This enabled us to map out four directional networks of each above-mentioned type of EU netHTA interaction. In our models, we take into account the indegree of interactions, meaning that we test our hypotheses based on the number of times an EU netHTA member was named by others as a frequent contact.

Explanatory Variables

First, we operationalized the extent to which interactions are horizontal or hierarchical by the indegree distribution. When the distribution of indegree (how often an EU netHTA
member was named as a frequent contact by others) tends to exhibit a larger number of members with a similar score, the network is horizontal. Alternatively, when the distribution of indegree tends to exhibit a larger number of both members with a low indegree on the one hand and members with a high indegree on the other hand, the network can be considered hierarchical. To test for this, we included a geometrically weighted indegree ($gwidegree$) in our model (Hunter, 2007).

Next, we operationalized the experience of HTA bodies based on the typology developed by Löblová (2016). Her chronological taxonomy divides countries into three separate worlds of European HTA agencies based on the time of their establishment of an HTA agency. The forerunners were the first countries to establish their HTA agencies in the 1980s and 1990s (Denmark, Finland, Norway, Spain, Sweden, Switzerland and the United Kingdom). Among the mainstreamers were those countries that set up their national HTA bodies around the mid-2000s when HTA made its way to mainstream health policy in Europe (Austria, Belgium, Croatia, France, Germany, Hungary, Ireland, Italy, Latvia, the Netherlands and Poland). The final category of countries is what Löblová (2016) called the non-adopters, those who did not follow the trend of HTA agencification. By now, however, these countries have set up their HTA bodies and can be considered late adopters (Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Lithuania, Malta, Portugal, Romania, Slovak Republic, Slovenia and the Ukraine). Note that some may have formally set up their HTA bodies without actually investing the resources to be in compliance in practice.

To capture the capacity of national HTA bodies, we used two measures. First, we took the full-time equivalent (FTE) of HTA staff from the European report on HTA national organizations (Chamova, 2017). Second, we asked our survey respondents about the FTE of their staff devoted to tasks related to EUnetHTA. These were categorized as 1 (less than 1 FTE), 2 (1 to 2 FTE), 3 (3 to 4 FTE) and 4 (more than 4 FTE).

Finally, we operationalized Europeanization by the extent to which national HTA staff are in contact with the Commission, the EUnetHTA secretariat and their national Ministry/Agency to address EUnetHTA-related matters. We obtained this information in our survey, in which we asked respondents to indicate how frequently they were in contact with either. Their answers were registered on a Likert scale as 0 (never), 1 (a few times a year), 2 (a few times a month), 3 (nearly every day) or 4 (once a day).

**Control Variables**

We controlled for several factors that are likely to affect EUnetHTA interactions. First, for both steps of hypothesis testing, we take into account another network structural characteristic, namely, transitivity. Transitivity is the tendency to interact with those that you are already indirectly connected to through others. This is a commonly found driver of interaction in a broad variety of social networks, including policy networks (Lubell et al., 2012). We operationalized transitivity by including a geometrically weighted shared-partner statistic ($gwesp$).

Second, we controlled for the fact that some members hold a special position in EUnetHTA, namely, that of a lead partner. With regard to the joint production of HTA assessments, the national HTA bodies in Austria, the Netherlands and Norway are lead partners (coded as 1).
Third, EUnetHTA may be more relevant for some national HTA bodies than others due to varying powers of private interest to regulate. The larger the pharmaceutical industry, the more national HTA bodies need networks such as EUnetHTA to credibly perform their tasks and strengthen their reputation (Carpenter & Krause, 2012; Vantaggiato, 2019). We controlled for the effect of industry size on the active use of EUnetHTA through outgoing ties for advice, best practices, information exchange and joint assessments. We measured industry size as the number of enterprises manufacturing basic pharmaceutical products and pharmaceutical preparation.4

IV. Results

Descriptive Results

Before testing our hypotheses on the network structure and drivers of EUnetHTA interactions, we present descriptive features of the network to uncover the importance of the network, its structure, external contact relations and purposes. The descriptive findings serve to present the functioning of the network and its composition more generally.

