

University of Groningen

Hospital care organization for patients with multimorbidity - An analysis of a wicked problem

Weil, Liann

DOI:

[10.33612/diss.1072033119](https://doi.org/10.33612/diss.1072033119)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2024

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Weil, L. (2024). *Hospital care organization for patients with multimorbidity - An analysis of a wicked problem*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen. <https://doi.org/10.33612/diss.1072033119>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Chapter 8)

General discussion



This thesis aimed to explore the underlying dimensions and complexities of the hospital care organization for patients with multiple long term conditions (MLTC) and to investigate opportunities that facilitate better identification of patients who might benefit most from adequately targeted integrated and collaborative care. To achieve this, we explored insights from healthcare professionals in part I. We examined barriers that medical specialists experience when managing patients with MLTC in the hospital and assessed the local relevance and feasibility of existing care coordination programs. In part II, we gathered insights from electronic health record data to better identify patients in need of integrated care and to guide collaborative care transitions. We analyzed the travel burden of patients with MLTC, developed prediction models for high future healthcare utilization, and clustered medical specialties providing care around the same patients with MLTC.

Based on the findings of this thesis, this chapter will first discuss several dimensions of the hospital care organization for patients with MLTC as a wicked problem. Second, the analyzed opportunities for facilitating a better identification of patients that might benefit most from adequately targeted integrated and collaborative care based on electronic health record (EHR) data will be discussed. Third, it will reflect on some methodological considerations. Finally, this discussion will elaborate on the implications for practice, provide suggestions for further research, and formulate concluding remarks.

The wicked problem of hospital care organization for patients with multiple long term conditions

Wicked problems are complex social problems that are difficult to define and do not have a clear solution.¹ In Table 1, ten common characteristics of wicked problems, as defined by Rittel & Webber (1973), are described. To address wicked problems, an understanding of the underlying complexity is needed.^{1,2} This thesis carefully analyzed the hospital care organization for patients with MLTC to contribute to understanding this problem. Based on our findings, four common characteristics of wicked problems are of particular relevance here: 1) the problem is multidimensional, 2) the problem is a symptom of other problems, 3) the problem has no true solutions, and 4) the problem is unique in each context (Table 1, highlighted in bold). These four characteristics are discussed because they predominantly emerged from our findings. Based on these key characteristics, the underlying complexities of the hospital care organization for patients with MLTC can be explained.



Table 1 - Ten common characteristics of wicked problems

1.	The problem is multidimensional
2.	The problem is a symptom of other problems
3.	The problem has no true solutions
4.	The problem is unique in each context
5.	No definitive formulation of the problem
6.	No stopping rule
7.	Infinite number of potential solutions
8.	No immediate or ultimate test for a solution
9.	“One shot” operation: no opportunity to learn by trial-and-error
10.	Problem solvers have no ‘right to be wrong’

Data from Rittel and Webber (1973)

Bold characteristics are of particular relevance in this thesis

The problem is multidimensional

The first characteristic of wicked problems that predominantly emerged from our findings is that multiple dimensions impact the delivery and organization of hospital care organization for patients with MLTC. First, according to medical specialists, several patient characteristics complicate hospital care for patients with MLTC (chapter 2). These include lower self-management skills, lower treatment adherence, and complex socio-cultural contexts. Similarly, in chapter 3, the feasibility of focusing on self-management was expected to be lower due to the limited capacities of patients. This multidimensionality of patients' psychosocioeconomic factors complicates decision-making and can impact patients' self-management skills.³⁻⁶ However, for patients with MLTC the quality of self-management and adherence to care is particularly important.⁷ Due to the long-term nature of their conditions, patients often have more responsibilities in daily disease management.^{8,9} Poor treatment adherence increase morbidity, mortality, healthcare utilization, and healthcare costs.⁷

Second, multiple factors influence the treatment and decision-making for patients with MLTC. In chapter 2, medical specialists stated that the focus on acute care and the interaction of symptoms challenge treatment provision. In chapter 4, we concluded that travel burden should be considered during decision-making, because patients with a higher travel burden might have more difficulties to access care. In chapter 5, we illustrated that various factors influence high healthcare utilization, such as the number of diseases, outpatient visits, hospitalizations, and number of involved medical specialists. In chapters 6 and 7, we found clusters with high healthcare utilization and risk of interacting treatments. Recent guidelines on the clinical management of patients with MLTC stress the importance of considering the multiple different dimensions during clinical decision-making.¹⁰ Nonetheless, multidisciplinary guidelines that consider



MLTC are limited, maintaining uncertainties for treatment and decision-making (chapter 2).¹¹

