Why common carrier and network neutrality principles apply to the Nationwide Health Information Network (NWHIN)

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ABSTRACT

The Office of the National Coordinator will be defining the architecture of the Nationwide Health Information Network (NWHIN) together with the proposed HealtheWay public/private partnership as a development and funding strategy. There are a number of open questions—for example, what is the best way to realize the benefits of health information exchange? How valuable are regional health information organizations in comparison with a more direct approach? What is the role of the carriers in delivering this service? The NWHIN is to exist for the public good, and thus shares many traits of the common law notion of 'common carriage' or 'public calling,' the modern term for which is network neutrality. Recent policy debates in Congress and resulting potential regulation have implications for key stakeholders within healthcare that use or provide services, and for those who exchange information. To date, there has been little policy debate or discussion about the implications of a neutral NWHIN. This paper frames the discussion for future policy debate in healthcare by providing a brief education and summary of the modern version of common carriage, of the key stakeholder positions in healthcare, and of the potential implications of the network neutrality debate within healthcare.

INTRODUCTION

One particularly challenging policy question about health information exchange is deciding what businesses or services need to operate for the good of the public (rather than purely for private profit), and how they should be managed. Some businesses or services are so necessary for the public good—such as, roads, water, electric utilities, and bridges—that they must be offered to the public in a non-discriminatory manner. For example, owning the only ferry[1] with access to an island puts the owner in such a position that he or she could affect the economic well-being of many. Under the law of common carriage, the ferry owner must sell the services in a fair and unbiased way. Should health information exchange services operate similarly?

The principle behind network neutrality is simple—users of the network should be able to exchange and use data as they choose, without interference by the organization providing the network data transport services. This paper discusses effects of network neutrality on the adoption of general telemedicine services, including wireless monitoring of vital signs at home, the adoption of personal health records (PHRs) and electronic health records (EHRs), and access to health education for patients

and providers. Network neutrality allows the consumer optimum choice and allows market selection to pick the winners and losers for technological services. No user can be 'locked in to' data exchange with only the partners specified by his or her network service provider or required to use only the analytic and information services offered by the network provider.

At least three components should be considered when exchanging health information: (1) the digital connectivity (which is usually the Internet); (2) the 'middleware" services for identifying participants, sending data from one place to another, security services such as token granting or certificate services to sign public keys, and forwarding of messages; and (3) information services available to users of the network to facilitate clinical operations such as record locator services (RLS), master patient index (MPI), and translation between different information standards. All these services are for the public good because they promote the seamless exchange of healthcare information across organizational boundaries. A few of the difficult policy questions to be considered here include determining the minimum set of services for health information exchange, who should manage what services, and how to manage those services. Some services might be best run by state or local government entities, or even national government entities; others might be best served by non-profit or by for-profit businesses. Again, deciding which type of entity should manage which type of service is a complex undertaking. For example, Health Insurance Portability and Accountability Act (HIPAA) regulations do not allow the federal government to provide funding to create a national patient identification, but given the large number of Medicaid, Medicare, and Veterans Affairs patients, the government would probably be involved in a comprehensive RLS service.

Whatever its architecture, it is imperative for purposes of fairness (large vs small providers), efficiency, and patient interest (access to data for critical medical questions) that concepts of network neutrality and common carriage be included in the Nationwide Health Information Network (NWHIN). We attempt to examine this subject by focusing on real-world translation of the concept of network neutrality for healthcare data exchange.

Much discussion has occurred in the media recently about network neutrality and telecommunications. Media articles have focused on the politics and policies of network neutrality—for example, from the *Wall Street Journal*, 'Should

Congress overturn the net neutrality rules?; from the *Washington Post*, 'How net neutrality regulation could undermine the open Internet'; and in the *New York Times*, 'A ruling could support F.C.C.'s net neutrality defense.'[2–4] However, most discussion has focused on the implications for Internet communications and companies that have a stake, either for or against, but there has been little discussion about the implications of network neutrality within healthcare. Our goal is a continuing discussion about network neutrality in order to assist policymakers in understanding and developing proactive health policy that will promote innovation in network-based healthcare services, and to serve the public good through application of the concept of common carriage to health information exchange.

