Reducing the chronic disease burden in China: tailoring a self-management intervention among Chinese people with chronic lung disease

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Chapter 7

General discussion

Introduction

Chronic diseases such as chronic lung disease (CLD) and hypertension pose a high chronic disease burden worldwide, especially in low-and middle-income countries [1,2,6], e.g., China. Identifying effective interventions to tackle chronic diseases in these low-resource countries is necessary. The generated evidence has shown that self-management interventions (SMIs) can help patients improve their health outcomes and reduce the disease burden [19,23]. Most studies focusing on SMIs tackling chronic diseases are in high-income countries [36,37], while patients in low- and middle-income countries – such as China – show significantly poorer self-management (SM) [38-40]. Evidence has been accumulated that it is possible to implement proven-effective SMIs – developed and tested in high-income countries – in patients from low-and middle-income countries [288,289]. Implementing such proven-effective SMIs can benefit these patients [288,289]. Also, adequate knowledge about SMIs - in high-income countries - can provide precise details to optimize patient SM behaviors, such as improved medication adherence [288,289]. However, the effectiveness of such SMIs may be sub-optimal due to the different contexts with different health, economic, and cultural backgrounds [36,37]. To address these differences, it is necessary to tailor proven-effective SMIs to ensure they align with the local context [36,37,288,289]. Yet, to our knowledge, there is a lack of evidence on tailoring a SMI tackling chronic disease – developed in a high-resource country – to the Chinese context.

The main aim of this thesis was to find evidence to tailor a SMI tackling chronic disease – proven effective in high-income countries – to the Chinese context. First, this thesis provides an overview of the burden due to hypertension. Specifically, this thesis examined the association between frailty and hypertension. Second, this thesis took CLD as an example to collect evidence on tailoring a SMI tackling CLD – proven effective in high-income countries – to the Chinese context. Compared with other diseases, such as hypertension, there was a high prevalence of CLD without adequate effective treatment [54]. A four-step process of tailoring SMI for the local context was followed: (a) identify the Chinese context, (b) select SMI and mode of delivery, (c) identify factors influencing the SMI implementation, and (d) integrate SMI into the Chinese context. This chapter summarizes the main findings of the included studies and relates them to existing literature. Additionally, the study's strengths and limitations are discussed. Furthermore, this thesis presents the implications for future research and practice.

Main findings

High chronic disease burden

Chapter 2 identified the disease burden of frailty in Chinese people with hypertension. To accomplish this, a cross-sectional survey was conducted (a) to identify the prevalence of

multidimensional frailty in people with hypertension and (b) to examine a possible relationship between general obesity and abdominal obesity to multidimensional frailty in older people with hypertension. Data from 995 community-dwelling people aged 65 years or older were analyzed. This study found a high prevalence of frailty in Chinese people with hypertension (46.5%). This finding aligned with previous studies [290,291]. The high prevalence of frailty in Chinese people with hypertension indicated increased disease burden, including decreased physical function, a lower life expectancy, and higher fragile psychology [290,291]. Interestingly, abdominal obesity could be a physical, psychological, and social-frailty concern for Chinese people with hypertension, while general obesity was positively related to physical frailty. The present study also demonstrated a high prevalence of hypertension and related risk factors among the participants. It indicated the necessity to identify effective interventions to reduce the disease burden by addressing the risk factors.

Previous reviews – focusing on chronic disease burden identification – identified the high disease burden in CLD, including the high rate of disability and morbidity [10,11]. Collective evidence has shown that CLD has resulted in high healthcare costs; exacerbations accounted for most of it [12,13]. Regardless of the high disease burden, there is poor disease knowledge and SM among people with CLD [31-33]. Identifying practical interventions to reduce the high chronic disease burden is necessary.

Self-management interventions can help to reduce the chronic disease burden

Taking CLD as an example, this thesis identified helpful interventions feasible for people with CLD in China. The systematic review (**Chapter 3**) focused on the effect of blended SMI on health-related effectiveness and process outcomes of SMIs for people with chronic obstructive pulmonary disease (COPD) or asthma. The data demonstrated that SMI could help patients manage their disease actively with(out) support from healthcare professionals (HCPs), reducing the disease burden and optimizing patient outcomes. However, most included studies in the systematic reviews came from high-income countries; this identification was in accordance with previous reviews [36,37]. Such SMIs tackling CLD – developed and tested in high-income countries – may not be feasible for patients in low-resource countries, e.g., China. The data from the systematic review also reported that the SMIs – either in the model of eHealth, face-to-face, or blended care – might fail if the intervention was not feasible for the local context. For example, eHealth was sub-optimal when local people were unfamiliar with eHealth or had inadequate eHealth literacy.

This study was the first to identify the effectiveness of (blended) SMIs in people with CLD. Besides, the systematic review identified the need to tailor SMIs for people with CLD in low- and middle-income countries.

The process of tailoring CLD SMI into the Chinese context

To align SMIs with the Chinese context, it is necessary to identify the local context before the SMI implementation [288,289]. Accordingly, this thesis identified the local context, including illness perceptions, experience with, and needs for SM (**Chapter 4**). A robust mixed-method study design was employed in people with CLD and HCPs in Chinese primary care (PC) and secondary care (SC). It was observed that Chinese patients had negative illness perception, limited disease knowledge, and poor SM skills, including the recognition and action on exacerbation. Multiple needs should be addressed when identifying effective SMIs, such as the individualized SM plan, increasing disease knowledge, and eHealth use. The identified local context topics – covering the local perceptions, behaviors and unmet needs - were independent of each other. It is necessary to tailor the SMI in the Chinese context, which consequently can help to optimize patient outcomes when implementing SMIs. It was also found that the identified local context, including factors influencing SMI implementation in the Chinese context, are the main priorities in China. Conversely, the effectiveness of health programs – like SMI implementation - can be undermined when the implementation misaligns with the local context [292].

Compared with other studies identifying the local context [250,293], our study provided a complete view from stakeholders in different healthcare settings. As far as we know, this is the first study to compare patients' illness perceptions from PC and SC. For two reasons, it was essential to compare the differences between these two healthcare settings. First, the different healthcare resources in PC and SC can lead to different perceptions of the disease and treatment [243]. Second, people with CLD in China can choose to go to PC and SC depending on their disease severity and expenditure ability [253]. This study also provided a preliminary view of how the HCPs perceived the disease and their experiences with patients, which could help provide direction to tailor a SMI. To explain, HCPs have the task of identifying the cost-effective SMIs to help patients self-manage their disease. Identifying the local experiences (poor SM) and needs regarding individualized SM plans and eHealth provided direction for selecting a suitable SMI tackling CLD in the next step.

Considering the local needs, the proven-effective SMI in high-resource countries were selected in this thesis: REducing Delay through edUcation on eXacerbations (REDUX). REDUX was developed and tested in the Netherlands, a high-income country [51]. It showed a positive effect in helping patients with COPD SM [51]. Besides, the characteristic of the intervention, e.g., an individualized and easy-to-use action plan, showed a potentially positive effect on people with CLD in China. Importantly, A key aspect of REDUX is that nurses play an important role in implementing the program [51]. Nurses can positively contribute to the SMI implementation by providing education and consultation to patients [278]. Studies have shown that nurses – in high-income countries – are capable of

fulfilling extended roles; they can offer an appropriate solution to the difficulties doctors face (e.g., an increasing workload and consequently limited consultation time) [278,294]. Also, nurses can coordinate multi-disciplinary teamwork during the SMI implementation in high-income countries [278]. In comparison, Chinese nurses deliver inadequate care to secure nursing quality due to insufficient nursing staff [295-297]. At the same time, China is ongoing a healthcare reform, in which an increased nurse staff is needed, and nurses are delegated more obligations to help patients SM their disease [298]. The healthcare reform also requires nurses to improve their professional skills to deliver care [298]. To enhance the professional skills to deliver care, the lessons learned from nurse-led SMI – in high-income countries – could help Chinese HCPs to improve their professional skills [278,294,298].

Besides, the implementation of the REDUX program should address the differences in the local context. Tailoring REDUX in the Chinese context was necessary to accomplish the goal. Accordingly, the stakeholder analysis aimed to identify factors influencing the REDUX implementation in China (**Chapter 5**). To do so, multiple stakeholders, including patients, HCPs, policymakers from the healthcare setting and healthcare insurance organizations, app developers, and cyber-security officers, were included. Specifically, qualitative interviews identified the level of support for REDUX and preferred delivery mode in patients, HCPs, and policymakers. Also, the necessary conditions to develop and implement digital health apps were identified with the quantitative survey in app developers and cyber-security officers. Collecting data from multiple stakeholders involved in developing and implementing SMI can provide a complete view of the factors influencing the REDUX implementation [77].