An important question is why members invest themselves in the network. Members are busy administrators, with multiple tasks in both the national and European executive branches (Egeberg, 2006; Trondal, 2010). The success of a network thus depends on the members’ perception of its added value and importance. If they find that the network is foremost a club of talk, they are less likely to engage in the network. Therefore, the way members perceive the functions and impact of the network is important. When asked to indicate the importance of varying functions of EUnetHTA on a scale from 0 (not at all important) to 3 (very important), a majority of EUnetHTA members regard the network as very important (see Figure 1). None of the functions were regarded as not important at all. Members consider it very important not only for the production of joint assessments (72%) but also to improve the administrative capacity of national HTA bodies (68%), for the development of HTA methods and requirements (64%) and for the exchange of scientific information (64%). While there is slight variation, this also demonstrates that no function stands out above all as the core task of EUnetHTA. In general, the EUnetHTA is regarded as a very important structure for cooperation by its members.

Turning to the structure of the network, a certain pattern of interaction emerges. Visualizing all interactions among EUnetHTA members, a core-periphery structure appears (see Figure 2). However, some members, such as the United Kingdom, Austria and Norway, are particularly central to the network. However, others remain on the periphery, such as Latvia, Cyprus, Estonia, Poland and Romania.

This is also exemplified in Figure 3. Looking at which EUnetHTA members were named most frequently by others for different purposes of interaction, we see an uneven distribution. The United Kingdom, Austria and Norway are most prominent across the board. These are the HTA bodies most others turn to for advice, best practices, information and joint assessments. Alternately, we see that peers do not name Ukraine, the Slovak Republic, Latvia and Bulgaria as frequent contacts at all. In general, the skewed indegree distribution indicates a rather hierarchical network structure.

4Data from the year 2017 can be found in the Eurostat data table sbs_na_ind_r2.
Finally, our descriptive results present who the members tend to contact externally concerning EUnetHTA-related matters. To uncover external contact relations, we asked how often their organization was in contact with (1) the EUnetHTA Secretariat, (2) the relevant national ministry/agency in their country and (3) the European Commission concerning matters addressed in the EUnetHTA. Contact was specified to concern both general discussions, exchange of views and informal advice concerning an HTA-related matter. We found that national HTA bodies tend to be in contact with their national ministry and/or agency most frequently (Figure 4, top graph). Whereas 8 per cent of the national HTA bodies contact their national ministry and/or agency once a day, none of them contact the EU Commission or the EUnetHTA Secretariat as frequently. While there is contact with the EUnetHTA Secretariat nearly every day for 18 per cent of the HTA bodies, this is still less than the 24 per cent of HTA bodies contacting their national ministry/agency nearly every day. Contact tends to be on a monthly basis with both the EUnetHTA Secretariat (46%) and the national ministry/agency (40%). This is much more frequent compared to contact with the Commission, which takes place once a month for 29 per cent of the national HTA bodies and only a few times a year for a large majority (71%). The yearly frequency of contact is less common in regard to both national ministry/agencies (28%) and the EUnetHTA Secretariat (36%).

On average, the chief organization national HTA bodies are in close contact with their national ministry and/or agency, followed by the EUnetHTA Secretariat and then the EU Commission (Figure 4, bottom left). This tells us two things. First, there is still a dominance of national-level principals over European-level principals. Second, the fact that the EUnetHTA Secretariat is in closer contact with the national HTA bodies than the EU Commission demonstrates another pathway to Europeanization. The network’s organization is more autonomous than it is supranational, operating in fact rather independently from the Commission. This contrasts with what the more classic, dichotomous intergovernmental-supranational divide would lead us to assume.

The purpose of contact with the national ministry and/or agency is mainly assistance in resolving disagreements with public authorities, but it also extends to assistance in capacity building, clarification of EU rules on HTA and training on HTA matters.
Contact with the EU Commission is clarification of EU rules on HTA as well as assistance in building administrative capacity to deal with HTA.