If the concept of network neutrality is not applied to health information exchange, the resulting health data exchange system might have dire end-user implications in healthcare at multiple levels, including the individual, organizational, community, and policy levels. The redirection and changing of quality of service attributes of information has the potential to affect how individuals access their personal health information over the Internet and the breadth and depth of telemedicine services available on the NWHIN infrastructure.

This discussion begins with a background section that includes an overview of the Federal Communications Commission's (FCC) rules for the regulation of the Internet, the history of the neutrality debate, examples of what can happen without regulations, and stakeholders' arguments in favor of, and against, a neutral network. The discussion will then analyze the implications of applying common carriage principles to the NWHIN that illustrate the importance of network neutrality for the NWHIN.

WHAT IS THE LAW OF COMMON CARRIAGE, PUBLIC CALLING, AND NETWORK NEUTRALITY?

Sometimes the public good must over-ride market-driven and potentially discriminatory business strategies. Society has decided that the ideas of 'common carriage' and 'public calling' must be applied to industries deemed critical for the good of the commons. The holder of a communications monopoly has extraordinary power to influence public events. This was recognized as early as the 1870s when a private technology company named Western Union was the only carrier of reports from the Associated Press. In the 1876 election, Western Union attempted to influence the outcome of the election by selectively transmitting reports favorable to one presidential candidate (Rutherford B Hayes).[1] The law of common carriage was developed to prevent such discrimination in important public services.

Such interventions can and do happen today. Cases involving Cox Cable, Madison River Communications, Verizon Wireless and Comcast illustrate this. Cox Cable told users not to use virtual private networks.[5] Comcast (a cable Internet service provider) disrupted BitTorrent uploads by spoofing transmission control protocol reset packets that appear to originate at the end destination.[6] Madison River[7] blocked the popular voice over IP service offered by Vonage and others from its network. Verizon is now fighting the FCC in court over network neutrality regulations for the 'freedom' to edit the Internet by selling priority spots to the highest bidders.[8 9] This effectively allows Verizon to provide both Internet access and actual search results based on their priorities, not on those of the end-user of the wireless services. All these examples indicate clearly that Internet service providers (ISPs) are willing to disable services to influence user behavior, and in general, they indicate that the people controlling information often display a willingness to manipulate it. The effects of such behavior on healthcare will be discussed in a later section.

The NWHIN employs a common infrastructure that is based on layers similar to the Internet, which, as Lessig[10] points out, is based on both open and controlled layers. Anyone can build a website with any content as long as it is based on controlled standards like HTTP, HTML, and XML. To have both provider- and patient-oriented services, the NWHIN must be what Lessig calls an innovation commons: 'Where innovators can develop and deploy new applications and services *without the permission of anybody else*.'[10] Similar to Lessig's view of the Internet commons, the NWHIN should, ideally, have three aspects of commons: (1) The commons of code that built the NWHIN and its applications; (2) the commons of free exchange of ideas of information about how the NWHIN runs; and (3) the commons of innovations built by the first two, 'the opportunity, kept open to anyone, to innovate and build upon the platform of the network.'[10]

To amplify our understanding of network neutrality, we employ a general technical definition of network neutrality rather than the definition used in recent FCC announcements concerning network regulations—the reasoning being that the new regulations make it difficult to understand the implications of a neutral network involving other issues beyond the technical definition of network neutrality. Our working definition is as follows: Network neutrality implies that all content providers pay the same price and have the same access to final consumers at the same quality for network service. This does not mean that all health information exchanges (HIEs) must charge the same price, or that HIEs are prohibited from offering different service bundles at different prices, but it does mean that HIEs need to sell their services in a fair and unbiased way that allows the market to decide which HIEs are the best value. The underlying themes of network neutrality are fairness and competition.

