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The future vision(s) of AI health in the Nordics: Comparing the national AI strategies

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ABSTRACT

Given the current hype around artificial intelligence (AI) in health, it is not surprising that we are seeing the well-established role and power of future visions being played out by a range of actors in the area. One example is the surge in the adoption of national AI strategies (NASs). NASs have a structuring function, justifying current political decisions as well as (re)framing the conditions of possibility of AI in society. This paper explores the sociotechnical imaginaries (SIs) of AI in health in the NASs of Denmark, Finland, Norway, and Sweden. The findings reveal that a shared common future vision can be identified, though some variations in the justification of how and why this should be realised exist between the states. This common future vision is of the inevitable and ever-increasing scale and scope of AI in health. This is a process driven and implemented by the private sector, a future which is normalised and legitimised through the promise of greater efficiency and progress. However, a tension between the role of states as simply reacting to, as well as being essential facilitators of, the realisation of this shared vision is identified, a tension that results from technological promises.

1. Introduction

It is well noted that future visions of emerging technology both shape policy but also reveal a lot about the past and present. Artificial intelligence (AI), which is increasingly heralded as being able to radically transform health and healthcare systems (Flores et al., 2013; Miotto et al., 2018), is a recent manifestation which can be situated within the established understanding of the role and power of futuring of emerging technology. AI, and in particular AI in health, is currently in a hype phase. For example, the global digital health market has, and is projected to continue, to increase at a tremendous rate, with the largest technology companies realising this potential and moving into digital health (Thomason, 2021). The international community has also begun to jump on the bandwagon. In 2021 the World Health Organization (2021a) published its Global Strategy on Digital Health 2020–2025, setting out their vision of how the disruption caused by AI in health (amongst other aspects of digital health) could be minimised, and how the opportunities of such applications could be best realised. A similar approach has been taken by the European Commission (2022) as part of its 'ehealth' strategy. States have also reacted to the hype around AI in health by adopting national AI strategies (NASs). There has been a surge in the number of these over the last six years. As of June 2022, the OECD.AI (2022) database listed 259 NASs, agendas and plans globally.

The research presented here is inspired by previous research on NASs, as well as the debate around sociotechnical imaginaries (SIs). It contributes by addressing a gap in knowledge regarding the future visions of AI in health in Nordic region, from the perspective of the

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NASs. To achieve this, a comparative analysis of the SIs of AI in health in the NASs of Denmark, Finland, Norway, and Sweden was undertaken. The NASs are interesting in that they provide a consolidated point where one can see public policy decision making on the adoption of AI into the public sector, investments in national ecosystem development, allocation of resources as well as regulation of third parties (Wilson, 2020). As such, NASs have a structuring function, justifying current political decisions and (re)framing the conditions of possibility of AI in society. Drawing on the work on Jasanoff (2004); (2015) and Jasanoff & Kim (2009); (2013) the research presented here focuses on the SIs found within the Nordic NASs, exploring the relationship between social actors, technology and how the future vision(s) in the NASs reflect broader social visions.

The findings reveal that despite some variation in the narratives of how and why the future of AI in health should be realised between the four states, a shared common future vision can be identified. This is one which sees the ever-increasing scale and scope of AI in health as inevitable, a process which is driven and implemented by the private sector. This is normalised and legitimised through the promise of efficiency and progress that AI in health can provide. Efficiency in healthcare is implicitly implied as desirable.

However, a well-established tension regarding technological promises can also be identified. This is understood in relation to the work of Van Lente & Rip (1998) whereby the shared future vision reveals a tension between agency-structure. The Nordic states claim that the promising technology of AI in health (the structure) is forcing their hand. In so doing they attribute a "quasi-autonomous character" to the technology, while simultaneously seeking to uphold their perceieved agency (ibid, p. 215). The future visions in the Nordic NASs position the states as having agency regarding their unique facilitatory role as being able to (de)regulate, as well as being the guardians of the public health data registries. Yet, their remaining agency in realising this future vision is time limited in that promises made must be acted upon. By deregulating and granting access to public health data registries to achieve their future visions the agency of the state will be further undermined.

This paper is structured as follows. Section 2 discusses SIs and its use in previous research. Section 3 covers the research on NASs in general, and that on the future of AI in health in the Nordics more specifically. Section 4 is the methodology. In Section 5 the results are presented at a country level, with an ongoing comparative analysis. This is followed by a discussion of the empirical and theoretical ramifications derived from the comparative analysis in Section 6.

2. Sociotechnical Imaginaries

Recently there has been an increase in interest in the relationship between the discourse and politics of technology (Mager & Katzenbach, 2021). Previous research on expectations and promises of technological development, and their coordinating role in mobilising resources at a macro, meso and micro level, have been central to this exploration (see Van Lente, 1993; Van Lente, 2000; Van Lente & Rip, 1998). As Van Lente & Rip (1998, p. 216) assert "Technological promises function as a yardstick for the present and as a signpost for the future". Promises thus require action, roles need to be allocated and protective spaces developed (Van Lente & Rip 1998, p. 216). The concept of technological promises highlights the importance of the cultural belief in technology as always leading to progress, and has been used, for example, to explore how expectations relate to the creation of 'inevitable' futures, as well as their role in the de facto governance of science and technology (Van Lente & Rip, 1998; Borup et al., 2006; Konrad et al., 2016).