The problem is a symptom of other problems

The second characteristic of wicked problems that is particularly relevant with respect to the hospital care organization for patients with MLTC is that the problem is a symptom of other problems. It is a symptom of the increasing prevalence of MLTC, the increasing number of medical specialties, and the monodisciplinary healthcare organization.¹²⁻¹⁴ These underlying problems contributed to the development of monodisciplinary guidelines and fragmented healthcare delivery.¹⁵ In chapter 2, medical specialists reported that the siloed functioning of the healthcare system and poor integration of services hindered them. Similarly, panelists in chapter 3 stated that a lack of a shared EHR limited the feasibility of relevant integrated care elements. As a consequence, patients with MLTC often receive fragmented and delayed hospital care, leading to potentially preventable hospital admissions or post-operative complications.^{3,6,16} In addition, the siloed organization of hospital care around medical specialties results in low patient satisfaction, poor quality of care, and higher healthcare costs.¹⁶⁻¹⁸

The problem has no true solutions

For wicked problems there is not one true solution, but merely possible approaches that either make the problem better or worse. Each implemented solution has important implications and cannot be reversed.¹ In chapter 2, we suggest that addressing the poor information exchange could be an adequate starting point to reduce barriers to managing patients with MLTC in the hospital. We argue that addressing such a fundamental barrier is pivotal because it impacts other levels, such as the patient, healthcare providers, or the healthcare system. In chapter 3, panelists also identified the limited integration of EHR across professionals as a barrier to the feasibility of care coordination elements. To increase feasibility, panelists suggested to improve EHR integration. On the one hand, such EHR integration or better information technologies could support the exchange of patient data, development of treatment plans, and coordination of care.¹⁹ On the other hand, they are often associated with privacy concerns, and their implementation is complex regarding both governance and data management.²⁰

Another example that illustrates that each implemented solution has important implications is the reimbursement of healthcare providers. We identified that current reimbursement systems inadequately address the needs of patients with MLTC, do not reward care coordination, and hinder the broader implementation of collaborative structures (chapters 2, 3, and 7).²¹ Reimbursement systems should stimulate care coordination, shared decision-making, sustainable use of personnel and resources, and a patient-centered approach.⁶ Nonetheless, optimal payment



reforms have not been identified yet.²¹ Some reforms showed improvements in, for example, the number of hospital admissions.²¹ At the same time, many examples with unintended adverse consequences, such as unnecessary tests and procedures, remain.^{6,22}

The problem is unique in each context

Another contributing factor to the missing 'true solutions' to a wicked problem is that the problem is unique in each context. Organizing care for patients with MLTC differs not only per country and corresponding healthcare system but also in primary versus secondary care. This thesis focused on the hospital context due to the high prevalence of patients with MLTC in hospitals and the greater risk of healthcare fragmentation stemming from the siloed healthcare organization around medical specialties.²³⁻²⁵

Our findings indicate that healthcare for patients with MLTC requires context-specific adaptations. In chapter 2, we found a discrepancy between general practitioners and medical specialists regarding their roles and responsibilities in chronic disease management. In addition, general practitioners commented more frequently on remuneration barriers compared to medical specialties. Hence, these perspectives should be considered when redesigning (hospital) care for patients with MLTC. In chapter 5, we identified patients with high future (potentially preventable) healthcare utilization within one hospital. To transfer the models to other hospitals, local retraining might be required to incorporate practice and population variations.²⁶ In addition, integrated care programs should be adapted to their local contexts.²⁷ In line with these recommendations, we applied a Delphi methodology to adapt care coordination programs to a local context (chapter 3). We illustrate that this methodology can be used to assess the feasibility and relevance of program elements and to incorporate stakeholders into the local adaptation of such programs. Feasibility and relevance of program elements differed depending on the primary or hospital panel. For example, hospital care professionals attributed greater relevance to visits by the 'case-manager' during each hospitalization. On the other hand, general practitioners attributed greater relevance and feasibility to home visits after an emergency department visit or hospitalization. Consequently, to improve hospital care for patients with MLTC, potential solutions need to be adapted to their unique contexts.

Opportunities to facilitate a better identification of patients in need of collaborative and integrated care

The outlined key characteristics of wicked problems that predominantly emerged from our findings contribute to understanding the problem of complex hospital care organization for patients with MLTC. Based on this understanding, the aim should not be to solve the wicked problem but to manage and address it better.²⁸

Wicked problems should be addressed with collaboration, coordination, and whole-system thinking.²⁹ Therefore, this thesis investigated opportunities that facilitate appropriately targeted collaborative and integrated care approaches.^{2,30}

Interprofessional collaboration

In chapter 2, we identified the lack of collaboration as an important barrier to managing patients with MLTC. Collaboration was influenced by a lack of assuming responsibility, unclear roles, poor communication, and fragmented healthcare delivery. In chapters 6 and 7, we used a machine learning algorithm to better understand the complexity of fragmented healthcare delivery and investigated opportunities for collaboration. We identified multiple comparable clusters across the four analyzed hospitals. For instance, we identified similar clusters with high simultaneous involvement of the cardiology, pulmonology, and internal medicine specialties. These similarities could signal a need for intensified collaboration among these specialties. By involving healthcare professionals to understand the underlying reasons for their shared involvement, our analyses can serve as guidance for exploring collaborative opportunities among clinical outpatient departments on a national level. In addition, it can aid policymakers and healthcare providers to discuss potential multidisciplinary guidelines developments and accompanying payment reforms.^{6,21} Such structural collaborations with appropriately targeted payment models could result in better coordinated care, quality of care, and treatment outcomes.^{31,32}