(Figure 4, bottom right). Contact with the EUnetHTA Secretariat, on the other hand, mostly relates to assistance in resolving disagreement with other EUnetHTA members and training on matters related to HTA.
Figure 3: Distribution of (in)degree centrality of EUnetHTA members across different types of interaction.

Figure 4: Frequency and purpose of contact with the EU Commission, the EUnetHTA Secretariat and the national Ministry/Agency.
Inferential Results

To examine whether the structure of EUenetHTA interactions is significantly more hierarchical than what one would expect by chance alone, we model the network for each type of interaction. Table 1 shows the estimated effects of our modelling terms (goodness-of-fit diagnostics can be found in the Supporting Information).

As indicated by the negative and significant coefficient for indegree distribution, we find that interactions are indeed unevenly distributed, demonstrating a hierarchical network structure. The network consists of low-degree members on the one hand and high-degree members on the other. This is true for each type of interaction, except for information exchange. For this type of interaction, we find a more horizontal type of exchange, with only small differences in degree centrality across members. Overall, we find support for our hypothesis that national HTA bodies tend to be involved in an unequal share of EUenetHTA interactions, leading to a hierarchical network structure (H1b).

The next step of our analysis is to explain what drives interactions in EUenetHTA and what HTA body characteristics lead some members to be more central than others. Table 2 summarizes the estimated effects for each type of interaction (goodness-of-fit diagnostics can be found in the Supporting Information). We controlled for structural dependencies, such as transitivity and degree distribution, as well as the fact that some members take on a lead role in the network and the effect of industry size on the use of EUenetHTA. While we generally do see a positive effect of being a lead partner on the popularity of network members, industry size does not significantly affect members’ activity in the network. Being responsible for a larger pharmaceutical industry slightly decreases the likelihood of seeking advice from others or performing joint assessments, although this effect only borders significance.

First, we find that the more experienced HTA bodies tend to be involved in a greater share of EUenetHTA interactions (H2). EUenetHTA members turn to both forerunners and mainstreamers significantly more often than to late adopters. This holds true for all types of interaction, even for the more horizontal exchange of information.

Table 1: Exponential random graph models of network structure in EUenetHTA interactions

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Advice (1)</th>
<th>Best Practices (2)</th>
<th>Information (3)</th>
<th>Joint Assessments (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edges</td>
<td>-2.662***</td>
<td>-2.211***</td>
<td>-2.803***</td>
<td>2.146***</td>
</tr>
<tr>
<td></td>
<td>(0.282)</td>
<td>(0.329)</td>
<td>(0.505)</td>
<td>(0.228)</td>
</tr>
<tr>
<td>Transitivity</td>
<td>0.611†</td>
<td>0.602***</td>
<td>1.010***</td>
<td>0.420**</td>
</tr>
<tr>
<td>(gwesp)</td>
<td>(0.322)</td>
<td>(0.170)</td>
<td>(0.173)</td>
<td>(0.160)</td>
</tr>
<tr>
<td>Indegree distribution</td>
<td>-1.819**</td>
<td>-1.670**</td>
<td>-0.634</td>
<td>2.774***</td>
</tr>
<tr>
<td>(gwidegree)</td>
<td>(0.602)</td>
<td>(0.529)</td>
<td>(0.551)</td>
<td>(0.570)</td>
</tr>
<tr>
<td>Akaike information criterion</td>
<td>278.960</td>
<td>475.186</td>
<td>548.690</td>
<td>512.170</td>
</tr>
<tr>
<td>Bayesian information criterion</td>
<td>293.266</td>
<td>489.492</td>
<td>562.996</td>
<td>526.476</td>
</tr>
</tbody>
</table>

*p < 0.1; †p < 0.05; **p < 0.01; ***p < 0.001.
Particularly with regard to joint assessments, members more frequently name experienced HTA bodies. While mainstreamers are more than eight times more likely to be involved in joint assessments than late adopters, turning to a forerunner is more than six times more likely than turning to a late adopter. For advice, however, members are more than seven times more likely to turn to forerunners, compared to six times the likelihood for mainstreamers. Both forerunners and mainstreamers are almost four times as likely to be involved in the exchange of best practices. However, for information, members are five to six times more likely to turn to forerunners and mainstreamers than to late adopters.