The concept of SIs emerged due to the recognition "that the capacity to imagine futures is a crucial constitutive element in social and political life" (Jasanoff & Kim, 2009, p. 122). Sitting between imagination as understood in political and cultural theory and that of sociotechnical systems, SIs draws attention to the interplay between social actors and technology and how these actors' future visions of the role of technology is also reflexive of broader social visions (Jasanoff, 2004, 2015; Jasanoff & Kim, 2009, 2013). Jasanoff, (2015, p. 3) defines SIs as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology". SI are significant because, as Jasanoff (2004, pp. 2–3) notes:

"Scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions – in short, in all the building blocks of what we term the social. The same can be said even more forcefully of technology".

Using SIs as an analytical framework allows one to shed light on the creation and perpetuation of norms by social actors in relation to realising their future vision. The technological visions are thus recognised as being played out in the present and being deeply intertwined with socio-cultural norms. Actors seek to create and convince others of the benefits of their future (Brown, Rappert, 2000), with these futures "almost always imbued with implicit understandings of what is good or desirable" (Jasanoff & Kim, 2009, p. 122–123).

Jasanoff's (2015) definition of SIs evolved from an earlier version in Jasanoff & Kim (2009) where the focus was on nation-states, government actors and public institutions as the main players in creating these imaginaries. The analysis of SIs in 'official discourses', be it that of experts, states or law and policy, has been the subject of sustained interest. A few recent examples include research on global health security and the pathogenic imaginary of actors in the international health arena (Lakoff, 2015), the policy discourses of science and technology in the United Kingdom (Smallman, 2018), the OECD's experts narratives on sustainability (Savaget & Acero, 2018), technopreneurialism and the national narrative in Singapore (Emily, 2019), gene editing in the USA (Bain et al., 2020), the Forth Industrial Revolution in Denmark (Schiølin, 2020), low carbon waste-energy futures in the UK (Levidow & Raman, 2020) digital touch for remote personal communication (Jewitt et al., 2021), the Forth Industrial Revolution in the World Economic Forum (Vicente & Dias-Trindade, 2021) and resistance to datafication of public administration in Norway (Reutter, 2022).

This focus on 'official discourses' has been the subject of critique for side-lining the role of other actors, such as civil society, individuals, or private sector interests, and in so doing is accused of failing to capture the nonlinear, contingent, contested, and complex processes of SIs content and performativity (Mager & Katenbach, 2021). Beyond the 'official discourses', recent SI research has looked

at the private sector on issues as diverse as Silicon Valley start-up schools (Williamson, 2018), commercial satellite imaginary (Olbrich & Witjes, 2016), corporate visions of smart cities (Sadowski & Bendor, 2019) rural entrepreneurs and farmers SIs of food security in Sweden (Eriksson et al., 2020) and the performance and translation of digital futures in the tech scene in Copenhagen (Hockenhull & Cohn, 2021). The role of civil society as well as contested futures has also been explored, including social movements and state narratives in South Korea (Kim, 2015), citizen science in the fracking debate in Colorado (Zilliox & Smith, 2018), data activism in Denmark (Lehtiniemi & Ruckenstein, 2018), family farming in Argentina (Goulet, 2020) and satellite imaginary and transparency in nuclear fuel cycle facilities (Lawrence, 2020).

The above reflects only a limited collection of the rich and growing body of literature exploring the content and performativity of SIs by a range of actors. While recognising this breadth, the research presented here focused specifically on one aspect of the 'official discourse', the NASs. This is because NASs combine "fierce national strategic positioning, and, at the same time, sketch bold visions of public goods and social order enabled through AI" thus they should be considered a "powerful and peculiar hybrid of policy and discourse" (Bareis & Katzenbach, 2021, p. 2).

Research drawing on SIs to explore the relationship between politics, discourse, and technology using a comparative analysis of NASs have proved fruitful and enlightening. Bareis & Katzenbach (2021) utilised SIs, as well as the concepts of expectation, myth, and the sublime to analyse the NASs of China, the United States, France, and Germany. They found that while there was a very similar narrative construction between the NASs, the AI imaginaries were different, a result of cultural, political, and economic difference between the countries (Bareis & Katzenbach, 2021). Paltieli (2021) argued that NASs, by using various imaginaries such as democratic, sociotechnical and data, are creating a new kind of relationship between the citizens and the government, one based on a future vision of an AI democracy. This body of literature using SIs to analyse national and international strategies provided a strong conceptual and empirical foundation upon which this research was built.