Approaches to better target integrated care

In chapter 2, we found that poor collaboration and communication partially stem from the fragmented healthcare delivery, resulting in mismanagement of patients. To prevent adverse outcomes that arise from this fragmented delivery, integrated care approaches have been recommended.³⁰ Since effective implementation remains complex and best-practice guidance is missing, this thesis analyzed EHR data to investigate how such approaches can be better targeted to patients that might benefit most. Big data analytics have the potential to identify optimal interventions for stratified groups of patients.¹⁹ In chapter 2, medical specialists suggested, for instance, that high-risk patients should be flagged within health information systems. In line with these findings, previous integrated care programs have been more effective when they comprehensively assessed patients' risks and needs and targeted patients that are likely to benefit.³³ To better identify such high-risk patients, we built prediction models for high (potentially preventable) healthcare utilization in the upcoming year (chapter 5). Our findings revealed that a high number of diagnoses, outpatient visits, and hospitalizations were important predictors. In addition, we explored the travel burden of patients with MLTC based on EHR data (chapter 4) and suggested that patients with a lower socio-economic status, higher age, and a higher travel-related treatment burden are potential target groups for integrated care and remote care coordination. The identified patient characteristics in this thesis



illustrate how routinely collected EHR data can be used to better identify patients at a higher risk of experiencing adverse outcomes of uncoordinated care.

Methodological considerations

Strengths

The first strength of this thesis is the application of multiple different and novel methodologies in the field of MLTC research. The combination of quantitative and qualitative data analyses allowed us to gain a deeper understanding of the heterogeneous patient population and underlying complexities.^{20,34-36} This increased understanding can help to organize hospital care for patients with MLTC better. We evaluated qualitative literature in chapter 2 and employed a Delphi methodology in chapter 3. The Delphi methodology is a feasible qualitative method for healthcare professionals with limited time.³⁷ Compared to our quantitative analyses, both qualitative studies provided different but essential information about the multidimensionality of the analyzed wicked problem. In addition, we used geospatial analysis in chapter 4, which has been scarcely employed to date in MLTC research and has the potential to reveal regional risk factors.¹⁹ Lastly, we performed different quantitative analyses, including machine learning applications, in chapters 4-7. The potential of big data analytics, such as machine learning, has been recognized as useful for improving risk adjustments, alerting clinicians in case of preventable events, or informing about risks in clinical decision support systems.¹⁹

A second strength is the analysis of large datasets from four different Dutch hospitals based on EHR data (chapters 4-7). Routinely collected EHR data offers great potential for gaining an overview of the complexity of the hospital care organization for patients with MLTC.³⁶ Routinely collected data often includes generally underrepresented groups, such as patients with dementia or who are too ill to provide informed consent.²⁰ In addition, EHR data is readily available and allows the inclusion of a high volume of patients.²⁰ Furthermore, registration data in the Netherlands is comparable across multiple hospitals, allowing for the potential adoption of our EHR data analyses in other Dutch hospitals.³⁸

Thirdly, this thesis contributed to an increased understanding of the presentation and management of patients with MLTC in the hospital.²⁰ Previous research has mostly focused on large primary care or population-based data sets.^{20,23} This thesis focused on hospital populations with MLTC, because they are a distinct subset of people with a high prevalence of MLTC.^{20,23} In addition, instead of merely providing insights into the pathophysiology of MLTC,^{39,40} our cluster analyses of simultaneously involved medical specialties can guide collaborative care transitions. These transitions are pivotal to better manage patients with MLTC in the hospital and, ultimately, better address the analyzed wicked problem.



Limitations

First, except for chapter 2, this thesis mainly focused on data from the Netherlands. We drew important implications from our results for the organization of Dutch hospital care, but the findings might be less generalizable or transferable to other countries. However, we clearly formulated the implications of our findings, which is deemed more relevant than generalizability when applying machine learning models in healthcare.⁴¹ In addition, we illustrated that a wicked problem is unique in each context, requiring adequate adaptation of our findings to new contexts. Our employed methodologies and corresponding findings of chapters 3-7 can be used in other contexts when translated accordingly.