Overall, the effects are both significant and large; however, we do not see a large difference in effect for either forerunners or mainstreamers compared to late adopters.

Table 2: Exponential random graph models of drivers of EUnetHTA interactions

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Advice (5)</th>
<th>Best Practices (6)</th>
<th>Information (7)</th>
<th>Joint Assessments (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edges</td>
<td>−4.714***</td>
<td>−3.311***</td>
<td>−4.198***</td>
<td>−2.946***</td>
</tr>
<tr>
<td>(1.674)</td>
<td>(0.834)</td>
<td>(0.939)</td>
<td>(1.024)</td>
<td></td>
</tr>
<tr>
<td>Transitivity (gwesp)</td>
<td>0.635</td>
<td>0.842***</td>
<td>1.026***</td>
<td>0.383*</td>
</tr>
<tr>
<td>(0.290)</td>
<td>(0.179)</td>
<td>(0.181)</td>
<td>(0.175)</td>
<td></td>
</tr>
<tr>
<td>Indegree distribution</td>
<td>−0.100</td>
<td>0.374</td>
<td>1.744+</td>
<td>−0.480</td>
</tr>
<tr>
<td>(0.831)</td>
<td>(0.905)</td>
<td>(1.012)</td>
<td>(0.936)</td>
<td></td>
</tr>
<tr>
<td>Lead partner</td>
<td>0.933*</td>
<td>0.422</td>
<td>0.532+</td>
<td>1.055**</td>
</tr>
<tr>
<td>(0.472)</td>
<td>(0.290)</td>
<td>(0.303)</td>
<td>(0.369)</td>
<td></td>
</tr>
<tr>
<td>Industry size (outgoing ties)</td>
<td>−0.002+</td>
<td>0.0001</td>
<td>0.0002</td>
<td>−0.001*</td>
</tr>
<tr>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HTA mainstreamers vs. late-adopters</td>
<td>1.786*</td>
<td>1.305*</td>
<td>1.801**</td>
<td>2.167**</td>
</tr>
<tr>
<td>(0.841)</td>
<td>(0.462)</td>
<td>(0.681)</td>
<td>(0.793)</td>
<td></td>
</tr>
<tr>
<td>HTA forerunners vs. late-adopters</td>
<td>1.979*</td>
<td>1.279*</td>
<td>1.660*</td>
<td>1.864*</td>
</tr>
<tr>
<td>(0.909)</td>
<td>(0.554)</td>
<td>(0.658)</td>
<td>(0.739)</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HTA staffing</td>
<td>−0.003</td>
<td>0.006+</td>
<td>0.004</td>
<td>0.005</td>
</tr>
<tr>
<td>(0.006)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.004)</td>
<td></td>
</tr>
<tr>
<td>EUnetHTA staffing</td>
<td>0.303</td>
<td>0.093</td>
<td>0.057</td>
<td>−0.079</td>
</tr>
<tr>
<td>(0.265)</td>
<td>(0.136)</td>
<td>(0.145)</td>
<td>(0.153)</td>
<td></td>
</tr>
<tr>
<td>Europeanization</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commission</td>
<td>0.330</td>
<td>0.013</td>
<td>0.422</td>
<td>0.746</td>
</tr>
<tr>
<td>(0.620)</td>
<td>(0.378)</td>
<td>(0.404)</td>
<td>(0.465)</td>
<td></td>
</tr>
<tr>
<td>EUnetHTA Secretariat</td>
<td>−0.363</td>
<td>−0.246</td>
<td>−0.422</td>
<td>−0.611+</td>
</tr>
<tr>
<td>(0.480)</td>
<td>(0.261)</td>
<td>(0.294)</td>
<td>(0.358)</td>
<td></td>
</tr>
<tr>
<td>National ministry/agency</td>
<td>−0.267</td>
<td>−0.482*</td>
<td>−0.356−</td>
<td>−0.422*</td>
</tr>
<tr>
<td>(0.362)</td>
<td>(0.209)</td>
<td>(0.214)</td>
<td>(0.250)</td>
<td></td>
</tr>
<tr>
<td>Akaike information criterion</td>
<td>269.848</td>
<td>464.821</td>
<td>531.627</td>
<td>486.955</td>
</tr>
<tr>
<td>Bayesian information criterion</td>
<td>327.070</td>
<td>522.042</td>
<td>588.849</td>
<td>544.177</td>
</tr>
</tbody>
</table>