3. The Nordic national AI strategies and the future of AI in health

The Nordic region has been the subject of interest regarding the current and future role of AI in society. Robinson's (2020) research discussed how the Nordic NASs draw upon societal values of trust, transparency, and openness, using them as organisational principles to support the adoption of their vision of AI. Dexe & Franke (2020) claimed that the Nordic region, in trying to gain ground and create a niche in AI in the international arena, have set out on a novel path. This is one that tries to posit 'ethical' AI as not only a moral imperative, but also one that can give the Nordic states a competitive advantage Dexe & Franke (2020). Van Berkel (et al., 2020, p. 1) research on the NASs of twenty-five countries identified "geographical and cultural clusters in relation to the future development of artificial intelligence applications". The Nordic region, similar to the findings of Robinson (2020), stood out for Van Berkel et al. (2020) in that the Nordic NASs refer to certain cultural conditions, such as trust, that facilitates the adoption of AI as well as the competitive advantage that stems from these.

There is also growing body of research on the future application of AI in health in the Nordic countries, as well as in specific areas of medicine within the national contexts. For example, Ala-Kitula, December et al. (2017) and Tyrväinen, et al. (2018) identified opportunities for the application of AI in health and social services both regionally and nationally in Finland. Andersson et al. (2021) explored the potential impact of AI on the medical physics profession in Sweden. Riis et al. (2020) researched the current use of prediction models to prevent certain hospital admissions and prevent medical errors in Denmark. Based on their findings Riis et al. (2020) reflected upon the broader potential of AI applications across healthcare in the country. Apell & Eriksson (2021) used a SIs analytical framework to look at the dynamics of the technological innovation systems in AI healthcare development in the West of Sweden. They found that the innovation systems were being hindered by a lack of resources, as well as limited information from healthcare practitioners on the areas of AI innovation that would be most useful (Apell & Eriksson, 2021). The experiences and encounters of healthcare experts with automated decision making in Western Sweden was explored by Bergquist & Rolandsson (2022). While Högberg & Larsson's (2022) work on the particularities of AI in health focused on the legal and normative principles of transparency and explainability in Sweden.

Numerous examples of where health has formed part of a broader analysis of NASs or international AI strategies also exist. For example, Ossewaarde & Gülenç (2020) discussed how in the British, German, and Dutch NASs, AI was mythologised, and how digital utopianism and technological solutions were being aligned with nationalist agendas. The future visions presented in these NASs are those of growth, prosperity, and security, with AI being presented as a solution for some of the most pressing national concerns, in particular cost containment of healthcare (Ossewaarde & Gülenç, 2020). Wilson's (2022) work, while not focusing on health per se, had similar findings. Undertaking a values analysis of sixteen NASs, Wilson (2022) explored the relationship between public value management, such as public engagement and participation in AI governance, and market value and efficiency. The findings reveal that engagement is often just in rhetoric, with Wilson (2022) warning of the dangers of the normalisation of AI in neoliberal technology frames that hide the real complexity of policy decision making. Radu's (2021, p. 190) claimed that the governance structures emerging in the 12 NASs they analysed, showed that "it is becoming increasingly difficult to disentangle public interest policies from market dominance interests".

This is by no means an exhaustive review of the literature of AI in health in the Nordic region. Rather, it is meant to highlight that many aspects of the role of AI in health are being discussed at a local, national, and regional level in the Nordic states. However, as of yet, the future of AI in health in the Nordic region, as set out in the NASs, has not been the subject of analysis. Doing so is important as, from a health democracy perspective, health is one of the most critical and everyday means by which one interacts with society (Strange et al., 2020). The future visions of the integration of AI in health in the NASs thus has implications well beyond addressing illness and improving wellbeing, but instead relates to broader social processes and visions.

4. Methodology

4.1. Cross national comparison

A cross national comparison of the NASs of Denmark, Finland, Norway, and Sweden was undertaken. Iceland would have been included; however, the Icelandic NAS was not formally published at the time the research was conducted (late 2021). A cross national comparison was used as it enriches our understanding of each states' SIs of AI in health, providing the opportunity to draw out similarities, differences, and case specific particularities (Bareis & Katzenbach, 2021), including those at a micro and macro level (May, 2011). A comparative analysis is particularly interesting in the Nordic region given the socio-political, economic, and geographical similarities between the states, see Section3 *The Nordic National AI Strategies and the Future of AI in Health.*

4.2. Data selection and analysis

NASs were the focus of analysis for this research as:

"National strategies consolidate and emphasize specific principles, policy frames and values that are active in national discourses on AI governance. This provides a consolidated point of reference for public sector decision-making in all aspects of AI governance, from the regulation of third parties, to investments in national ecosystems and the direct adoption of AI in the public sector" (Wilson, 2020, p. 2).

NASs do not simply outline future visions of AI, they also reinforce and justify existing power structures and norms. By framing the debate on AI, states can normalise and legitimise their political choices, as well as marginalise certain voices (Ossewaarde & Gülenç, 2020). The concept of SIs allows for the NASs to be analysed from the perspective that they "…can be mined for insights into the framing of desirable futures. as well as for specific verbal tropes and analogies that help identify the elements of the imaginary [.]" (Jasanoff, 2015, p. 20). As such, SIs provide a unique window through which to view how the political culture is nurturing various future visions and the distribution of resources which are based on claims of working towards the national interest (Jansanoff & Kim, 2009).