There are abundant descriptions of the meaning of network neutrality. Although the term 'network neutrality' is new, the concept is not. In an 1860 USA federal law subsidizing West to East coast telegraph construction, we find this: 'Messages received from any individual, company, or corporation, or from any telegraph lines connecting with this line at either of its termini, shall be impartially transmitted in the order of their reception, excepting that the dispatches of the government shall have priority.'[11] Tim Wu, the man credited with coining the term 'network neutrality,' discusses it in the context of 'preserving Darwinian competition for every conceivable user of the Internet so that only the best will survive.' Tim Burners Lee, the generally acknowledged creator of the world wide web defines network neutrality as follows: 'If I pay to connect to the Net with a certain quality of service, and you pay to connect with that or greater quality of service, then we can communicate at that level.'[12] While these definitions vary, the underlying themes, again, are fairness and competition. Neutral networks do not bias traffic based on content, source, ownership, destination, or any other attribute of the data or metadata in ways undesirable to end-users or content/service providers.

FEDERAL COMMUNICATIONS COMMISSION

In 2010, the FCC announced new rules concerning the regulation of the Internet.[13] These regulations created a two-tiered system that distinguishes between fixed and mobile broadband providers, and they include three guidelines for network neutrality:

1. Transparency means the manner in which the network is managed and operated must be disclosed to all users in an

unbiased way. Fixed and mobile broadband providers must disclose the network management practices, performance characteristics, and terms and conditions of their broadband services.

2. No blocking means that the organization operating a network is not allowed to stop traffic from users based on where the data came from, where the data are going, or what the data contain. Fixed broadband providers cannot block lawful content, applications, services, or non-harmful devices; mobile broadband providers cannot block lawful websites, or applications that compete with their voice or video services.

3. No unreasonable discrimination means that user traffic may not be 'altered' (ie, delayed in some way) by those managing the network. Fixed broadband providers may not unreasonably discriminate in transmitting lawful network traffic.

In April 2011, the House of Representatives voted by 240 to 179 to overturn the FCC's network neutrality regulations,[14] which presents an opportunity to re-examine the network neutrality debate. In November 2011 Senate Republicans pushed to overturn the so-called net neutrality rules, and a resolution introduced to do so failed by 52 to 46 in the Senate. The White House had threatened to veto the action if the Senate approved it.[15]

Understanding the principal stakeholders

In order to better understand how network neutrality may affect key healthcare stakeholders, we will briefly discuss some of the stakeholders that oppose or promote network neutrality in telecommunications, and their reasons for doing so.

Stakeholders opposed to network neutrality

AT&T, Verizon, Cisco, and 3M are just a few of the companies that oppose neutrality regulations.[16] The primary argument of ISPs involves the 'pipeline' that delivers content to consumers, and the idea of whether an ISP can 'own' that pipeline. ISPs believe that they should be able to control what goes through the pipe, and that they should also be able to charge an access fee for the right to use the pipe,[17] in addition to the standard fee that the ISP's customer already pays.

Despite the many examples of ISPs blocking content,[17] opponents of neutrality argue that there is limited evidence to suggest that ISPs have future plans to block content or slow network performance. These critics suggest that regulations are not needed, given that the types of discrimination ISPs exhibit is either lawful or can be resolved by existing FCC regulations not related to neutrality. Opponents of neutrality also believe that network neutrality regulations will stifle network growth by preventing ISPs from discriminating among types of data based on business arrangements; thus, ISPs would have no incentive to expand their existing networks. In other words, it is fiscally irresponsible to expend large amounts of financial capital when there is a reduced ability to collect a return on the investment.

Stakeholders in favor of network neutrality

A wide range of stakeholders are in favor of network neutrality. Companies such as Amazon, eBay, Google, Yahoo, Netflix, Microsoft, and most health-related service providers, are proponents of network neutrality.[18] On a purely practical level, any organization that provides content or uses content can gain footing through network neutrality. These are companies that provide the content that flows through the pipe, and they also create the applications that use the content.