The findings from **Chapter 5** noted that most patients, HCPs, and policymakers supported REDUX. The factors influencing the support for REDUX – including facilitators and barriers – were identified. Addressing these factors in the REDUX implementation process can help to optimize the implementation effect. This study also indicated that engaging the local stakeholders and improving their interest in REDUX could promote implementation success. These findings can be helpful for the local stakeholders to implement REDUX in China, which consequently could help people with CLD improve their health outcomes and reduce the disease burden. The preference for the delivery mode was varied, indicating that the REDUX version to use (e.g., digital or paper-based) should be tailored during its implementation in China.

The data from **Chapter 5** also identified that it was possible for the Chinese patients to make nationwide doctor appointment; this could be because there is a lack of strict referral and counter-referral system between different healthcare settings, such as SC and PC [264]. That indicated that there is still a big room to improve the healthcare referral system. Besides, the process to develop and implement the health apps was in line with the international guideline recommendations about the app

development process, design, and technical issues. Similarly, it was mentioned by most cyber-security officers that their work process aligned with the international guideline recommendations related to access control, authentication, data transfer, data retention, security and confidentiality, integrity, informing patients, body area network communication, and breach notification. The collective data showed that it was highly possible to implement REDUX in China, yet barriers should be addressed in the implementation process.

Based on the findings from **Chapter 5**, it was recommended that factors influencing SMI implementation and the implementation strategies should be tailored. The finding was in line with other studies, which demonstrated that a context-driven SMI could improve the possibility of implementing SMI successfully and optimize local resource use [46,250,271]. The similarity was that implementing SMI in a new context depends on multiple context mediators, including individual and organizational support, healthcare resources, leadership, and organizational culture and climate [46]. For example, when the local organization was supportive of the context-driven SMI, the organizational support would improve the integration of the context-driven SMI into the local organizational daily work process [46,271]. In addition, the supportive leaders, e.g., those working in the healthcare settings (nurse leaders, physician chiefs) and healthcare insurance organizations (administration managers), could assign dedicated staff to promote the SMI implementation, which helps assist the SMI implementation [46-48].

Next, the study design – focusing on implementing REDUX in China and assessing the effectiveness and the preconditions (i.e., feasibility, acceptability, and appropriateness) - was discussed in a protocol paper (**Chapter 6**). The small-scale pilot study is designed to achieve the study objective. Implementation science identifies the need for a precondition assessment, while such an assessment is lacking in previous studies [91-95]. Identifying the preconditions is necessary before the SMI implementation for two reasons. First, it could help to examine whether the SMI is tailored to the people with CLD in China. Second, these measurements could optimize local resource use before implementing the large-scale intervention.

Overall, this thesis illustrated an entire process of tailoring SMI to design context-driven interventions and improve their uptake in a different context. Furthermore, this thesis provided an overview of the local context from different stakeholders about their prevailing perceptions of lung health and lung-related SM. The collective evidence offers a starting point for further scientific research on tailoring SMI tackling chronic disease such as CLD and hypertension.

Strength and limitations

Several strengths of this thesis are worth mentioning. First, the tailored SMI tackling CLD within the Chinese context used multiple well-designed strategies, ensuring the tailoring process's validity. The

precise design allowed us to make statements about the needs and experiences in China, which can support the implementation of SMI such as REDUX. That is important because the ultimate goal of SMI is to ensure patient-centered care and delivery mode preferred by patients. The identification of contextual information can help achieve this goal. Second, multiple stakeholders were involved, thereby increasing the validity of the evidence. Previous stakeholder analysis studies on healthcare innovations were limited to the stakeholder group of policymakers, which could not represent all voices relevant when implementing the SMIs [81,82]. This thesis involved multiple stakeholders in different study phases to provide complete insights on the same topic. For example, patients, nurses, and doctors in Chinese PC and SC were included when identifying the local context. Then, the entire map of perceptions and behaviors related to SM from different stakeholders can be overviewed. Also, when identifying the factors influencing the REDUX implementation in the Chinese context, patients, HCPs, people working in healthcare insurance, app developers, and cyber-security officers were involved, which provided complete data on developing and implementing the REDUX program in China. Third, the in-time data collection and assessment were less influenced by recall bias or other confounding factors. For example, in the data collection phase of the mixed-method study, the participants were asked to complete the quantitative surveys directly after the interviews. The consequent quantitative and qualitative data assessment improves the validity of this study. Fourth, the study design and reporting guidelines were employed in the study process of the included studies. Specifically, the preferred reporting items according to the systematic reviews and meta-analysis guideline [168] were applied when conducting the systematic review. Also, the standard protocol items: recommendations for interventional trials [299], and template for intervention description and replication [300], were applied to guide the study design of REDUX for people with CLD in China. In addition, a framework approach [239] was used to guide the qualitative data analysis in the mixed-method study. Besides, a stakeholder analysis guideline [252] was used to identify the factors influencing the REDUX implementation in the Chinese context. The guidelines used in this thesis could help provide a clear and pragmatic interpretation of the recommendations for practice and further studies. Fifth, during the study process, the local stakeholders were closely connected in the research; their involvement helped to increase the possibility of successful study conduction and optimize the local resource.

Furthermore, the cooperation of the stakeholders from the Netherlands and China could pave the way for the future development and implementation of SMI in China. Specifically, REDUX was developed and tested in the Netherlands, a high-income country with a developed healthcare system. At the same time, there is plenty of room for improvement in the Chinese healthcare system, e.g., the implementation of effective SMIs, referral and counter-referral system between the PC and SC, and delivering integrated care to patients, which can optimize the SMI implementation significantly [301,302].

The international cooperation in this thesis widens the view to help deliver targeted care to patients in the low-and middle-income countries. International cooperation is of great importance. For example, the Lancet COPD commission emphasized that it was necessary to advance COPD research on effective treatment by combining all COPD communities worldwide [54].

Besides the strengths, there are also limitations within the research process that will be described below. The first limitation lies in the recruitment method, that is, the purposive sampling during the qualitative data collection. Such a sampling method is prone to selection bias [303]. We specifically used snowball sampling, a form of purposive sampling. People tend to refer those they know and have similar traits in the data collection process. And thus, this sampling method could have a potential sampling bias and margin of error. This meant that the research may have only included a selective group and the study results must be interpreted carefully. Besides, when participants know that they have already been selected for a research project, it can initiate a change in their behaviors, e.g., they may allow the researcher to reach the expected conclusion against their perceptions. To reduce the limitation of purposive sampling, the researchers used some additional methods: (a) increased the sample size in the data collection phase, and (b) included questions initiating participants to express their perceptions regarding the interview topic lists. Yet, the data interpretation should be done carefully.

The second limitation is related to the external validity of the results. Specifically, there were only a limited number of research settings were studied and the settings varied over the study projects. Accordingly, it is possible that the generalizability of the data to the Chinese context can be sub-optimal. To explain, the mixed-method study focusing on the local context was collected in a regional location, i.e., Henan province. Whereas the data in the stakeholder analysis study was collected from eight provinces. Considering that there is significant healthcare resource inequality and diverse customs within different provinces in China, with 31 provinces including a population of over 1.45 billion, data from our included participants in this thesis (in total 1173) possibly could not represent the voice all over China. Thus, caution must be taken to translate the results nationwide.

Due to the limited time and COVID regulations in China, the REDUX implementation was planned, but the actual implementation of it was not (yet) conducted. Evaluating the effect of REDUX takes considerable time because the effect during research is measured between two consecutive exacerbations[51]. In the past four years, China has strictly followed the COVID regulations, which meant that the healthcare focus – in Chinese PC and SC - was COVID vaccination and tests with inadequate attention on chronic disease management. The delayed implementation of the intervention in practice leads to the fact that the effect and preconditions of REDUX on Chinese people are still unknown. Therefore, the thesis should be interpreted cautiously due to the mentioned limitations.