The official English language translation of the NASs of Denmark, Finland, Norway, and Sweden were selected, see Table 1. The analysis of the data followed the multi-stage thematic analysis presented in Braun and Clarke (2006). While qualitative thematic analysis can be undertaken either inductively or deductively (Kuckartz, 2014), this research was data driven, being inductive in nature. After a thorough reading of the documents, the first round of coding (using NVivo software) was of all references to health. Keywords which were used to identify health included wellbeing, medicine, health(care), disease, illness, medical, diagnosis, cancer, nurse(s), physician(s), MR images and doctor(s). The second round of coding placed these health references in a timeline designated by three codes: the "Past/Current AI application", "Future Imaginaries" and "Undetermined Timeframe". The next step involved open coding of all the references to health in these three time-based codes. These were then compiled into nine higher order codes, or themes: "Accountability in Decision Making", "Facilitatory Role of State", "Governance", "Limitations of AI", "Participation", "Public Healthcare System", "Public-Private Partnerships", "Regulation" and "Transparency". The results presented below represent those from the "Future Imaginaries" code, however these findings were contextualised during the analysis by drawing on the other two time-based codes and the entire NAS text more generally.

5. Results

5.1. Denmark

The future visions of AI in health in Denmark are characterised as being either short-term and very specific applications of AI, or much broader socio-economic benefits discussed without referring to a timeframe. When detailing the short-term benefits of AI for

Table 1
Research data.

Country	Document	Author	Reference
Denmark	*National Strategy for Artificial Intelligence*	Ministry of Finance and Ministry of Industry, Business and Financial Affairs	Ministry of Finance and Ministry of Industry, Business and Financial Affairs of Denmark Denmark (2019)
Finland	*Leading the Way into the Age of Artificial Intelligence: Final Report of Finland's Artificial Intelligence Programme 2019*	Ministry of Economic Affairs and Employment Competition and Consumers	Ministry of Economic Affairs and Employment of Finland Finland (2019)
Norway	*National Strategy for Artificial Intelligence*	Norwegian Ministry of Local Government and Modernisation	The Norwegian Ministry of Local Government and Modernisation Norway (2020)
Sweden[a]	*National Approach to Artificial Intelligence*	Government Offices of Sweden	Government Offices of Sweden (2018)
	Artificial Intelligence in Swedish Business and Society – Analysis of Development and Potential	Vinnova (The Swedish Government's Innovation Agency)	Vinnova - The Swedish Government's Innovation Agency Vinnova (2018)

a As with previous research, (see Dexe & Franke, 2020), two documents were drawn upon for the analysis of the Swedish case. The *National Approach to Artificial Intelligence* functions more as an executive summary of a much more detailed government commissioned report produced by Vinnova (The Swedish Government's Innovation Agency). As such the Vinnova report was also included.

individuals, two out of five points in the NAS related to health, namely individualised treatment (referring to a current heart failure detection initiative) and better technical support with hearing, reading, and writing (Denmark, 2019, p. 11). Regarding the future of AI in the public sector, two out of five points on the short-term benefits of AI referred to health. These were the improved diagnosis and treatment of diseases and more efficient resource management (ibid, p. 11).

The Danish future vision of AI in health is one of several "Focus Areas" which aim to ensure the "future proofing" of Denmark (ibid, p. 18). The goal of these Focus Areas is to continue "paving the way for Denmark to take the lead in responsible development and use of artificial intelligence" globally (ibid, p. 18) and to capitalise on areas where "Denmark has particularly good preconditions for using artificial intelligence" (ibid, p. 61), specifically the existence of "high quality data" in the form of national registries (ibid, p. 18).

In the long term the NAS states that "Using artificial intelligence holds great potential to offer better and more effective treatment in the healthcare system" (ibid, p. 54). Further to this, it also notes that it can improve the effectiveness of the healthcare system at large and aid healthcare practitioners to create a "modern and effective healthcare system" (ibid, p. 62). The integration of AI in health in Denmark is normalised and legitimised, as the following quote reflects:

"The healthcare sector is an area in which expertise and technology are developing, and changing the way in which we provide services. The healthcare system has regularly transformed technological advances into new opportunities within diagnostics and treatment. This provides better results for patients. Artificial intelligence is a logical step in this development" (ibid, p.62).

Beyond the benefits of more effective diagnosis and efficient resource management, the expansion of AI in health in Denmark is also justified as being essential to meet broader societal challenges. These include, an aging population, more challenging chronic illnesses, the need to provide targeted high-quality treatment and to meet the increasing expectations of Danish citizens for innovation and better treatment (ibid, p. 63).

The Danish NAS describes "Signature Projects" of AI in health to justify the previous, ongoing, and future resource allocation to meet their future vision (ibid, p. 21). This justification is linked to broader, yet to be defined, positive reform of the healthcare sector, reform which is already underway:

"Artificial intelligence can help improve the healthcare sector by improving patient treatment and optimising hospital operation. In addition to signature projects, objectives for healthcare will be set. which support the proposed healthcare reform and a stronger, close, and cohesive healthcare system, and thus have a structural and long-term perspective" (ibid, p. 55).