Proponents also argue that without neutrality regulations, innovation of those services that use the Internet will be stifled. Neutral networks promote experimentation and innovation in markets characterized by high levels of uncertainty, such as the telecommunications market,[19] and companies creating network-based medical services are operating in these uncertain markets. This has the potential to delay, and possibly prevent, the creation of products that improve the quality of care while reducing costs.[19]

Lastly, proponents of network neutrality regulations assert that a neutral network maximizes consumer choice. In a neutral network, it is less likely that patients will be restricted in the types of content and services they use. If ISPs are allowed to discriminate amongst certain types of content and/or show preferential treatment to their own content or to data from content providers with whom they have a business arrangement, consumers are harmed, and in most cases without any knowledge of this preferential treatment. The end-users of the NWHIN are important stakeholders in promoting patient-centric quality care at a reasonable cost. This is discussed further in the following section, which highlights the end-users of the NWHIN, including patients and their care providers.

APPLY NETWORK NEUTRALITY TO HIEs

The end users of information are increasingly demanding open, neutral environments for computer-based services. In academic publishing more than 5700 mathematicians joined an organized boycott of Elsevier in response to that publisher's restrictive access policies to scientific knowledge.[20] Dunn[21] has suggested an open-source model for clinical trials that may, based on analogies to the open-source software community, speed up the process of translating clinical evidence into practice. Kohane and Mandl[22] have called for 'data liquidity' *within* EHRs and the ability to create plug-and-play clinical applications based on standardized data models. They believe in building an 'extensible ecosystem of applications that will stimulate a market for competition on value and price, based on a neutral platform supporting interoperable apps.' Proposals for open neutral systems in publishing, research, and within EHRs, similar to proposals for network neutrality, do not propose the complete elimination of regulation. Rather they propose systems of rules that create a structured, *fair* market for ideas and services.

To be neutral and open, HIE should be non-discriminatory in content, ownership, source address, and destination address, as the NWHIN cannot have a stake in the content of the data, where it originated, or where it is going. This is the fundamental principle of a 'public calling,' or network neutrality, as we call it today. This means that if an ISP, such as Comcast, partners with Onpatient or Dossia, it would not be permitted to give preferential network layer treatment to a PHR from Onpatient or Dossia services over, for example, Microsoft's competing HealthVault service. This does not mean, however, that Comcast would be blocked from bundling any PHR service with other services provided by Comcast as long as it does so non-discriminatorily. On the contrary, network neutrality is fundamental to providing network users with unbiased choices in an environment that is conducive to innovation and investment.[23]

It seems intuitive that HIE is geared towards public advantage, yet in 2010 Vest and Gamm[24] pointed out that 'while notable exceptions exist, reluctance to engage in widespread information sharing is nearly ubiquitous among providers, extending from small medical practices to large hospital systems.' This has changed in the past 3 years as more providers and healthcare organizations are exchanging healthcare data—

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but largely within their own organizations. Moreover, there are vendors in the EHR market that believe interoperability means the ability to exchange data with users of the same EHR system, which does not contribute to the common good. In this case, the market could work better for the 'public calling' as technology vendors see the potential for profit in the exchange of medical information, particularly in translating between standards.

Treating HIE as a public good[24] would be efficient based on evidence from the economic efficiency of the Internet as a public calling,[25] and would benefit all individuals simultaneously, as public good argues for its inclusion under 'common carriage' laws. Excluding any single individual decreases the value of HIE to all users exchanging healthcare information, as illustrated by network economics.[26] Treating the HIE as a public good allows the commons to benefit from HIE by obtaining less expensive and more effective healthcare. As Vest and Gamm suggest, 'moving toward HIE as a public good possibly structured as a public utility supported by government, and/or payers and providers could simultaneously overcome these problems of competition, retain the benefits of localized exchange, gain the benefits of broader exchange, and address the issue of sustainability.'