Second, despite the advantages of utilizing EHR data, they also have some drawbacks. For this thesis, EHR data collection from different hospitals in the Netherlands has been laborious, as each hospital stored and provided access to data differently. Differences in data entry by healthcare professionals can create messy data and impact the quality of collected data.²⁰ In addition, the analysis can become complex quite fast due to the inclusion of large volumes of both patients and variables.²⁰ Furthermore, an analysis of EHR alone cannot explain care trajectories before and after a hospital admission or outpatient visit.²⁰ Linkage of primary care, population-based, and social services data would be ideal to further unravel the complexity of healthcare delivery for patients with MLTC.^{19,42} However, such linkage is complex regarding governance and data management and has yet to be achieved in the Netherlands.^{20,43}

Third, we used diagnosis groups of the Dutch Hospital Data - Clinical Classification Software (DHD-CCS) in the studies based on EHR data, resulting in a generic description of diseases. More detailed diagnosis codes, such as the International Classification of Diseases codes (ICD-10), might have provided more in-depth information on, for instance, the diagnoses that medical specialties treated in certain clusters of patients. Nonetheless, including diagnosis prevalence based on ICD-10 codes could have resulted in an overfitting of prediction models and was likely to induce too little variance to interpret the results of cluster analyses.⁴⁴

Implications for practice

Education and training

Our findings have several implications concerning the education and training of patients and healthcare providers. First, chapters 2 and 3 recognized that patients could benefit from more education. This could improve patients' treatment adherence, active involvement in their prognosis and care, and understanding their responsibility in chronic care management. As suggested in chapter 4, remote care coordination might be of added value for some patients, especially due to the increasing possibilities of technology. However, we identified that vulnerable people might have more difficulties in using such

technologies. In addition, based on a large survey, the Dutch Patient Federation identified that patients with MLTC often miss information about the interactions of their conditions.⁴⁵ The Federation recommends that patient organizations for individual diseases should also inform patients about (associated) MLTC. In line with the Federation's recommendations and in accordance with a recent study in the primary care setting in the Netherlands, we argue that better education and targeted information provision towards patients could contribute to a more effective provision of care.⁴⁶

Second, providing patient-centered and integrated care should be recognized as a standard part of care rather than an additional task. To this end, medical education might require a more generalist focus, which has been recognized as a priority for the future by the Dutch Federation of Medical Specialties and is in line with previous guidelines on the clinical management of patients with MLTC.^{10,47} To date, medical education is still organized around individual diseases and did not adapt yet to the increasing prevalence of multiple co-occurring long term diseases.^{6,48} Promising developments towards such patient-centered and integrated care include the recommendations by the European Federation of Internal Medicine multimorbidity working group, and the guideline developments by the Dutch Association of Specialists in Internal Medicine (NIV) and the Dutch Federation of Medical Specialties towards a multidisciplinary assessment for patients with MLTC.^{49,50}

Third, we identified knowledge gaps among medical specialists in mental-somatic MLTC and psycho-socioeconomic determinants of health. This gap is alarming, considering the higher prevalence of both mental and concurrent physical disorders in highly deprived areas.⁵¹ Moreover, patients with MLTC who have at least one mental health condition have a considerably worse prognosis.⁵² Consequently, medical specialists might need to acquire new skills and competencies that better address psycho-socioeconomic determinants of patients with MLTC.⁵⁰

Hybrid case finding approach

In line with previous research, we recommend a hybrid case finding approach to identify patients most in need of integrated care.^{27,35,53} A hybrid case finding approach aims to incorporate the benefits of both qualitative and quantitative methods. This thesis has illustrated that patients with MLTC are complex and that multiple dimensions need to be considered. The combination of both qualitative and quantitative methods can improve our understanding of these underlying complexities. It could substantiate which factors contribute to a need for integrated care, how patients and healthcare providers experience these, and how they can be adequately measured. For example, in chapter 4 we quantitatively measured the need for care coordination by analyzing patients' (travel-related) treatment burden. This quantitative measure could be compared to a qualitative assessment of patients' experienced treatment burden to



investigate how the need for care coordination can be best measured. In addition, combining qualitative and quantitative methods could substantiate whether the patients identified by our prediction models are indeed the patients most in need of integrated care. We argue that the identification of patients by the models should be compared to the identification based on clinical judgment alone or to more straightforward threshold values. Moreover, it should be evaluated whether the identified patients also self-report to experience fragmented care. Since quantitative measures cannot substantiate if patients or healthcare providers also experience adverse outcomes of fragmented care, a hybrid case finding approach should be investigated to better identify patients in need of integrated care.

Data solidarity

Data solidarity refers to enabling data usage in ways that generates significant public value, returns profits to the public domain, and concurrently prevents and mitigates harm.⁵⁴ It argues that merely giving people more control over their data to address the power inequalities between data processors and data subjects is inadequate to solve structural problems.⁵⁴ Instead, inequalities of power should be addressed by strengthening collective forms of control, responsibility, and oversight. Data solidarity should be embraced for the hospital care organization for patients with MLTC. Data sharing can reduce adverse outcomes from fragmented healthcare delivery, creating high public value.¹⁶ At the same time, harm mitigation policies should be in place to minimize and manage risks of data use as much as possible and offer support to harmed individuals.⁵⁵ Embracing data solidarity ensures that the benefits and costs of digital practices are shared collectively and fairly. It helps to protect individuals from harm and suggests that the ownership, oversight, and governance of data should go beyond the individual-focused model.⁵⁴