Finally, the future vision of AI in health in the Danish NAS is one where the state has a central role in upholding the "mandatory principle" that AI be used "responsibly", that it does not undermine trust in society or the confidence of citizens and healthcare staff and that it has limited decision-making capacity (ibid, p. 64). For example, in the future vision it is noted that physicians must always be the one making the final decision in diagnoses (ibid, p. 64). To realise their vision, the NAS notes that the participation of citizens, as well as Danish businesses and health authorities will be required, and that the state would need to develop a legislative framework and investment ecosystem through a "long-term plan for utilisation of new technology and innovation in the healthcare area" (ibid, p. 64).

Thus, while the progression of AI in health is seen as logical, inevitable, and positive in the Danish NAS, the state positions itself as being essential in facilitating the realisation of this future vision, through legislative reform and investment, as well as being best placed to manage the consequences of this 'progress'. The future vision is justified based on improving efficiency in healthcare which will in turn help to address a broad range of societal demands and problems.

5.2. Finland

The future vision of AI in health in the Finnish NAS (Finland, 2019) acknowledges the significance of the development of AI but does not mythologise it to the same extent as can be seen in the Danish NAS. Rather, the Finnish NAS notes that AI "can" lead to better wellbeing through economic growth, and that it is "believed" to be able to revolutionise healthcare (ibid, p. 3,44). This slightly more tempered language can also be seen in the description of the future visions of specific AI applications in health. For example, the NAS states that "[r]obots and intelligent devices *can* extend the independent living of elderly people" and that "[s]elf-tracking of personal health has become very popular. This generates mass data that *could* be very valuable to the healthcare sector" (ibid, p. 37,100 emphasis added).

The Finnish future vision of the areas where AI will be used in healthcare are those where "human presence and empathy are not essential", such as lifting machines, AI applications being used to predict patients' condition, provide drug response guidance, its use in clinical drug trials and self-tracking to monitor diabetes (ibid, p. 33,100). In the Finnish vision, partial AI automation of certain processes is seen as being able to free up healthcare workers from office duties, allowing them to spend more time with patients (ibid, p. 33). At the same time, overall healthcare expenditure would be reduced, and patient care improved, if nurses, supported by AI, could take over some of the tasks which are currently done by physicians (ibid, p. 100). There are also references to how AI can improve the general wellbeing of the population, which would result from the automatisation of routine tasks to free up individuals' time, as well as the more effective matching of people with jobs (ibid, p. 121).

The Finnish NAS provides a timeline for the realisation of aspects of their future vision of AI in health, noting that by 2025:

"Artificial intelligence has been harnessed to produce anticipatory and humancentric services in the public and private sectors. Services are more clearly focused in accordance with the needs, which makes them more effective. The new service structure has thus enhanced citizens' wellbeing and reduced unhappiness. By doing this, it has helped to strengthen social stability and the functioning of the democratic society" (ibid, p. 123).

Significant contemporary societal challenges are used to justify the need for the expanded use of AI in health. Similar to those found within the Danish NAS, the Finnish NAS notes that an aging population and the social exclusion of young people is causing "sustainability gaps in the state economy" (ibid, p. 100). Sharing data on wellbeing and people's needs, as well as having the capacity to

capitalise on this data through AI applications, is claimed to be a solution to bridge this gap (ibid, p. 100). The inevitable increase of private sector health application and services using AI, most notably on mobile phones, is also used to justify the position that "[i]t would be advisable for the public healthcare to make AI programs that propose diagnoses generally available, because other actors will make such applications in any case" (ibid, p. 100).

There are more self-imposed limitations on the Finnish future vision than the Danish one. The Finnish NAS notes that a "sensible balance from the perspectives of individuals, society and companies, enabling also wellbeing and growth" must be adopted, one that is between the US enterprise model and the Chinese administration driven one (ibid, p. 52). The NAS also draws on research to show how the use of AI in healthcare leads to a change in the division of labour between healthcare professionals. As such it proposes the "centaur" method - a combination of an AI system and a physician in diagnosis - as "absolutely the best" approach for the future to limit the decision-making power of AI applications (ibid, p. 99).

There is acknowledgment that the realisation of the Finnish future vision of AI in health is not one that the state themselves control, as the following quote reflects:

"The introduction of AI and robotics in healthcare also depends on sectoral regulation and the attitudes among professionals, doctors and nurses towards the new technology. Equipment manufacturers and service providers in the sector must ensure that the new technology will earn the trust of both professionals and patients" (ibid, p. 33).

One example of such sectoral regulation raised was the EU's General Data Protection Regulation (GDPR). It was stated that if the GDPR were to be interpreted in an overly strict manner in favour of privacy, it could "endanger the realisation of the fundamental rights (e.g., right to wellbeing and health, and sufficient social welfare and healthcare services) of others" (ibid, p. 54). Thus, as in the Danish future vision, we see a tension whereby on the one hand the expanding role of AI in health is claimed to be inevitable, yet on the other, the state is required to deregulate nationality and regionally and grant access to the public health data to see the realisation of this vision.