In particular, HIE organizations have the potential to serve the public. Lenert et al[27] point out that 'an example of a 'public good' implemented within many RHIOs has the potential capability to quickly and automatically locate and retrieve the most relevant electronic health records for a patient. This capability could be thought of as a public service-like function, readily available to all authorized providers but not necessarily economically viable to create or be self-supporting.' Lenert points out that the market failed with HIE, stemming from 'the mismatch between the public utility-like mission adopted by many organizations and the requirements for free market success for sustainability.' HIE organizations that subsidize connectivity services, and provide universal access to their networks along with other services for the good of the community, are operating like public utilities.

For public good, HIE organizations should (1) allow establishment of secure connections among organizations wishing to share HIE without prejudice and (2) respond to queries with only limited restrictions due to privacy concerns. A trusted entry should be responsible for identification, authorization, and logging to ensure that any request is from an authorized source, and that if the request is fraudulent it can be detected and traced back. The focus should be more on accountability than on restricted access, given that one way to break HIE for the public good is requiring 'greater" evidence of a therapeutic relationship with the patient than the standard in order to respond to requests about potential health information. Secure and complete logging should provide the proper deterrent to attempted fraud, allowing a reasonable security standard based on customary therapeutic models.

A key policy question is, What are the potential HIE services that promote the good of the public? A report by Frost and Sullivan[28] about the HIE market classifies HIE services as core or value-added services in the data, consumer, user and identity management, and management areas. Below are some examples of core services:

- Record locator services (RLS)—The RLS links all the individual data in electronic health records into a compressive virtual record.
- Master patient index (MPI)—An MPI service provides a unique identifier for each individual.

- Master provider index—A master list of healthcare providers that are willing and able to share medical data.
- Token granting service (TGS)—Security infrastructure such as Kerberos requires a token or ticket in order to authenticate a user.
- Certificate granting—Public/private key infrastructure requires a trusted organization to sign the public key of each healthcare organization wishing to exchange data. This could be a regional health information organization (RHIO) service invoked as a fee structure for each organization, perhaps based on size.
- Data mediation—Services that convert data from one coding format to another, or from one messaging format to another.

In a survey discussing improving usability of EHRs Middleton et al discuss how standardization of interoperability of external services is critical for creating more effective EHRs, and also safer and more secure EHRs. Without national-level agreement on the types of services supported, functions and requirements for how EHRs should behave when communicating with other systems, the goal of safe, highly useable EHRs may be difficult to achieve.[29]

Recently, the Office of the National Coordinator (ONC) published a request for information[30] related to conditions for trusted exchange (CTE) of healthcare information over the NWHIN, which it defines as follows: "CTEs would reflect NWHIN's portfolio of standards, services, and policies and would be incrementally added to and refined over time… CTEs would be established under three categories: interoperability; safeguards; and business practices." Network validated entities (NVEs) are suggested as mechanisms to ensure that HIE is in compliance with CTEs. We propose that both privately supported HIE organizations and publicly supported RHIOs can function as NVEs; we suggest several strategies above supporting this view. RHIOs are well situated to have "authority for monitoring and oversight" as well as become "… accreditation body and validation bodies involved in determining compliance with the adopted CTEs."[30]

Most of the goals of CTE fit well within the framework of common carriage and network neutrality. However, care is needed in order to keep processes transparent. Question 13 in the request for information discusses the concept of an eligibility criterion for 'valid' purpose to allow the exchange of information. From a network neutrality point of view, this may be overly constraining; data processing should not be biased based on content, ownership, source, or destination, and requiring validity criteria seems to violate this principle. It is likely that overly strict eligibility criteria will stifle rather than promote innovative services in the NWHIN. Any move to an open-accessibility assumption must take into account legitimate concerns about patient privacy and system security. Authentication and authorization are important aspects of CTE security: "The requirement to authenticate and authorize the parties for which the NVE facilitates exchange could be accomplished either directly or indirectly by the NVE. In the case of the latter, the NVE would need to require the party for which it facilitates electronic exchange to perform authentication and authorization in order to be in compliance with this CTE."[27] As discussed, this is a viable strategy to support RHIOs as part of the common carriage principles.