Recommendations for future research

The findings in this thesis have demonstrated that mapping the local context is essential for researchers to tailor SMI tackling CLD. The identified contextual factors can improve the possibility of implementation success and optimize local resource use. During the local context identification, we cooperated with local stakeholders. In particular, we involved the local HCPs and policymakers; they motivated other people to be involved in the research and facilitated communication with the local participants. To promote the practical relevance of the SMI, it is vital to co-cooperate with the local stakeholders. Accordingly, identifying local beliefs and behaviors is recommended before the SMI implementation. That is, the implementors should address different contexts when implementing the SMI. It can be explained that people - between China and high-income countries - have different experiences and perceptions on the same topic.

Similarly, there are different strategies for managing CLD in these countries. Before implementing SMI such as REDUX in China, the local context should be addressed. Therefore, future researchers should emphasize the type of proven-effective SMI and local context identification to observe the feasibility of implementing the SMI. Also, the facilitation for the SMI implementation should be addressed to optimize the possibility of implementation success.

As mentioned, China is undergoing a new healthcare reform [88] and has published the updated healthcare policy, i.e., Healthy 2030 [72]. Both health innovations have addressed the importance of improving patient SM and reducing disease burden. A critical reason for the high support level for REDUX was its response to the Chinese healthcare reform priority. The experience of coping with COVID within China has demonstrated the ability of humans to rapidly adapt behaviors to improve health once the sense of urgency is sufficiently high [304]. Therefore, it is recommended that the implementers focus on the SMI that responded to the policy priority. The following approaches should be addressed when implementing SMI in future research. First, it is necessary for the policymakers to address the importance of SMI when determining the Chinese healthcare policy priority [305], e.g., facilitating and training patients to acquire lifelong skills to manage their disease. Second, identifying the appropriate theories [306,307], such as social learning theory and cognitive–behavioral concepts and acceptance, underpin course design, which can help develop future research directions in SMI. Third, it is recommended to identify the factors influencing SMI implementation under the existing healthcare policy priority; this can help optimize SMI uptake and implementation.

This thesis offers a starting point for further scientific research on reducing the chronic disease burden; this is important because the identification of tailoring SMI into the local context can improve the possibility of implementing SMI successfully. Future research must demonstrate the added value of addressing the tailoring steps in practice. In addition, even though REDUX has not been validated

for settings other than PC, it may have potential in secondary or tertiary care. Hence it is proposed to examine its validity in these settings in future studies as well. Besides, it was evidenced in this thesis that positive illness perceptions were highly relative to optimized patient SM and vice versa. However, it is unclear whether the positive belief in SMI can optimize the effect of SMI. The current evidence has demonstrated that positive patient beliefs about the likely success of medication intervention have been associated with improved patient health outcomes [308]. Thus, future research is needed to identify the association between positive patient beliefs and the effect of SMI. Importantly, researchers are recommended to identify what kinds of positive patient beliefs can influence which intervention outcomes, such as health-related effectiveness and process outcomes, and the mechanisms of how the positive patient belief and intervention outcomes are related. SMI combined with eHealth can help people with CLD to manage this disease by engaging them in self-care tasks, which foster behavior change toward better health [309]. However, attrition can be problematic when neglecting individual factors, such as the value of the users, e.g., personal-psychological situation [310]. It is recognized that theory-based SMI can help to solve such problems with strategies [311,312]. For example, behavior change techniques can aid in enhancing SMI with strategies, e.g., goal setting, action planning, self-monitoring, problem-solving, and goal review [309,313]. Therefore, in future studies, it is necessary to identify whether the behavior change techniques in SMI can result in substantial positive changes in patient health behaviors and psychological outcomes.

Furthermore, this thesis specifically covered the tailoring of REDUX to the Chinese context, but the broad use of the tailoring process is unclear. From the perspective of effectiveness and efficiency, it is necessary to identify the effectiveness and preconditions of such an intervention with a pilot study in practice before the full-scale implementation and evaluation. It is also suggested to expand the tailoring process in the SMI to other chronic diseases, such as hypertension, a chronic disease with a prevalence of 27.5% in the Chinese people [314]. To apply such a process to other chronic disease management, the factors should be specific to the particular disease-related context rather than the one-to-all model [315]. It is also plausible that the tailoring process could be generalized to other low- and middle-income countries, yet this remains to be assessed. The methods and lessons in the implementation process can boost the implementation of SMI in different contexts.

Practical implications and recommendations

Enhance the knowledge of disease and awareness of SMIs

This thesis reported poor disease knowledge and sub-optimal SM in Chinese people with CLD. Targeted efforts to increase knowledge of disease and SMI will be useful to reduce the disease burden [54]. Several methods can be helpful for this. First, it is urged to educate patients on the disease, e.g., the

risk factors and development of the disease and the benefits of SMIs, including decreased admission and medication use, which can optimize the effect of SMIs. Second, for future SMIs, efforts to slow down the CLD progression should focus on early disease identification and improve treatment efficacy. Thirdly, undergraduate medical and nurse students should be trained to deliver SMIs to patients and target the SMI delivery model for different patients in their vocational training.

Enrich the SMI delivery technique and mode

In recent years, healthcare systems in many countries have invested substantial effort in developing eHealth to reduce the burden of CLD [316,317]. SMIs tackling CLD combined with eHealth can help patients SM their disease without the time and place restrictions, which will benefit patients [24]. Currently, eHealth literacy is a lack in Chinese patients. In the updated Chinese healthcare policy, it has been required to promote the use of eHealth and increase eHealth literacy in Chinese people [72]. One possible way is for HCPs to promote eHealth use to facilitate communication, stimulate the demand for services, and increase access to health information for disease management.

Additionally, it is expected to apply meta-universe technology, e.g., virtual reality and artificial intelligence, in SMI delivery. Meta-universe technology allows HCPs to share their knowledge with patients and to communicate their experience without words to their doctors, allowing for powerful and effective communication, enhanced awareness of the disease, and potential interventions [318,319]. Assessing the effect of SMI with meta-universe technology on people with CLD in practice is necessary. It is recommended to apply such technologies in SMI tackling CLD to increase patient engagement and help patients enjoy the intervention process.

Extend the networks with different stakeholders

Eliminating CLD requires consistent and coordinated action from multiple stakeholders, such as physicians, general practitioners, social workers, physiotherapists, people working on healthcare insurance, and nurses, in healthcare practice. The multiple-disciplinary collaboration has effectively delivered patient-centered care with consistent medical advice, which can improve patient health outcomes and reduce healthcare costs [320,321]. The multiple-disciplinary collaboration requires shared consultations, collaboration via referral, and counter-referral between different healthcare settings, e.g., between SC and PC [321]. Currently, the Chinese healthcare system is devoted to promoting multiple-disciplinary collaboration. Still, there is a need for more cooperation between different level healthcare settings, e.g., between SC and PC, and this is one major challenge in existing care provision [322,323]. For example, the lack of the counter-referral from SC to PC and fixed HCP barrier the multiple-disciplinary collaboration[323]. To tackle the missing coordination, multiple strategies should be developed and applied. First, the Chinese healthcare reform should put effort into advancing the referral and counter-referral system between Chinee PC and SC. Secondly, the patients must have a

physician and/or general practitioner or nurse who can help provide unified, integrated care and navigate the way of multiple disciplinary cooperation. For example, in Chinese PC, the general practitioner or doctor is the first point of contact for patients and provides access to services in collaboration with other HCPs. Thirdly, interprofessional education programs should be introduced to help provide comprehensive and continuous care. The lessons of multiple-disciplinary cooperation from high-income countries could be helpful for Chinese HCPs. Furthermore, diagnosis-related reimbursement in the SC should also be applied in PC since such healthcare settings ensure people receive quality comprehensive care - from promotion and prevention to treatment and rehabilitation - as close as feasible to people's everyday environment [324].

Leadership engagement in the Chinese context – engagement of nurse leaders and chief physicians – can also improve the SMI uptake. That is related to the hierarchical management structure in China [325,326]. The health bureau's executive leaders in healthcare institutions are appointed administratively in China. Additionally, even though institutions are endowed with a certain autonomy, coordinated by the upper government, executives are willing to take measures because the promising effect of these SMI could be seen during their tenure [327]. Therefore, leadership engagement is necessary to ensure the SMI is implemented timely. To realize this, it is advocated to cooperate with such stakeholders at the start of SMI implementation, which can help to optimize the uptake of the proven-effective SMIs and assign the prioritized resource to promote the SMI implementation.