5.3. Norway

The narrative surrounding the Norwegian future vision of AI in health is rather more limited compared to the other three states. However, like the others, the Norwegian NAS notes that in areas where Norway has a distinct advantage, including health, AI will be invested in to capitalise on these opportunities (Norway, 2020, p. 7). The Norwegian future vision highlights Norway's participation in the EU's Digital Europe Programme 2021–2027, with resources from this programme being targeted at areas where they will be most effective in Norway, including in the health sector (ibid, p. 38). While the other NASs also link their vision to the the EU (and other international organisations), this comes across more strongly in the Norwegian case. This is unsurprising given that the Norwegian NAS, being adopted later than the other Nordic NASs, was developed at the same time as the emergence of the EU AI ecosystem (see Minkkinen et al., 2022).

The Norwegian NAS sets out a vision where AI systems could take on tasks currently performed by healthcare professionals.

"In the long term, more tasks which today are performed by healthcare personnel *may* be performed by autonomous systems and artificial intelligence. Relevant examples span from automatic generation of patient records, patient logistics and fleet management of the ambulance service to autonomous surgical robots" (ibid, p. 23 emphasis added).

However, this is qualified by stating that the provision of care remains the responsibility of the healthcare workers (ibid, p. 23). While the above details the specific applications of AI that 'may' occur in the health sector, the role of the state as reacting to inevitable technological developments beyond its control is a key justification for the future vision in the Norwegian NAS. While the expansion of AI applications in health is framed as inevitable, the state is also positioned as playing a crucial facilitatory role in this. For example, the NAS states that development of AI in health may be hindered as "[t]here may be a need to develop regulatory frameworks in some health-related areas before testing of methods based on AI takes place" (ibid, p. 22).

There are also discussions about investment in the AI health ecosystem and the state's role in granting access to public health data:

"The Government will establish a health analysis platform, a national system for making health data accessible for research purposes and for other, secondary uses. The platform will allow more advanced analysis of Norwegian health data and will form the basis for new types of medical and health research. Among other things, it will allow health data to be used more actively in developing medicines and medical technology" (ibid, p.23).

In summary, the Norwegian NAS sets out a rather more limited narrative around its future vision as compared to the other states. The vision is one which sees AI in health as expanding, inevitable and an area where Norway has a natural advantage. Their role is to facilitate this, by sharing public health data, but also to (de)regulate to support innovation while minimising potential harm to individuals and society resulting from these developments.

5.4. Sweden

The future vision in the Swedish NAS frames AI in health as "particularly important for the development of both Swedish business and society", (Vinnova, 2018, p. 8). It is claimed that "the potential for using AI within healthcare is assessed as being very great, even groundbreaking" (ibid, p. 36). Like Denmark and Finland, in addition to societal and economic benefits, the need to address the challenges of; an aging population, a shortage of specialists, the need to improve efficiency of healthcare and addressing the demands of younger citizens, are all used to justify the Swedish future vision (ibid, p. 38,39).

The Swedish NAS sets out a future vision whereby AI is used to improve certain aspects of healthcare (like Norway, and to a lesser extent Finland) and is framed as leading to positive impacts for Swedish society and business at large, (like Denmark, Finland and to a

lesser extent Norway). The NAS notes that AI applications have the possibility to increase the quality and efficiently of care at several interacting levels of the Swedish healthcare system (ibid, p. 38). This includes improving operational performance and efficiency of administrative systems, resources and staff work tasks, supporting diagnosis and decision making (an area highlighted as having "great potential in the near future"), combining health data to provide a holistic view of the patients' health, empowering the patients to manage their own health, solutions for home care and healthy living, population health management, precision medicine and finally integrated diagnostics (ibid, p. 38,40). Further to this, it is a future vision where "there are great opportunities to increase quality by introducing assessments/analyses beyond human ability" and "[m]ajor potential effects within healthcare are noted in the good prospects to work preventively using AI so as to identify health problems early on through AI-improved diagnostics" (ibid, p. 38). The potential of AI in research and development in the MedTech industry is "assessed to be very significant" in the NAS (ibid, p. 38). While acknowledging that it is problematic to put timeframes on development work, the NAS refers to research to suggest that from 2025 onwards, unsupervised context aware learning could provide real-time clinical diagnosis (ibid, p. 28).

Another significant aspect of the future vision in the Swedish NAS is the predicted increase in economic growth and profitability of the healthcare sector with the introduction of future AI applications (ibid, p. 34). The NAS notes that "healthcare has been identified as the vertical industry with the greatest gap between what can be done with existing AI technology and what has already been done" (ibid, 2018, p. 67). Sweden is framed as being well positioned in the international market for the development of MedTech, a market which the NAS claims will increase significantly over the next few years. The NAS specifies that Sweden's competence in protein research means that it can take a foothold in the global market, as well as highlighting the potential of AI within the Biopharma area (ibid, p. 39).