To better analyze and understand the hospital care organization for patients with MLTC, easier access to routinely collected EHR data from hospitals and primary care should be facilitated.^{16,19} This thesis contributes to the scarcity of available evidence on hospital level data.²⁰ To fully grasp the complexity around patients with MLTC, combined data of health insurers, primary care data, or population based longitudinal data is needed.^{19,20} If data systems remain disconnected and are not politically and financially incentivized, the full potential of big data analytics to reduce fragmented care and support person-centered care cannot be exploited.^{16,19}

In the Netherlands, there has been ongoing discourse for over a decade concerning the adoption of a unified EHR, yet its realization has not been accomplished.^{56,57} It remains difficult to collect high-quality data from multiple sources, and systems are not yet interconnected.^{58,59} Healthcare providers are frustrated by the fragmented EHR systems, which increase administrative burden and time constraints.^{56,60,61} Nonetheless, a lack of trust and privacy concerns among healthcare providers, patients, and policymakers have hindered the implementation of a nationwide EHR in the Netherlands.⁶² Recently, multiple

Dutch healthcare and governmental institutions have agreed upon an 'Integral Care Agreement' (Integraal Zorg Akkoord).⁵⁹ The different parties have agreed upon several choices that contribute to a national exchange of patient data.⁴³ The agreement acknowledges that the increasing prevalence of patients with MLTC pressures the (financial) sustainability of the Dutch healthcare system. In line with our findings, the agreement recognizes that adequate electronic information exchange is essential for good and save healthcare delivery and to decrease the administrative burden for healthcare providers. We welcome these recent developments in the Netherlands that seem to start embracing data solidarity. Ultimately, we hope that the agreement will achieve its aim by realizing optimal data usage and sharing for healthcare, policy, and research, and will thus contribute to improving healthcare for patients with MLTC.

Suggestions for further research

If adequately targeted, reduced adverse outcomes due to fragmented healthcare delivery can be achieved through integrated and collaborative care. This thesis elaborated on opportunities to appropriately target integrated and collaborative care approaches to patients that might benefit most. Future research should further substantiate how high-need patients can be best identified. To achieve this, we first recommend exploring the potential of a hybrid case finding approach. Future studies should assess whether 1) quantitative methods applied to the whole depth of EHR data, 2) qualitative measures based on clinicians' and patients' experiences, or 3) a combination of quantitative and qualitative methods are most effective in identifying such high-need patients.

Second, as a follow-up to our cluster analyses, further in-depth analyses of available EHR data can improve our understanding of the identified clusters by providing more detailed information on diagnoses of patients or involvement of medical subspecialties. To investigate where and how collaborative care transitions are valuable, we recommend discussing the results of the cluster analyses with involved policymakers and healthcare professionals. This thesis showed that analyzing the simultaneous involvement of medical specialties can serve as guidance for exploring collaborative opportunities. Future studies should substantiate the potential of these analyses for reforming collaborative structures. Lastly, future research should assess which reimbursement systems stimulate long-term care coordination and collaboration for patients with MLTC.

Concluding remarks

This thesis illustrated that hospital care organization for patients with MLTC should be addressed as a wicked problem. To better understand and address this problem, this thesis provided important insights into the complexity and multidimensionality of the hospital care organization for patients with MLTC. In addition, it described opportunities to adequately target integrated and collaborative care approaches towards patients most in need. To improve hospital

care organization for patients with MLTC, healthcare providers should receive more patient-centered training that addresses patients' multiple dimensions and is less focused on individual diseases. Patients themselves need support to improve self-management skills and treatment outcomes. A hybrid case findings approach should be embraced to aid policymakers and healthcare providers identify appropriate target groups for interventions. Data systems across providers should be interconnected, and data needs to be collected, stored, and shared to maximize benefits for patients and healthcare providers and minimize harm to individuals. In addition, political and financial incentives must reward care coordination and collaboration. In that way, the full potential of big data analytics can be employed to appropriately target integrated and collaborative care towards patients with MLTC.

We urge policymakers, healthcare professionals, and researchers to address hospital care for patients with MLTC as a wicked problem. Recognizing this problem is needed to embrace a bolder approach that focuses on measuring the efficacy of 'good solutions' rather than 'true solutions.' Besides requiring appropriately targeted payment reforms that allow for uncertainties, are adaptive, and multidisciplinary, the wicked problem of the hospital care organization for patients with MLTC should be addressed with collaboration, coordination, and whole-system thinking.