Moreover, by collaborating with international researchers and HCPs, the context-driven approaches can be improved under the global vision. Currently, China is undergoing a round of health reform; the perspectives outside of the box can result in inventive solutions to the diploma in the healthcare field, e.g., implementing the cost-effective SMIs, proven-effective in high-income countries, coping with chronic disease in the Chinese context. Cooperating with the organization – focusing on reducing the chronic disease burden – facilitates SMI implementation in low-resource settings. For example, the World eHealth Living Lab (WeLL) was created in the Netherlands, which is the independent knowledge platform for eHealth research, development and implementation. Such a platform promotes communication and cooperation among policymakers, HCPs, researchers, and health-related companies worldwide. Within the research presented in this thesis, the research team – from WeLL, affiliated with the Leiden University Medical Center, and Faculty of Nursing and Health, Zhengzhou University, Faculty of Nursing and Health, Henan University, and Henan Provincial People's Hospital – shared insights and knowledge in the field of tailoring a SMI tackling CLD. From our experience, the collaborative effort can promote the tailoring and implementation of a SMI at an international level. Specifically, with the guidance and supervision of an experienced research group in the Netherlands, Chinese HCPs implement the SMI developed and tested in the Netherlands, which

can facilitate the widespread use of proven-effective SMIs. At the same time, Chinese researchers and HCPs can benefit from international networks and receive professional research and clinical training from high-income countries. Future cooperation between WeLL and Chinese stakeholders on the development and implementation of SMI tackling CLD will continue.

Conclusion

In conclusion, the high chronic disease burden of hypertension and CLD in China requires an urgent need to implement SMIs. This thesis mapped the four-step tailoring process – including the local context identification, selection of the SMI and mode of delivery, identification of the factors that influence the SMI implementation, and integration of SMI into the local context – before implementing the SMI into practice. Tailoring the SMI implementation was recommended to help reduce the implementation failure and optimize local resources' use. Ultimately, the tailored SMI aims to improve health outcomes and reduce the disease burden. It is plausible that the tailoring process could also be generalized to other chronic diseases, such as hypertension.

References

1. Lewington S, Lacey B, Clarke R, et al. The Burden of Hypertension and Associated Risk for Cardiovascular Mortality in China. *Jama Internal Medicine* 2016; **176**(4): 524-32.
2. He J, Gu D, Chen J, et al. Premature deaths attributable to blood pressure in China: a prospective cohort study. *Lancet* 2009; **374**(9703): 1765-72.
3. Liu P, Li Y, Zhang YX, Mesbah SE, Ji T, Ma LN. Frailty and hypertension in older adults: current understanding and future perspectives. *Hypertension Research* 2020; **43**(12): 1352-60.
4. Gobbens RJJ, Luijkx KG, Wijnen-Sponselee MT, Schols J. In Search of an Integral Conceptual Definition of Frailty: Opinions of Experts. *Journal of the American Medical Directors Association* 2010; **11**(5): 338-43.
5. Jiao J, Guo N, Xie LL, et al. Association between Frailty and 90-Day Outcomes amongst the Chinese Population: A Hospital-Based Multicentre Cohort Study. *Gerontology*.
6. Wang S, Gong W, Tian Y. Voluntary pulmonary function screening identifies high rates of undiagnosed asymptomatic chronic obstructive pulmonary disease. *Chron Respir Dis* 2016; **13**(2): 137-43.
7. Wang C, Xu JY, Yang L, et al. Prevalence and risk factors of chronic obstructive pulmonary disease in China (the China Pulmonary Health CPH study): a national cross-sectional study. *Lancet* 2018; **391**(10131): 1706-17.
8. Huang KW, Yang T, Xu JY, et al. Prevalence, risk factors, and management of asthma in China: a national cross-sectional study. *Lancet* 2019; **394**(10196): 407-18.
9. Washington Uo. Global Health Data Results Tool. http://ghdx. (accessed February 24 2022).
10. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2015; **386**(9995): 743-800.
11. He J, Gu D, Wu X, et al. Major causes of death among men and women in China. *N Engl J Med* 2005; **353**(11): 1124-34.
12. Zhu BF, Wang YF, Ming J, Chen W, Zhang LY. Disease burden of COPD in China: a systematic review. *International Journal of Chronic Obstructive Pulmonary Disease* 2018; **13**: 1353-64.
13. Cai L, Cui WL, He JH, Wu XN. The economic burden of smoking and secondhand smoke exposure in rural South-West China. *Journal of Asthma* 2014; **51**(5): 515-21.
14. Pavord ID, Jones PW, Burgel PR, Rabe KF. Exacerbations of COPD. *Int J Chron Obstruct Pulmon Dis* 2016; **11 Spec Iss**(Spec Iss): 21-30.

15. Song X, Zhang W, Hallensleben C, et al. Associations Between Obesity and Multidimensional Frailty in Older Chinese People with Hypertension. *Clin Interv Aging* 2020; **15**: 811-20.

16. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci* 2009; **4**: 50.

17. Lorig KR, Holman H. Self-management education: history, definition, outcomes, and mechanisms. *Ann Behav Med* 2003; **26**(1): 1-7.

18. Richard AA, Shea K. Delineation of Self-Care and Associated Concepts. *Journal of Nursing Scholarship* 2011; **43**(3): 255-64.

19. Audulv A, Norbergh, K.-G., Asplund, K., Hornsten, A. An ongoing process of inner negotiation–a Grounded Theory study of self-management among people living with chronic illness. *J Nurs Healthc Chronic Illn* 2009; **1**: 283–93.

20. Miller WR, Lasiter S, Ellis RB, Buelow JM. Chronic disease self-management: A hybrid concept analysis. *Nursing Outlook* 2015; **63**(2): 154-61.

21. Wagner EH, Austin BT, Von Korff M. Organizing care for patients with chronic illness. *Milbank Q* 1996; **74**(4): 511-44.

22. Newman S, Steed L, Mulligan K. Self-management interventions for chronic illness. *Lancet* 2004; **364**(9444): 1523-37.

23. Bartlett SJ, Lambert SD, McCusker J, et al. Self-management across chronic diseases: Targeting education and support needs. *Patient Education and Counseling* 2020; **103**(2): 398-404.

24. Eysenbach G. What is e-health? *J Med Internet Res* 2001; **3**(2): E20.

25. Erbe D, Eichert HC, Riper H, Ebert DD. Blending Face-to-Face and Internet-Based Interventions for the Treatment of Mental Disorders in Adults: Systematic Review. *Journal of medical Internet research* 2017; **19**(9).

26. McGowan PT. Self-Management Education and Support in Chronic Disease Management. *Primary Care* 2012; **39**(2): 307-+.

27. Song XY, Hallensleben C, Zhang WH, et al. Blended Self-Management Interventions to Reduce Disease Burden in Patients With Chronic Obstructive Pulmonary Disease and Asthma: Systematic Review and Meta-analysis. *Journal of Medical Internet Research* 2021; **23**(3).

28. Barbanel D, Eldridge S, Griffiths C. Can a self-management programme delivered by a community pharmacist improve asthma control? A randomised trial. *Thorax* 2003; **58**(10): 851-4.

29. Garcia-Aymerich J, Hernandez C, Alonso A, et al. Effects of an integrated care intervention on risk factors of COPD readmission. *Respir Med* 2007; **101**(7): 1462-9.

30. Peytremann-Bridevaux I, Staeger P, Bridevaux PO, Ghali WA, Burnand B. Effectiveness of chronic obstructive pulmonary disease-management programs: Systematic review and meta-analysis. *American Journal of Medicine* 2008; **121**(5): 433-U125.

31. Cao WD, Milks MW, Liu XF, et al. mHealth Interventions for Self-management of Hypertension: Framework and Systematic Review on Engagement, Interactivity, and Tailoring. *Jmir Mhealth and Uhealth* 2022; **10**(3).

32. Innab A, Kerari A. Impact of Behavioral Interventions on Patient Activation in Adults with Hypertension: A Systematic Review and Meta-Analysis. *Inquiry-the Journal of Health Care Organization Provision and Financing* 2022; **59**.

33. Cao Y, Lin SH, Zhu D, et al. WeChat Public Account Use Improves Clinical Control of Cough-Variant Asthma: A Randomized Controlled Trial. *Medical Science Monitor* 2018; **24**: 1524-32.