The major challenges in realising the Swedish future vision of AI in health are largely related to issues hampering private sector innovation. This includes regulation that stifles progress, notably GDPR, as well as a lack of business model in Sweden that incentivises the private sector to work on health-related issues (ibid, p. 39). In addition, a lack of access to data is highlighted as a "fundamental challenge" to innovation and that "[e]ven anonymous medical data is in short supply" (ibid, p. 39). Where it is available it is noted that it is often siloed, thus limiting the training data available and the ability to fully apply and realise the potential of precision medicine (ibid, p. 40). The NAS notes that even if this data were to become available it would also require a massive amount of work by doctors or other medically competent staff to manually annotate the data (ibid, p. 40). According to the NAS, systematic change resulting from innovation, being essential for the achievement of the future vision, cannot be driven by the public healthcare sector due to a lack of resources and competencies (ibid, p. 40). As such, the private sector is positioned as essential in the realisation of the Swedish future vision of AI in health, as is the case with the other three NASs.

In terms of self-imposed limitations, ensuring the privacy of sensitive patient data is highlighted as something that must be maintained (ibid, p. 40). Sustainability is also raised as a "cross-cutting theme", whereby it is stated that AI applications in healthcare (as well as self-driving cars) must be "ethical, safe, secure, reliable and transparent" which is "particular to critical systems and systems that may affect the physical world" (Sweden, 2018, p. 5). As such, "In AI applications, ethical, safety and security considerations cannot be an afterthought; they must be an integral part of the early design stage" (ibid, p. 5).

However, the NAS also claims there is a need for deregulation and greater sharing of public health data, noting that "[a]s AI has such high data requirements, support for researchers and innovators will be needed to balance a good level of privacy protection with effective innovation" (Vinnova, 2018, p. 40). A possible techno-fix solution to this balancing act is provided in the Swedish NAS, namely that "[i]mportant lines of development to achieve this *may* be identified in developments of so-called 'block chain' solutions." (ibid, p. 40 emphasis added).

In summary, the Swedish future vision frames the expansion of the role of AI in health as inevitable and reliant on private sector innovation. However, as with the other NASs, the state position themselves as having a critical role in facilitating the realisation of this inevitable progress and expansion. In the Swedish case this involves the financing of competence development, working to deregulate, investment in the private sector and developing frameworks for new public-private partnerships.

6. Discussion

When comparing the future visions of AI in health across all the Nordic NASs, a central common future vision can be identified. This common future vision frames the increase in scale and scope of AI in health as inevitable. These developments are led by the private sector, whose role in the development and implementation of AI in health will increase over time. The expanding role of the private sector is normalised and legitimised through a promise of efficiency and progress that AI in health can provide. This is not a new phenomenon, and the future role of the private sector should be understood within the context of the already expanded role and integration of the private sector in public health provision in the Nordic states (Tynkkynen et al., 2018). One could argue that the similarities between the SIs in the Nordic NASs are due to a shared socio-democratic SI. However, further research on SIs of AI health in other NASs, upon which regional variations could be discerned, would be required to substantiate this claim.

Additional research would need to be undertaken to identify the relationship between specific private sector future visions of AI in health and those within the Nordic NASs. However, Mager and Katzenbach (2021, p. 223) claim that "… imaginaries are increasingly dominated by technology companies that not only take over the imaginative power of shaping future society, but also partly absorb public institutions' ability to govern these very futures with their rhetoric, technologies, and business models." Radu's (2021) assertion that disentangling private interest from public policy in NASs is becoming increasingly difficult, seems to hold true regarding the future vision of AI in health in the Nordic NASs. One specific example is the narrative of the inevitability of progress of technology, which is a concept propagated by the private sector and has become institutionalised in NASs and government regulations (see Mager & Katzenbach, 2021).

Considered within the existing body of literature (specifically Radu, 2021; Wilson, 2022), the common future vision in the Nordic NASs can be seen as blending with private sector future visions. As such, the extent to which the states have agency over the future visions is called into question. Further to this, one should recognise that it is not just the private sector or technology limiting the room for manoeuvre of states. The Nordic states are actors within emerging multi-actor networks, such as that of the EU AI ecosystem (Minkkinen et al., 2022), the global governance of AI health (WHO, 2021b), and a broader international landscape on AI governance with its range of actors (Schiff et al., 2020). While being beyond the scope of this paper, this would be an enlightening line of inquiry for further research.