References

1. Rittel HWJ, Webber MM. Dilemmas in a general theory of planning. *Policy Sci.* 1973;4(2):155-169. doi:10.1007/bf01405730
2. Head BW, Alford J. Wicked Problems: Implications for Public Policy and Management. *Adm Soc.* 2015;47(6):711-739. doi:10.1177/0095399713481601
3. Damarell RA, Morgan DD, Tieman JJ. General practitioner strategies for managing patients with multimorbidity: a systematic review and thematic synthesis of qualitative research. *BMC Fam Pract.* 2020;21(1):131. doi:10.1186/s12875-020-01197-8
4. Sinnott C, Mc Hugh S, Browne J, Bradley C. GPs' perspectives on the management of patients with multimorbidity: systematic review and synthesis of qualitative research. *BMJ Open.* Sep 13 2013;3(9):e003610. doi:10.1136/bmjopen-2013-003610
5. Whitehead L, Palamara P, Allen J, Boak J, Quinn R, George C. Nurses' perceptions and beliefs related to the care of adults living with multimorbidity: A systematic qualitative review. *J Clin Nurs.* 2021;doi:10.1111/jocn.16146
6. Boyd CM, Fortin M. Future of Multimorbidity Research: How Should Understanding of Multimorbidity Inform Health System Design? *Public Health Rev.* 2010;32(2):451-474. doi:10.1007/bf03391611
7. World Health Organization. Adherence to long-term therapies - Evidence for action. 2003. Accessed January 25, 2024. <https://www.paho.org/en/documents/who-adherence-long-term-therapies-evidence-action-2003>
8. Walker C, Swerissen H, Belfrage J. Self-management: its place in the management of chronic illnesses. *Aust Health Rev.* 2003;26(2):34. doi:10.1071/ah030034a
9. Lorig KR, Holman HR. Self-management education: History, definition, outcomes, and mechanisms. *Ann Behav Med.* 2003;26(1):1-7. doi:10.1207/s15324796abm2601_01
10. National Institute for Health and Care Excellence. Multimorbidity: clinical assessment and management. NICE guideline [NG56]. 2016. Accessed June 15, 2023. <https://www.nice.org.uk/guidance/ng56/evidence/full-guideline-pdf-2615543103>
11. Boyd CM, Darer J, Boulton C, Fried LP, Boulton L, Wu AW. Clinical Practice Guidelines and Quality of Care for Older Patients With Multiple Comorbid Diseases: Implications for Pay for Performance. *JAMA.* 2005-08-10 2005;294(6):716. doi:10.1001/jama.294.6.716
12. The Academy of Medical Sciences. Multimorbidity: a priority for global health. 2018. Accessed June 15, 2023. <https://acmedsci.ac.uk/file-download/82222577>
13. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: a systematic review of the literature. *Ageing Res Rev.* 2011;10(4):430-439.
14. Dalen JE, Ryan KJ, Alpert JS. Where Have the Generalists Gone? They Became Specialists, Then Subspecialists. *Am J Med.* 2017;130(7):766-768. doi:10.1016/j.amjmed.2017.01.026
15. Xu X, Mishra GD, Jones M. Evidence on multimorbidity from definition to intervention: An overview of systematic reviews. *Ageing Res Rev.* 2017;37:53-68. doi:10.1016/j.arr.2017.05.003
16. Joo JY. Fragmented care and chronic illness patient outcomes: A systematic review. *Nurs Open.* 2023;10(6):3460-3473. doi:10.1002/nop.21607
17. van der Aa MJ, van den Broeke JR, Stronks K, Plochg T. Patients with multimorbidity and their experiences with the healthcare process: a scoping review. *J Comorb.* 2017;7(1):11-21.
18. Van Walraven C, Oake N, Jennings A, Forster AJ. The association between continuity of care and outcomes: a systematic and critical review. *J Eval Clin Pract.* 2010;16(5):947-956. doi:10.1111/j.1365-2753.2009.01235.x
19. Schulte T, Bohnet-Joschko S. How can Big Data Analytics Support People-Centred and Integrated Health Services: A Scoping Review. *Int J Integr Care.* 2022;22(0):23. doi:10.5334/ijic.5543
20. Witham MD, Cooper R, Missier P, Robinson SM, Sapey E, Sayer AA. Researching multimorbidity in hospital: can we deliver on the promise of health informatics? *Eur Geriatr Med.* 2023;doi:10.1007/s41999-023-00753-6
21. Remers TEP, Nieuweweme N, Van Dulmen SA, Rikkert MO, Jeurissen PPT. The Impact of Payment Reforms on the Quality and Utilisation of Healthcare for Patients With Multimorbidity: A Systematic Review. *Int J Integr Care.* 2022;22(1):10. doi:10.5334/ijic.5937
22. Mookherjee S, Vidyarthi AR, Ranji SR, Maselli J, Wachter RM, Baron RB. Potential Unintended Consequences Due to Medicare's "No Pay for Errors Rule"? A Randomized Controlled Trial of an Educational Intervention with Internal Medicine Residents. *J Gen Intern Med.* 2010;25(10):1097-1101. doi:10.1007/s11606-010-1395-9
23. Ho IS-S, Azcoaga-Lorenzo A, Akbari A,