34. Yang SN, Ko HK, Hsiao YH, et al. Long-acting muscarinic antagonist versus long-acting β2 agonist/corticosteroid for moderate to severe chronic obstructive pulmonary disease patients: Exacerbation risk assessment. *J Chin Med Assoc* 2019; **82**(6): 488-94.

35. Zhang S, King D, Rosen VM, Ismaila AS. Impact of Single Combination Inhaler versus Multiple Inhalers to Deliver the Same Medications for Patients with Asthma or COPD: A Systematic Literature Review. *Int J Chron Obstruct Pulmon Dis* 2020; **15**: 417-38.

36. FitzGerald JM, Al Efraij K. Asthma in low-income and middle-income countries: an urgent call to action. *Thorax* 2018; **73**(10): 898-9.

37. Halpin DMG, Celli BR, Criner GJ, et al. It is time for the world to take COPD seriously: a statement from the GOLD board of directors. *European Respiratory Journal* 2019; **54**(1).

38. Soriano JB, Kendrick PJ, Paulson KR, Gupta V, Vos T, Collaborators GBDCRD. Prevalence and attributable health burden of chronic respiratory diseases, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet Respiratory Medicine* 2020; **8**(6): 585-96.

39. Guan WJ, Ran PX, Zhong NS. Prevention and management of COPD in China: successes and major challenges. *Lancet Respiratory Medicine* 2016; **4**(6): 428-30.

40. Lin J, Xing B, Tang H, et al. Hospitalization Due to Asthma Exacerbation: A China Asthma Research Network (CARN) Retrospective Study in 29 Provinces Across Mainland China. *Allergy Asthma Immunol Res* 2020; **12**(3): 485-95.

41. Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. *Bmj-British Medical Journal* 2013; **347**.

42. Daivadanam M, Ingram M, Sidney Annerstedt K, et al. The role of context in implementation research for non-communicable diseases: Answering the 'how-to' dilemma. *PLoS One* 2019; **14**(4): e0214454.

43. Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. *Implementation Science* 2013; **8**.

44. May CR, Johnson M, Finch T. Implementation, context and complexity. *Implement Sci* 2016; **11**(1): 141.

45. Sarkies MN, Francis-Auton E, Long JC, Pomare C, Hardwick R, Braithwaite J. Making implementation science more real. *BMC Med Res Methodol* 2022; **22**(1): 178.

46. Nilsen P, Bernhardsson S. Context matters in implementation science: a scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. *BMC Health Serv Res* 2019; **19**(1): 189.

47. Pfadenhauer LM, Mozygemba K, Gerhardus A, et al. Context and implementation: A concept analysis towards conceptual maturity. *Z Evid Fortbild Qual Gesundhwes* 2015; **109**(2): 103-14.

48. Fan VS, Gaziano JM, Lew R, et al. A Comprehensive Care Management Program to Prevent Chronic Obstructive Pulmonary Disease Hospitalizations A Randomized, Controlled Trial. *Annals of Internal Medicine* 2012; **156**(10): 673-U46.

49. Trappenburg J, Jonkman N, Jaarsma T, et al. Self-management: One size does not fit all. *Patient Education and Counseling* 2013; **92**(1): 134-7.

50. Huang YC, Garcia AA. Culturally-tailored interventions for chronic disease self-management among Chinese Americans: a systematic review. *Ethnicity & Health* 2020; **25**(3): 465-84.

51. Hallensleben C, Meijer E, Biewenga J, et al. REducing Delay through edUcation on eXacerbations (REDUX) in patients with COPD: a pilot study. *Clinical eHealth* 2020; **3**: 63-8.

52. Yadav UN, Hosseinzadeh H, Baral KP. Self-management and patient activation in COPD patients: An evidence summary of randomized controlled trials. *Clinical Epidemiology and Global Health* 2018; **6**(3): 148-54.

53. Bourbeau J, Saad N, Joubert A, et al. Making collaborative self-management successful in COPD patients with high disease burden. *Respiratory Medicine* 2013; **107**(7): 1061-5.

54. Stolz D, Mkorombindo T, Schumann DM, et al. Towards the elimination of chronic obstructive pulmonary disease: a Lancet Commission. *The Lancet* 2022; **400**(10356): 921-72.

55. Baker R, Camosso-Stefinovic J, Gillies C, et al. Tailored interventions to address determinants of practice. *Cochrane Database of Systematic Reviews* 2015; (4).

56. Wensing M. The Tailored Implementation in Chronic Diseases (TICD) project: introduction and main findings. *Implementation Science* 2017; **12**.

57. Berwick DM. Disseminating innovations in health care. *Jama* 2003; **289**(15): 1969-75.

58. Brakema EA, van der Kleij R, Poot CC, et al. A systematic approach to context-mapping to prepare for health interventions: development and validation of the SETTING-tool in four countries. *Bmj Global Health* 2021; **6**(1).

59. Mathieson A, Grande G, Luker K. Strategies, facilitators and barriers to implementation of evidence-based practice in community nursing: a systematic mixed-studies review and qualitative synthesis. *Prim Health Care Res Dev* 2019; **20**: e6.

60. Fang XC, Wang XD, Bai CX. COPD in China The Burden and Importance of Proper Management. *Chest* 2011; **139**(4): 920-9.

61. Leventhal HMD, Nerenz D The common sense representation of illness danger. 1980: 7–30.

62. Tiemensma J, Gaab E, Voorhaar M, Asijee G, Kaptein AA. Illness perceptions and coping determine quality of life in COPD patients. *International journal of chronic obstructive pulmonary disease* 2016; **11**: 2001-7.

63. Kaptein AA, Scharloo M, Fischer MJ, et al. Illness perceptions and COPD: an emerging field for COPD patient management. *J Asthma* 2008; **45**(8): 625-9.

64. Kaptein AA, Tiemensma J, Broadbent E, Asijee GM, Voorhaar M. COPD depicted - patients drawing their lungs. *Int J Chron Obstruct Pulmon Dis* 2017; **12**: 3231-6.

65. Glattacker M, Heyduck K, Meffert C. [Development of a questionnaire to assess treatment representations in rehabilitation patients]. *Rehabilitation (Stuttg)* 2009; **48**(6): 345-53.

66. Leventhal H, Diefenbach M, Leventhal EA. ILLNESS COGNITION - USING COMMON-SENSE TO UNDERSTAND TREATMENT ADHERENCE AND AFFECT COGNITION INTERACTIONS. *Cognitive Therapy and Research* 1992; **16**(2): 143-63.

67. Dempster M, Howell D, McCorry NK. Illness perceptions and coping in physical health conditions: A meta-analysis. *Journal of psychosomatic research* 2015; **79**(6): 506-13.

68. Hagger MS, Orbell S. A meta-analytic review of the common-sense model of illness representations. *Psychology & health* 2003; **18**(2): 141-84.

69. Nguyen TNM, Whitehead L, Saunders R, Dermody G. Systematic review of perception of barriers and facilitators to chronic disease self-management among older adults: Implications for evidence-based practice. *Worldviews on Evidence-Based Nursing* 2022; **19**(3): 191-200.

70. Joo JY, Liu MF. The Experience of Chronic Illness Transitional Care: A Qualitative Systematic Review. *Clinical Nursing Research* 2022; **31**(2): 163-73.

71. Dennett EJ, Janjua S, Stovold E, Harrison SL, McDonnell MJ, Holland AE. Tailored or adapted interventions for adults with chronic obstructive pulmonary disease and at least one other long-term condition: a mixed methods review. *Cochrane Database of Systematic Reviews* 2021; (7).

72. Jia C, Li S, Zhang C-m, et al. Development and practice of medical alliances for respiratory diseases in China. *Chinese Journal of Hospital Administration* 2019; **35**: 617-9.

73. Hallensleben C, van Luenen S, Rolink E, Ossebaard HC, Chavannes NH. eHealth for people with COPD in the Netherlands: a scoping review. *Int J Chron Obstruct Pulmon Dis* 2019; **14**: 1681-90.

74. Dineen-Griffin S, Garcia-Cardenas V, Williams K, Benrimoj SI. Helping patients help themselves: A systematic review of self-management support strategies in primary health care practice. *PLoS One* 2019; **14**(8): e0220116.

75. Chaudoir SR, Dugan AG, Barr CHI. Measuring factors affecting implementation of health innovations: a systematic review of structural, organizational, provider, patient, and innovation level measures. *Implementation Science* 2013; **8**.