*p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001.

5Odds ratios are calculated by exponentiating the relevant model coefficient.
experience built up since the mid-2000s seems to be sufficiently more to create a divide with late adopters.

Second, we find only limited support for our hypothesis on capacity being a driver of EUnetHTA interactions (H3). While we find no effect of staffing specifically designated for EUnetHTA-related tasks, we do see a weak effect of more general levels of staffing with regard to best practices. National HTA bodies with higher levels of HTA staffing are slightly more attractive to gain best practices from. We find no significant effect of capacity for any other type of interaction. However, because both forerunners and mainstreamers tend to be better staffed than late adopters, we created a separate model to ascertain the effect of capacity while leaving out the factor of experience (see Table S2 in the Supporting Information). The results show that, except for seeking advice, HTA bodies with more capacity in relation to HTA were indeed sought out significantly more by their peers. However, there is still no sign that capacity related to EUnetHTA tasks affects network position.

Finally, we find support for our hypothesis that Europeanization, or lack thereof, plays a role in the share of some of the EUnetHTA interactions (H4). The more closely tied HTA bodies are to their national ministry/agency, the less likely EUnetHTA members are to turn to them. This negative association is significant for best practices and bordering significant for information exchange and joint assessments. In addition, joint assessments are less likely with those that are in more frequent contact with the EUnetHTA Secretariat. The latter negative effect may be explained by the fact that contact with the EUnetHTA Secretariat mostly serves the purpose of resolving disagreements with other EUnetHTA members.

Conclusion

This article has demonstrated that European administrative networks are important coordinating structures for the integration of EU health policies. Beyond the radar of high politics, an important part of EU health cooperation has developed discretely within such network structures.

When national representatives interact, pool resources and decide on the way forward, the crucial question becomes whether some members are more influential than others in such a process, and if so, why? The question of influence is very important when the issue at play is about deciding which methods, evidence and procedures become joint and common in European HTAs. The common understanding developed is likely to be decisive on which technologies are taken up and what constitutes ‘value for money’ in national health systems.

Our findings have several implications for both the study of EU health policy and the more general study of European administrative networks.

For the study of EU health policy, our descriptive results demonstrate that network members consider the EAN examined here to be a very important structure for the governance of HTA. The large majority of network members see the network as ‘very important’ in carrying out different functions, that is, the production of joint assessments to improve the administrative capacity of national HTA bodies, the development of HTA methods and requirements, and the exchange of scientific information. Thus, national HTA bodies have considerable reasons to engage in a network that they clearly regard
as offering added value. We also see that the voluntary EUnetHTA examined here has been an important forerunner for the permanent and powerful European administrative network in HTA, the coordination group, which has just been agreed on by the European Parliament and the Council. On the one hand, the member states proved prepared for another significant step in the development of EU health policy integration. On the other hand, they insisted on a member state-led EAN, where national experts in joint actions become responsible for HTAs and the role of the Commission was toned down. An independent HTA was long dropped as an unrealistic idea (Löblová, 2021). This demonstrates EANs as important building blocks in the emerging institutional architecture of an EU health policy.