HealtheWay, the proposed public/private partnership by the ONC, has historical evidence from the Internet illustrating the effectiveness of public/private partnerships in developing network infrastructure. The Internet started with public funding from the military to build the Advanced Research Projects

Agency Network (ARPANET). Later organizations such as the National Science Foundation funded basic research to transform ARPANET into the public Internet. However, now most innovation and funding for Internet development are from private sources. Although the NWHIN differs from the Internet, many principles from its public/private funding point towards a very successful development methodology.

IMPLICATIONS FOR HEALTHCARE

A good example of potential negative implications is the vertical wireless home monitoring[31][32] solution called Oncare, developed by Zora, and recently announced by Verizon. Verizon was able to give preference to network traffic from their Oncare home monitoring service, thus providing better quality of service than other competing home monitoring solutions, such as MedicalAlert. A service provider favoring data from its partner is, in general, bad for all users and all service providers, with the obvious exception of the favored provider.

The successful adoption of PHRs may well depend on a neutral network because there is great value in providing patients with many choices when picking a PHR application that can best fit their needs. In the early phase of PHRs, there were many vendors, such as Google, Microsoft, and Dossia, which were trying to meet users' needs in the PHR application space. Google was so concerned about network neutrality that it lobbied the FCC to require network neutrality in the C block of spectrum that was auctioned off in 2008[33][34]; it then backed up its belief by bidding over US$4 billion to assure that the C block would require a neutral network—Google knows it needs network neutrality in order for its wireless users to access its services without bias. These different PHR applications have different feature sets, different graphical user interfaces, and different functionality, because these PHR vendors are experimenting with these applications. It is market selection that will determine the winners and losers in this application area. The more choices there are in the market for each end-user, the greater the value of this 'best' solution. This market selection is in process—Google Health stopped operating on January 1, 2012.

In a neutral network, hospitals will not be restricted in their telemedical activities. Telemedicine and telecommunications-based healthcare delivery services have made great strides in transforming the delivery of healthcare in the USA. Telemedicine is 'the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities.'[35]

In a non-neutral network, the benefits of telemedicine may not be realized. Telemedicine has the potential to break down barriers associated with access to medical treatment for rural residents.[36][37] For example subrecommendation 3C is that the National Institute of Mental Health should support research on effectively deploying health information technology on the delivery of mental health services, particularly where technology has an opportunity to reach underserved populations.[38] The cost-saving benefit of information technology has the potential to be realized with the passing of the Patient Protection and Affordable Care Act (PPACA) and the Health Information Technology for Economic and Clinical Health (HITECH) Act.[39][40] For details see PPACA (2010),[41] Health Care Education and Reconciliation Act of 2010,[42] and the HITECH

Act (2009).[43] Without a level playing field, these benefits may be diminished.

Network neutrality does not impede but rather, meshes well with HIPAA security and privacy regulations. Current Internet protocols such as SSH, radius, diameter, IPsec, S/MINE, IKE, ISAKMP, PGP, SSL, TLS and many other standards have proved effective, efficient, and secure for many applications with high security and privacy requirements, such as credit card data (as discussed in the payment card industry standards).[44] The nature of network neutrality promotes security and privacy because of its emphasis on transparency in data content, source, ownership, and destination and reliance on end-to-end security associations.

CONCLUSION

The debate and issues surrounding common carriage and network neutrality will have an impact on the NWHIN and the key healthcare stakeholders that use it. HIE is critical to the public good, and network neutrality will promote the creation of innovative services, such as telecommunications-based healthcare delivery systems, among others. These services have the potential to favorably affect the patient and provider through the delivery of more efficient and less expensive healthcare. Without neutral networks, healthcare can be adversely affected. One example presented was Verizon's preference to network traffic from their home monitoring service. Healthcare professionals and policy makers should take part in, and understand the current and future policy debates about federal laws, FCC policy, and industry-lobbying efforts concerning network neutrality's role in HIE. To be effective, the exchange of healthcare data must not be overly constrained. At the same time, robust infrastructure must exist to track down offenders breaking privacy rules. The successful adoption of HIEs may very well depend on the acceptance of a neutral NWHIN.

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