76. Baines R, Tredinnick-Rowe J, Jones R, Chatterjee A. Barriers and Enablers in Implementing Electronic Consultations in Primary Care: Scoping Review. *Journal of Medical Internet Research* 2020; **22**(11).

77. Ariens LF, Schussler-Raymakers FM, Frima C, et al. Barriers and Facilitators to eHealth Use in Daily Practice: Perspectives of Patients and Professionals in Dermatology. *J Med Internet Res* 2017; **19**(9): e300.

78. Al-Subaihin AA, Sarro F, Black S, Capra L, Harman M. App Store Effects on Software Engineering Practices. *Ieee Transactions on Software Engineering* 2021; **47**(2): 300-19.

79. Ross J, Stevenson F, Lau R, Murray E. Factors that influence the implementation of e-health: a systematic review of systematic reviews (an update). *Implementation Science* 2016; **11**.

80. Chatzipavlou IA, Christoforidou SA, Vlachopoulou M. A recommended guideline for the development of mHealth Apps. *Mhealth* 2016; **2**: 21.

81. Eze E, Gleasure R, Heavin C. Mobile health solutions in developing countries: a stakeholder perspective. *Health Syst (Basingstoke)* 2018; **9**(3): 179-201.

82. Franco-Trigo L, Marques-Sanchez P, Tudball J, Benrimoj SI, Martinez-Martinez F, Sabater-Hernandez D. Collaborative health service planning: A stakeholder analysis with social network analysis to develop a community pharmacy service. *Research in Social & Administrative Pharmacy* 2020; **16**(2): 216-29.

83. McInnes E, Middleton S, Gardner G, et al. A qualitative study of stakeholder views of the conditions for and outcomes of successful clinical networks. *Bmc Health Services Research* 2012; **12**.

84. Taghizadeh S, Zarnag RK, Farhangi MA. Stakeholder analysis of childhood obesity prevention policies in Iran. *Arch Public Health* 2021; **79**(1): 36.

85. Franco-Trigo L, Fernandez-Llimos F, Martinez-Martinez F, Benrimoj SI, Sabater-Hernandez D. Stakeholder analysis in health innovation planning processes: A systematic scoping review. *Health Policy* 2020; **124**(10): 1083-99.

86. Li PY, Duan ZQ, Zhang ZW, He YZ, Li WM, Wen J. Impacts of government supervision on hospitalization costs for inpatients with COPD: An interrupted time series study. *Medicine* 2020; **99**(5).

87. Paolucci F, Mentzakis E, Defechereux T, Niessen LW. Equity and efficiency preferences of health policy makers in China-a stated preference analysis. *Health Policy and Planning* 2015; **30**(8): 1059-66.

88. Zou K, Li HY, Zhou D, Liao ZJ. The effects of diagnosis-related groups payment on hospital healthcare in China: a systematic review. *Bmc Health Services Research* 2020; **20**(1).

89. Philip NY, Rodrigues J, Wang HG, Fong SJ, Chen J. Internet of Things for In-Home Health Monitoring Systems: Current Advances, Challenges and Future Directions. *Ieee Journal on Selected Areas in Communications* 2021; **39**(2): 300-10.

90. Jones LK, Ladd IG, Gregor C, Evans MA, Graham J, Gionfriddo MR. Evaluating implementation outcomes (acceptability, adoption, and feasibility) of two initiatives to improve the medication prior authorization process. *Bmc Health Services Research* 2021; **21**(1).

91. Zhang MM, Yang YJ, Su D, Zhang T, Jiang XX, Li HP. A randomized controlled trial of a guided self-disclosure intervention to facilitate benefit finding in Chinese breast cancer patients: Study protocol. *Journal of Advanced Nursing* 2019; **75**(8): 1805-14.

92. Provoost S, Kleiboer A, Ornelas J, et al. Improving adherence to an online intervention for low mood with a virtual coach: study protocol of a pilot randomized controlled trial. *Trials* 2020; **21**(1).

93. Shen HX, Edwards H, Courtney M, McDowell J, Wu M. Peer-led diabetes self-management programme for community-dwelling older people in China: study protocol for a quasi-experimental design. *Journal of Advanced Nursing* 2012; **68**(12): 2766-77.

94. Tseng TJ, Chang ANM, Wu CJ. A randomized control trial of an asthma self-management program for adolescents in Taiwan: A study protocol. *Contemporary Clinical Trials Communications* 2017; **8**: 122-6.

95. Beck D, Been-Dahmen J, Peeters M, et al. A Nurse-Led Self-Management Support Intervention (ZENN) for Kidney Transplant Recipients Using Intervention Mapping: Protocol for a Mixed-Methods Feasibility Study. *Jmir Research Protocols* 2019; **8**(3).

96. Nohra RG, Sacre H, Salameh P, Rothan-Tondeur M. Evaluating the feasibility, acceptability and pre testing the impact of a self-management and tele monitoring program for chronic obstructive pulmonary disease patients in Lebanon Protocol for a feasibility study. *Medicine* 2020; **99**(6).

97. Book Reviews. *Journal for Nurses in Professional Development* 1994; **10**(3): 175-8.

98. van Teijlingen E, Hundley V. The importance of pilot studies. *Nurs Stand* 2002; **16**(40): 33-6.

99. Gilbert T, Neuburger J, Kraindler J, et al. Development and validation of a Hospital Frailty Risk Score focusing on older people in acute care settings using electronic hospital records: an observational study. *Lancet (London, England)* 2018; **391**(10132): 1775-82.

100. Bos AJG. Aging and frailty or frailty and aging? *Geriatrics & Gerontology International* 2016; **16**(7): 880-.

101. Chen XJ, Mao GX, Leng SX. Frailty syndrome: an overview. *Clinical interventions in aging* 2014; **9**: 433-41.

102. Aprahamian I, Sassaki E, Dos Santos MF, et al. Hypertension and frailty in older adults. *Journal of clinical hypertension (Greenwich, Conn)* 2018; **20**(1): 186-92.

103. Basile G, Catalano A, Mandraffino G, et al. Relationship between blood pressure and frailty in older hypertensive outpatients. *Aging clinical and experimental research* 2017; **29**(5): 1049-53.

104. Gobbens RJ, Luijkx KG, Wijnen-Sponselee MT, Schols JM. In search of an integral conceptual definition of frailty: opinions of experts. *Journal of the American Medical Directors Association* 2010; **11**(5): 338-43.

105. Schuurmans H, Steverink N, Lindenberg S, Frieswijk N, Slaets JPJ. Old or frail: What tells us more? *Journals of Gerontology Series a-Biological Sciences and Medical Sciences* 2004; **59**(9): 962-5.

106. Gobbens RJ, van Assen MA, Luijkx KG, Wijnen-Sponselee MT, Schols JM. The Tilburg Frailty Indicator: psychometric properties. *Journal of the American Medical Directors Association* 2010; **11**(5): 344-55.

107. Torlasco C, Faini A, Makil E, et al. Cardiovascular risk and hypertension control in Italy. Data from the 2015 World Hypertension Day. *International journal of cardiology* 2017; **243**: 529-32.

108. Su P, Ding H, Zhang W, et al. Joint Association of Obesity and Hypertension with Disability in the Elderly-- A Community-Based Study of Residents in Shanghai, China. *The journal of nutrition, health & aging* 2017; **21**(4): 362-9.

109. Walston J, McBurnie MA, Newman A, et al. Frailty and activation of the inflammation and coagulation systems with and without clinical comorbidities: results from the Cardiovascular Health Study. *Archives of internal medicine* 2002; **162**(20): 2333-41.

110. Bagshaw SM, Stelfox HT, Johnson JA, et al. Long-term association between frailty and health-related quality of life among survivors of critical illness: a prospective multicenter cohort study. *Critical care medicine* 2015; **43**(5): 973-82.

111. Gobbens RJ, van Assen MA. The prediction of quality of life by physical, psychological and social components of frailty in community-dwelling older people. *Quality of life research : an*

international journal of quality of life aspects of treatment, care and rehabilitation 2014; **23**(8): 2289-300.

112. Zamboni M, Mazzali G, Zoico E, et al. Health consequences of obesity in the elderly: a review of four unresolved questions. *International Journal of Obesity* 2005; **29**(9): 1011-29.

113. Hubbard RE, Lang IA, Llewellyn DJ, Rockwood K. Frailty, Body Mass Index, and Abdominal Obesity in Older People. *Journals of Gerontology Series a-Biological Sciences and Medical Sciences* 2010; **65**(4): 377-81.