Turning to the more general study of European administrative networks, our contribution is twofold. First, we find evidence that networks of national experts are not as horizontal in structure as often depicted (Schout & Jordan, 2005; Lavenex, 2008; Slaughter & Hale, 2010; Heidbreder, 2015). While these networks are not subject to supranational steering and enable interaction among counterparts on equal terms in principle, in reality, they are not at all free from hierarchy. Indeed, some members are able to take on a more central role in the network due to their experience and advancement as regulators on the subject matter (Vantaggiato et al., 2021). By doing so, national regulators that have developed a certain regulatory tradition steer the network and are able to push their preferences and approaches towards convergence on a European level. This may explain why some of the more experienced HTA regulators, such as Germany, France and Spain, insisted on maintaining a member state-led network, as opposed to transferring their powers to a more central Commission (Löblová, 2021).

Second, this hierarchical structure of interaction is particularly relevant for the interactions that matter most, that is, the central task of preparing joint assessments, as well as advice giving and the exchange of best practices. Information exchange, however, still occurs in a more horizontal fashion. This finding underscores the relevance of differentiating types of interaction that take place in administrative networks. Our study signifies that, the more network interaction goes beyond the mere exchange of information, the more such forms of governance are steered by members in a position of power.

Turning to the explanations for different members’ network positions, our inferential results showed that, in particular, those with a long national experience in health technology assessments become lead actors. The members coming from national systems that have been late in adopting health technology assessments, in contrast, are instead more peripheral in the network. Experience counts, and experienced members become first movers in defining the way forward. Experience also goes hand in hand with the capacity to handle HTA matters. Late adopters tend to be worse off in terms of staffing and may not have invested the same type of resources to implement HTA policies compared to forerunners and mainstreamers. The division between the more scarcely resourced late adopters and the more resource-rich and experienced HTA bodies is mirrored in the network structure. In addition, it is interesting to see that, whereas the European Commission is not often contacted on EUnetHTA-related matters, those that do contact the Commission, that is, the more Europeanized members, are also more central actors in the network.

Overall, our findings suggest that networked health cooperation develops in its own right and is a highly important structure of cooperation for national health actors. At the same time, we see that not all network members are equally relevant when actors join.
forces to develop common standards and methods. The actors at the centre are more frequently contacted for information, best practices, participation in joint action and advice. In their central role, these actors are more likely to influence decision-making, outcomes and the way forward (Christopoulos & Ingold, 2015, p. 480). Sitting at the centre of a network is a position of power.

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**References**


**Supporting Information**

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**Table S1**: European administrative networks dealing with implementation or enforcement of EU health legislation, by name and abbreviation.

**Table S2**: Exponential random graph models of the drivers of EUnetHTA interactions omitting the variables measuring experience of HTA bodies to check the significance of capacity measures (see goodness-of-fit diagnostics in Figures S9–S12).

**Figure S1**: Goodness-of-fit diagnostics for Model 1 on seeking advice.

**Figure S2**: Goodness-of-fit diagnostics for Model 2 on exchange of best practices.

**Figure S3**: Goodness-of-fit diagnostics for Model 3 on information exchange.

**Figure S4**: Goodness-of-fit diagnostics for Model 4 on joint assessments.

**Figure S5**: Goodness-of-fit diagnostics for Model 5 on seeking advice.

**Figure S6**: Goodness-of-fit diagnostics for Model 6 on exchange of best practices.

**Figure S7**: Goodness-of-fit diagnostics for Model 7 on information exchange.

**Figure S8**: Goodness-of-fit diagnostics for Model 8 on joint assessments.

**Figure S9**: Goodness-of-fit diagnostics for Model 5 on seeking advice.

**Figure S10**: Goodness-of-fit diagnostics for Model 6 on exchange of best practices.

**Figure S11**: Goodness-of-fit diagnostics for Model 7 on information exchange.

**Figure S12**: Goodness-of-fit diagnostics for Model 8 on joint assessments.