- et al. Variation in the estimated prevalence of multimorbidity: systematic review and meta-analysis of 193 international studies. *BMJ Open*. 2022;12(4):e057017. doi:10.1136/bmjopen-2021-057017
24. De Regge M, De Pourcq K, Meijboom B, Trybou J, Mortier E, Eeckloo K. The role of hospitals in bridging the care continuum: a systematic review of coordination of care and follow-up for adults with chronic conditions. *BMC Health Serv Res*. 2017;17(1):doi:10.1186/s12913-017-2500-0
25. Fabbri E, Zoli M, Gonzalez-Freire M, Salive ME, Studenski SA, Ferrucci L. Aging and Multimorbidity: New Tasks, Priorities, and Frontiers for Integrated Gerontological and Clinical Research. *J Am Med Dir Assoc*. 2015;16(8):640-647. doi:10.1016/j.jamda.2015.03.013
26. de Hond AAH, Kant IMJ, Fornasa M, et al. Predicting Readmission or Death After Discharge From the ICU: External Validation and Retraining of a Machine Learning Model. *Crit Care Med*. 2023;51(2):291-300. doi:10.1097/ccm.0000000000005758
27. Hong CS, Siegel AL, Ferris TG. Caring for high-need, high-cost patients: what makes for a successful care management program? 2014;
28. Head BW, Xiang W-N. Why is an APT approach to wicked problems important? *Landsc Urban Plan*. 2016/10/01/ 2016;154:4-7. doi:10.1016/j.landurbplan.2016.03.018
29. Head BW. Forty years of wicked problems literature: forging closer links to policy studies. *Policy Soc*. 2018;38(2):180-197. doi:10.1080/14494035.2018.1488797
30. Hurst JR, Dickhaus J, Maulik PK, et al. Global Alliance for Chronic Disease researchers' statement on multimorbidity. *Lancet Glob Health*. 2018;6(12):e1270-e1271. doi:10.1016/s2214-109x(18)30391-7
31. Rietbroek MV, Slats AM, Kiès P, et al. The Integrated Dyspnea Clinic: An Evaluation of Efficiency. *Int J Integr Care*. 2018;18(4):15-15. doi:10.5334/ijic.3983
32. Bell C, Appel CW, Frølich A, Prior A, Vedsted P. Improving Health Care for Patients with Multimorbidity: A Mixed-Methods Study to Explore the Feasibility and Process of Aligning Scheduled Outpatient Appointments through Collaboration between Medical Specialties. *Int J Integr Care*. 2022;22(1):17. doi:10.5334/ijic.6013
33. McCarthy D, Ryan J, Klein S. Models of care for high-need, high-cost patients: an evidence synthesis. *Commonwealth Fund New York (NY)*; 2015.
34. Vos L, Chalmers SE, Dückers ML, Groenewegen PP, Wagner C, Van Merode GG. Towards an organisation-wide process-oriented organisation of care: A literature review. *Implement Sci*. 2011;6(1):8. doi:10.1186/1748-5908-6-8
35. de Ruijter UW, Kaplan ZLR, Bramer WM, et al. Prediction Models for Future High-Need High-Cost Healthcare Use: a Systematic Review. *J Gen Intern Med*. May 2022;37(7):1763-1770. doi:10.1007/s11606-021-07333-z
36. Hassaine A, Salimi-Khorshidi G, Canoy D, Rahimi K. Untangling the complexity of multimorbidity with machine learning. *Mech Ageing Dev*. 2020/09/01/ 2020;190:111325. doi:10.1016/j.mad.2020.111325
37. Tuross M, Linstone HA. The Delphi method-techniques and applications. 2002;
38. Nederlandse Zorgautoriteit. Regeling medisch-specialistische zorg - NR/REG-2403a. https://puc.overheid.nl/doc/PUC_747630_22/12023.
39. Prados-Torres A, Calderón-Larrañaga A, Hanco-Saavedra J, Poblador-Plou B, van den Akker M. Multimorbidity patterns: a systematic review. *J Clin Epidemiol*. 2014/03/01/ 2014;67(3):254-266. doi:10.1016/j.jclinepi.2013.09.021
40. Busija L, Lim K, Szoek C, Sanders KM, McCabe MP. Do replicable profiles of multimorbidity exist? Systematic review and synthesis. *Eur J Epidemiol*. Nov 2019;34(11):1025-1053. doi:10.1007/s10654-019-00568-5
41. Futoma J, Simons M, Panch T, Doshi-Velez F, Celi LA. The myth of generalisability in clinical research and machine learning in health care. *Lancet Digit Health*. 2020;2(9):e489-e492. doi:10.1016/S2589-7500(20)30186-2
42. Majnaric LT, Babic F, O'Sullivan S, Holzinger A. AI and Big Data in Healthcare: Towards a More Comprehensive Research Framework for Multimorbidity. *J Clin Med*. Feb 14 2021;10(4) doi:10.3390/jcm10040766
43. Helder C. Nationally comprehensive network of infrastructures [Landelijk dekkend netwerk van infrastructuren]. 2024. January 22. Accessed January 27, 2024. <https://open.overheid.nl/documenten/8e2d80a7-6b6e-440e-9ba7-1fc191072a8a/file>
44. James G, Witten D, Hastie T, Tibshirani R. An introduction to statistical learning. Springer; 2013;112. https://hastie.su.domains/ISLR2/ISLRv2_website.pdf
45. Patiëntenfederatie Nederland. Living with multiple conditions [Leven met meerdere