114. Kalish VB. Obesity in Older Adults. *Primary Care* 2016; **43**(1): 137-+.

115. Oreopoulos A, Kalantar-Zadeh K, Sharma AM, Fonarow GC. The Obesity Paradox in the Elderly: Potential Mechanisms and Clinical Implications. *Clinics in Geriatric Medicine* 2009; **25**(4): 643-+.

116. Kalish VB. Obesity in Older Adults. *Primary Care* 2016; **43**(1): 137-44.

117. Goisser S, Kemmler W, Porzel S, et al. Sarcopenic obesity and complex interventions with nutrition and exercise in community-dwelling older persons - a narrative review. *Clinical interventions in aging* 2015; **10**.

118. Crow RS, Lohman MC, Titus AJ, et al. Association of Obesity and Frailty in Older Adults: NHANES 1999-2004. *Journal of Nutrition Health & Aging* 2019; **23**(2): 138-44.

119. Mezuk B, Lohman MC, Rock AK, Payne ME. Trajectories of Body Mass Indices and Development of Frailty: Evidence from the Health and Retirement Study. *Obesity* 2016; **24**(8): 1643-7.

120. Blaum CS, Xue QL, Michelon E, Semba RD, Fried LP. The association between obesity and the frailty syndrome in older women: The women's health and aging studies. *Journal of the American Geriatrics Society* 2005; **53**(6): 927-34.

121. Jeoung BJ, Lee YC. A Study of relationship between frailty and physical performance in elderly women. *Journal of exercise rehabilitation* 2015; **11**(4): 215-9.

122. Tucker JM, Tucker LA, Lecheminant J, Bailey B. Obesity increases risk of declining physical activity over time in women: a prospective cohort study. *Obesity (Silver Spring, Md)* 2013; **21**(12): E715-20.

123. Scott KM, Bruffaerts R, Simon GE, et al. Obesity and mental disorders in the general population: results from the world mental health surveys. *International Journal of Obesity* 2008; **32**(1): 192-200.

124. Chang HH, Yen ST. Association between obesity and depression: Evidence from a longitudinal sample of the elderly in Taiwan. *Aging & Mental Health* 2012; **16**(2): 173-80.

125. Dixon JB. The effect of obesity on health outcomes. *Molecular and Cellular Endocrinology* 2010; **316**(2): 104-8.

126. Kam ACS, Leung EKS, Chan PYB, Tong MCF. Cross-cultural adaptation and psychometric properties of the Chinese tinnitus functional index. *International journal of audiology* 2018; **57**(2): 91-7.

127. Pan WH, Yeh WT. How to define obesity? Evidence-based multiple action points for public awareness, screening, and treatment: an extension of Asian-Pacific recommendations. *Asia Pacific journal of clinical nutrition* 2008; **17**(3): 370-4.

128. Anuurad E, Shiwaku K, Nogi A, et al. The new BMI criteria for asians by the regional office for the western pacific region of WHO are suitable for screening of overweight to prevent metabolic syndrome in elder Japanese workers. *Journal of occupational health* 2003; **45**(6): 335-43.

129. Alberti KG, Zimmet P, Shaw J. The metabolic syndrome--a new worldwide definition. *Lancet (London, England)* 2005; **366**(9491): 1059-62.

130. Wang Y, Mi J, Shan XY, Wang QJ, Ge KY. Is China facing an obesity epidemic and the consequences? The trends in obesity and chronic disease in China. *International Journal of Obesity* 2007; **31**(1): 177-88.

131. Dong L, Liu N, Tian X, et al. Reliability and validity of the Tilburg Frailty Indicator (TFI) among Chinese community-dwelling older people. *Archives of gerontology and geriatrics* 2017; **73**: 21-8.

132. Biritwum RB, Minicuci N, Yawson AE, et al. Prevalence of and factors associated with frailty and disability in older adults from China, Ghana, India, Mexico, Russia and South Africa. *Maturitas* 2016; **91**: 8-18.

133. Hoogendijk EO, van Hout HP, Heymans MW, et al. Explaining the association between educational level and frailty in older adults: results from a 13-year longitudinal study in the Netherlands. *Annals of epidemiology* 2014; **24**(7): 538-44.e2.

134. Garcia-Esquinas E, Jose Garcia-Garcia F, Leon-Munoz LM, et al. Obesity, fat distribution, and risk of frailty in two population-based cohorts of older adults in Spain. *Obesity (Silver Spring, Md)* 2015; **23**(4): 847-55.

135. Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: Evidence for a phenotype. *Journals of Gerontology Series a-Biological Sciences and Medical Sciences* 2001; **56**(3): M146-M56.

136. Boutin E, Natella PA, Schott AM, et al. Interrelations between body mass index, frailty, and clinical adverse events in older community-dwelling women: The EPIDOS cohort study. *Clinical nutrition (Edinburgh, Scotland)* 2018; **37**(5): 1638-44.

137. Feng Z, Lugtenberg M, Franse C, et al. Risk factors and protective factors associated with incident or increase of frailty among community-dwelling older adults: A systematic review of longitudinal studies. *PloS one* 2017; **12**(6): e0178383.

138. Villareal DT, Apovian CM, Kushner RF, Klein S. Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. *American Journal of Clinical Nutrition* 2005; **82**(5): 923-34.

139. Chudiak A, Jankowska-Polanska B, Uchmanowicz I. Effect of frailty syndrome on treatment compliance in older hypertensive patients. *Clinical interventions in aging* 2017; **12**: 805-14.

140. Jankowska-Polanska B, Dudek K, Szymanska-Chabowska A, Uchmanowicz I. The influence of frailty syndrome on medication adherence among elderly patients with hypertension. *Clinical interventions in aging* 2016; **11**: 1781-90.

141. Cooper R, Hardy R, Bann D, et al. Body mass index from age 15 years onwards and muscle mass, strength, and quality in early old age: findings from the MRC National Survey of Health and Development. *The journals of gerontology Series A, Biological sciences and medical sciences* 2014; **69**(10): 1253-9.

142. Mlynarska A, Mlynarski R, Golba KS. Anxiety, age, education and activities of daily living as predictive factors of the occurrence of frailty syndrome in patients with heart rhythm disorders. *Aging & mental health* 2018; **22**(9): 1179-83.

143. Roberts RE, Deleger S, Strawbridge WJ, Kaplan GA. Prospective association between obesity and depression: evidence from the Alameda County Study. *International Journal of Obesity* 2003; **27**(4): 514-21.

144. Kojima G, Jivraj S, Iliffe S, Falcaro M, Liljas A, Walters K. Alcohol Consumption and Risk of Incident Frailty: The English Longitudinal Study of Aging. *Journal of the American Medical Directors Association* 2019; **20**(6): 725-9.

145. Kojima G, Liljas A, Iliffe S, Jivraj S, Walters K. A systematic review and meta-analysis of prospective associations between alcohol consumption and incident frailty. *Age and Ageing* 2018; **47**(1): 26-34.

146. Prat MS, Fernandez X, Ribo L, Palomera E, Papiol M, Serra P. Loss of appetite in elderly people in the community and its relationship with functional capacity. *Medicina Clinica* 2008; **130**(14): 531-3.

147. Soriano JB KP, Paulson KR, Gupta V, Vos T, Collaborators GBDCRD. Prevalence and attributable health burden of chronic respiratory diseases, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet Respir Med* 2020; **8**(6): 585-96.

148. Soriano JB, Abajobir AA, Abate KH, et al. Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Respiratory Medicine* 2017; **5**(9): 691-706.

149. Organization WH. Chronic obstructive pulmonary disease (COPD). *Geneva, Switzerland: WHO* 2015; **http: // www.who.int/respiratory/copd/en/ Accessed October** 2015.

150. Morrison D, Agur K, Mercer S, Eiras A, Gonzalez-Montalvo JI, Gruffydd-Jones K. Managing multimorbidity in primary care in patients with chronic respiratory conditions. *NPJ primary care respiratory medicine* 2016; **26**: 16043.

151. Mannino DM, Buist AS. Global burden of COPD: risk factors, prevalence, and future trends. *Lancet* 2007; **370**(9589): 765-73.