Some variation in the justifications for this future vision exist between the NASs, but efficiency is central to all. As Jasanoff & Kim (2009, p. 122–123) claimed, within futures one can see what is implied to be good or desirable, in the case of the future of AI in health in the Nordic NASs this is efficiency in healthcare provision. Interestingly, other commonly held desirable qualities in healthcare, such as improving health equality and equity, are not included in this common future vision. Additionally, except for Norway, AI in health was explicitly linked to addressing significant contemporary and future democratic and societal challenges in the NASs. These include ageing populations, the disengagement of youth, unsustainable state economies and the rising expectations of healthcare provision of citizens. These were all presented as undermining the democratic social order in the three states. Here we can see a similar process to what Savaget & Acero (2018) identified in the Danish context, whereby the public sector is constructing a very narrow SI of technology to posit it as a solution to specific social challenges. In the case of the Nordic NASs the narrow focus on specific applications of AI substantiates technological promises of increasing efficiency and progress in healthcare, which are claimed to be able to address these societal challenges. The proposition of AI as a solution to pressing national concerns linked to the undermining of democracy can also be seen in other non-Nordic NASs (see Ossewaarde & Gülenç, 2020; Wilson, 2022).

The common future vision of the inevitable increase in the scale and scope of AI in health, which is by and large driven by the private sector, can be seen as a significant tension within the future vision of AI health in the Nordic NASs. The four states justify their future vision as reacting to technological (and societal) developments beyond their control. Yet, they also frame themselves as being critical to the realisation of their vision. The "crucial" faciliatory role of the Nordic states, set out in the NASs, is most apparent in two areas. First, they position themselves as being the law makers and breakers, able to (de)regulate where they see fit to allow the private sector to innovate and meet their common future vision (innovation being seen as impossible or problematic in the public sector). Second, they are the gatekeepers or guardians of health/other public health data registries. Granting access to public health data registries, seen as an enormously valuable national resource to train algorithms,[1] is claimed to be another means by which the states can facilitate, as well as control, progress towards their future vision.

This can be understood in relation to Van Lente & Rip's (1998, p. 215) reflections on the agency-structure tension regarding promising technology, where "[t]he two-headed monster of the self-justifying technology is reflected in a two-headed sense of agency: being (co-) driver of the train, as well as being driven." In this case the Nordic states are representing the promising technology of AI in health (the structure) as determining their actions, thus attributing a "quasi-autonomous character" to the technology (ibid, p. 215). At the same time the states are trying to reinforce and protect their perceived agency, with the future visions in the NASs being one avenue to do so. In the NASs the Nordic states highlight their agency in terms of their crucial facilitatory role, due to their unique position as being able to (de)regulate to nurture innovation and being the gatekeepers of the public health data registries.

Yet in setting out a future vision in the NASs, the states have made promises of a future where there will be more efficient healthcare. This is problematic as it can undermine the remaining foundation of their agency, or the areas where they position themselves as having a faciliatory role. As Van Lente & Rip (1998, p. 216), stated "Technological promises function as a yardstick for the present and as a signpost for the future". AI in health is imagined as a solution for future societal challenges, and in so doing, like the findings of Pfotenhauer (et al. (2019), future visions can frame current social challenges as resulting from a lack of innovation. The promise of efficiency in healthcare in the future, means that current healthcare provision is seen as inefficient and lacking when viewed through this promissory lens. This then forces the hand of the state to facilitate innovation by granting the private sector more room to innovate (through deregulation of AI in health) and granting access to the public health data registries. As such, their agency is further limited by their promise, as promises made must be acted upon (Van Lente & Rip, 1998). By deregulating and granting access to public health data registries to achieve their future vision, the space where the states have a facilitatory role will be further undermined. In addition, the technological promises made in the NASs lead to a narrowing of the integration of AI into society, as social and material path dependencies form which leads to irreversibility or lock-in effects, limiting innovative scope (see Borup et al., 2006; Bareis & Katzenbach, 2021). This reduces the room for manoeuvre of states and limits their ability to exert their agency beyond this innovate scope. One can see this in the Nordic NASs whereby current and future resource allocation in the private sector to facilitate innovation of AI in health limits the scope of future visions available to the states. As such, the common future vision of AI in health in the Nordic NASs can be seen as another example of the tension identified by Van Lente & Rip (1998).

7. Conclusion

What is revealed through this analysis of the SIs in the Nordic NASs, is that there is a common future vision of AI in health shared by all four states. This is one where the increase in scale and scope of AI in health is seen as inevitable. It is a future where the private sector leads these developments as well as the implementation of AI applications in healthcare. The role of the private sector is

[1] The Swedish public health data registry has been described as *guldgruvan* (goldmine) by state agencies in 2010 (SKL, 2010).

normalised and legitimised through the promise of efficiency and progress that AI in health can provide. Efficiency in healthcare is implied to be desirable, while other desirable qualities of future healthcare provision, such as improving health equality and equity are not included. AI in health is presented as vital to allow all states, except Norway (which warrants further exploration) to meet broader societal and democratic challenges now and in the future. Failure to do so would risk undermining the democratic system within which current public healthcare is provided.

However, a tension can be identified between the role of states as both reacting to and being essential facilitators of the realisation of their shared vision. The future vision of AI in health in the Nordic NASs can be seen as another example of the well-established agency-structure tension that arises regarding technological promises and emerging technology. Drawing on Van Lente & Rip's (1998) analogy, the common future imaginary in the Nordic NASs sees the states as simultaneously driving and being driven toward the future of AI in health.

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The author regrets that in the original version of the article one of the hyperlinks was incorrect.

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