- aandoeningen] Accessed January 26, 2024, <https://www.patiëntenfederatie.nl/downloads/rapporten/1274-rapportage-multimorbiditeit/file>
46. Kuipers SJ, Nieboer AP, Cramm JM. Making care more patient centered; experiences of healthcare professionals and patients with multimorbidity in the primary care setting. *BMC Fam Pract*. 2021;22(1):doi:10.1186/s12875-021-01420-0
47. Federatie Medisch Specialisten. Vision Document Medical Specialist 2025: ambition, trust, collaboration [Visiedocument Medisch Specialist 2025: ambitie, vertrouwen, samenwerken]. Accessed January 25, 2024, <https://demedischspecialist.nl/sites/default/files/Visiedocument%20Medisch%20Specialist%202025-DEF.pdf>
48. Bezzina C, Pope L. Multimorbidity and the need to rethink Medical Education. *J Multimorb Comorb*. 2023;13:doi:10.1177/26335565231207811
49. Nederlandse Internisten Vereniging. Multidisciplinary assessment chronic patients with multiple secondary healthcare providers [Multidisciplinaire beoordeling Chronisch zieken met meerdere behandelaars 2eLijn]. Accessed January 26, 2024, <https://www.internisten.nl/lopende-projecten/multidisciplinaire-beoordeling-chronisch-zieken-met-meerdere-behandelaars-2elijijn/>
50. Bernabeu-Wittel M, Para O, Voicehovska J, et al. Competences of internal medicine specialists for the management of patients with multimorbidity. EFIM multimorbidity working group position paper. *Eur J Intern Med*. Mar 2023;109:97-106. doi:10.1016/j.ejim.2023.01.011
51. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;380(9836):37-43.
52. Nunes BP, Flores TR, Mielke GI, Thumé E, Facchini LA. Multimorbidity and mortality in older adults: A systematic review and meta-analysis. *Arch Gerontol Geriatr*. 2016;67:130-138. doi:10.1016/j.archger.2016.07.008
53. Haime V, Hong C, Mandel L, et al. Clinician considerations when selecting high-risk patients for care management. *Am J Manag Care*. 2015;21(10):e576-82.
54. Prainsack B, El-Sayed S, Forgó N, Szoszkiwicz Ł, Baumer P. Data solidarity: a blueprint for governing health futures. *Lancet Digit Health*. 2022;4(11):e773-e774. doi:10.1016/s2589-7500(22)00189-3
55. McMahon A, Buyx A, Prainsack B. Big Data Governance Needs More Collective Responsibility: The Role of Harm Mitigation in the Governance of Data Use in Medicine and Beyond. *Med Law Rev*. 2019;doi:10.1093/medlaw/fwz016
56. Safak Abdelrahman. Opinion: 'Implement the electronic patient record nationally after all' [Opinie: 'Voer het elektronisch patiëntendossier alsnog landelijk in']. *Het Parool*. May 7, 2022. Accessed January 25, 2024. <https://www.parool.nl/columns-opinie/opinie-voer-het-elektronisch-patiëntendossier-alsnog-landelijk-in~b795e444/?referrer=https://www.google.com/>
57. Eerste Kamer der Staten-Generaal. 31.466 Elektronisch patiëntendossier. Accessed January 25, 2024. https://www.eerstekamer.nl/wetsvoorstel/31466_elektronisch
58. Wammes JJG, Jeurissen P, Westert GP. 2015 International Profiles of Health Care Systems - The Dutch Health Care System 2016:115-122. Accessed December 28, 2023. https://www.commonwealthfund.org/sites/default/files/documents/___media_files_publications_fund_report_2016_jan_1857_mossialos_intl_profiles_2015_v7.pdf
59. Integraal Zorg Akkoord - Samen werken aan gezonde zorg. 2022. Accessed February 5, 2024. <https://www.rijksoverheid.nl/documenten/rapporten/2022/09/16/integraal-zorgakkoord-samen-werken-aan-gezonde-zorg>
60. Hansson A, Svensson A, Ahlstrom BH, Larsson LG, Forsman B, Alsen P. Flawed communications: Health professionals' experience of collaboration in the care of frail elderly patients. *Scand J Public Health*. Nov 2018;46(7):680-689. doi:10.1177/1403494817716001
61. Schiøtz ML, Host D, Christensen MB, et al. Quality of care for people with multimorbidity - a case series. *BMC Health Serv Res*. 2017;17(1):745. doi:10.1186/s12913-017-2724-z
62. van der Maat M, Reitsma-van Rooijen M, de Jong J. Especially people with a poor health status object to a national EHR (Electronic Health Record) [Vooral mensen met een slechte gezondheid maken bezwaar tegen het landelijke EPD]. NIVEL. Accessed January 25, 2024, <https://www.nivel.nl/sites/default/files/bestanden/Factsheet-mensen-met-slechte-gezondheid-bezwaar-EPD.pdf>