152. Braman SS. The global burden of asthma. *Chest* 2006; **130**(1 Suppl): 4s-12s.

153. Effing TW, Vercoulen JH, Bourbeau J, et al. Definition of a COPD self-management intervention: International Expert Group consensus. *Eur Respir J* 2016; **48**(1): 46-54.

154. Lorig KR, Holman HR. Self-management education: History, definition, outcomes, and mechanisms. *Ann Behav Med* 2003; **26**(1): 1-7.

155. Jonkman NH, Schuurmans MJ, Groenwold RHH, Hoes AW, Trappenburg JCA. Identifying components of self-management interventions that improve health-related quality of life in chronically ill patients: Systematic review and meta-regression analysis. *Patient Education and Counseling* 2016; **99**(7): 1087-98.

156. Wang L, Martensson J, Zhao Y, Nygardh A. Experiences of a health coaching self-management program in patients with COPD: a qualitative content analysis. *International journal of chronic obstructive pulmonary disease* 2018; **13**: 1527-36.

157. Hosseinzadeh H, Shnaigat M. Effectiveness of chronic obstructive pulmonary disease self-management interventions in primary care settings: a systematic review. *Australian Journal of Primary Health* 2019; **25**(3): 195-204.

158. Morrison D, Mair FS, Yardley L, Kirby S, Thomas M. Living with asthma and chronic obstructive airways disease: Using technology to support self-management - An overview. *Chronic respiratory disease* 2017; **14**(4): 407-19.

159. Baumel A, Kane JM. Examining Predictors of Real-World User Engagement with Self-Guided eHealth Interventions: Analysis of Mobile Apps and Websites Using a Novel Dataset. *Journal of medical Internet research* 2018; **20**(12).

160. Elbert NJ, van Os-Medendorp H, van Renselaar W, et al. Effectiveness and cost-effectiveness of ehealth interventions in somatic diseases: a systematic review of systematic reviews and meta-analyses. *Journal of medical Internet research* 2014; **16**(4): e110.

161. McLean S, Nurmatov U, Liu JLY, Pagliari C, Car J, Sheikh A. Telehealthcare for chronic obstructive pulmonary disease: Cochrane Review and meta-analysis. *British Journal of General Practice* 2012; **62**(604).

162. Minatodani DE, Chao PJ, Berman SJ. Home telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association* 2013; **19**(8): 573-8.

163. Ariens LFM, Schussler-Raymakers FML, Frima C, et al. Barriers and Facilitators to eHealth Use in Daily Practice: Perspectives of Patients and Professionals in Dermatology. *Journal of Medical Internet Research* 2017; **19**(9).

164. Kloek C, Bossen D, de Bakker DH, Veenhof C, Dekker J. Blended Interventions to Change Behavior in Patients With Chronic Somatic Disorders: Systematic Review. *Journal of medical Internet research* 2017; **19**(12): e418.

165. Erbe D, Eichert HC, Riper H, Ebert DD. Blending Face-to-Face and Internet-Based Interventions for the Treatment of Mental Disorders in Adults: Systematic Review. *Journal of medical Internet research* 2017; **19**(9): e306.

166. Koff PB, Jones RH, Cashman JM, Voelkel NF, Vandivier RW. Proactive integrated care improves quality of life in patients with COPD. *European Respiratory Journal* 2009; **33**(5): 1031-8.

167. van der Meer V, Bakker MJ, van den Hout WB, et al. Internet-based self-management plus education compared with usual care in asthma: a randomized trial. *Annals of internal medicine* 2009; **151**(2): 110-20.

168. Moher D, Liberati A, Tetzlaff J, Altman DG, Grp P. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *International Journal of Surgery* 2010; **8**(5): 336-41.

169. Frandsen TF, Bruun Nielsen MF, Lindhardt CL, Eriksen MB. Using the full PICO model as a search tool for systematic reviews resulted in lower recall for some PICO elements. *J Clin Epidemiol* 2020; **127**: 69-75.

170. Cohen J. A power primer. *Psychol Bull* 1992; **112**(1): 155-9.

171. Mirza S, Clay RD, Koslow MA, Scanlon PD. COPD Guidelines: A Review of the 2018 GOLD Report. *Mayo Clinic Proceedings* 2018; **93**(10): 1488-502.

172. Chaet AV, Morshedi B, Wells KJ, Barnes LE, Valdez R. Spanish-Language Consumer Health Information Technology Interventions: A Systematic Review. *Journal of medical Internet research* 2016; **18**(8): e214.

173. Gillick MR. The critical role of caregivers in achieving patient-centered care. *JAMA* 2013; **310**(6): 575-6.

174. Noordman J, van der Weijden T, van Dulmen S. Communication-related behavior change techniques used in face-to-face lifestyle interventions in primary care: A systematic review of the literature. *Patient Education and Counseling* 2012; **89**(2): 227-44.

175. Higgins JPT, Altman DG, Gotzsche PC, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *Bmj-British Medical Journal* 2011; **343**.

176. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: what is "quality of evidence" and why is it important to clinicians? *Bmj-British Medical Journal* 2008; **336**(7651): 995-9B.

177. Balshem H, Helfand M, Schunemann HJ, et al. GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol* 2011; **64**(4): 401-6.

178. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Medica* 2012; **22**(3): 276-82.

179. Lang TA SM. How to report statistics in medicine. Philadelphia: American College of Physicians; 1997.

180. Romeo A, Edney S, Plotnikoff R, et al. Can Smartphone Apps Increase Physical Activity? Systematic Review and Meta-Analysis. *Journal of medical Internet research* 2019; **21**(3).

181. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *Bmj* 1997; **315**(7109): 629-34.

182. DerSimonian R, Laird N. Meta-analysis in clinical trials revisited. *Contemp Clin Trials* 2015; **45**(Pt A): 139-45.

183. Higgins JPT GS. Cochrane Handbook for Systematic Reviews of Interventions. 2018.

184. Higgins JPT TJ, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, editors. . Cochrane Handbook for Systematic Reviews of Interventions. 2nd Edition. ; 2019.

185. Viechtbauer W, Cheung MW. Outlier and influence diagnostics for meta-analysis. *Res Synth Methods* 2010; **1**(2): 112-25.

186. Wallace BC, Schmid CH, Lau J, Trikalinos TA. Meta-Analyst: software for meta-analysis of binary, continuous and diagnostic data. *Bmc Medical Research Methodology* 2009; **9**.

187. Bentley CL, Mountain GA, Thompson J, et al. A pilot randomised controlled trial of a Telehealth intervention in patients with chronic obstructive pulmonary disease: challenges of clinician-led data collection. *Trials* 2014; **15**: 313.

188. Cameron-Tucker HL, Wood-Baker R, Joseph L, Walters JA, Schuz N, Walters EH. A randomized controlled trial of telephone-mentoring with home-based walking preceding rehabilitation in COPD. *International journal of chronic obstructive pulmonary disease* 2016; **11**: 1991-2000.

189. Casas A, Troosters T, Garcia-Aymerich J, et al. Integrated care prevents hospitalisations for exacerbations in COPD patients. *Eur Respir J* 2006; **28**(1): 123-30.

190. Chau JPC, Lee DTF, Yu DSF, et al. A feasibility study to investigate the acceptability and potential effectiveness of a telecare service for older people with chronic obstructive pulmonary disease. *International journal of medical informatics* 2012; **81**(10): 674-82.

191. Haesum LKE, Ehlers LH, Hejlesen OK. The long-term effects of using telehomecare technology on functional health literacy: results from a randomized trial. *Public health* 2017; **150**: 43-50.

192. Jehn M, Donaldson G, Kiran B, et al. Tele-monitoring reduces exacerbation of COPD in the context of climate change--a randomized controlled trial. *Environmental health : a global access science source* 2013; **12**: 99.

193. Nguyen HQ, Donesky-Cuenco D, Wolpin S, et al. Randomized controlled trial of an internet-based versus face-to-face dyspnea self-management program for patients with chronic obstructive pulmonary disease: pilot study. *Journal of medical Internet research* 2008; **10**(2): e9.

194. Sorknaes AD, Bech M, Madsen H, et al. The effect of real-time teleconsultations between hospital-based nurses and patients with severe COPD discharged after an exacerbation. *J Telemed Telecare* 2013; **19**(8): 466-74.

195. Stamenova V, Liang K, Yang R, et al. Technology-Enabled Self-Management of Chronic Obstructive Pulmonary Disease With or Without Asynchronous Remote Monitoring: Randomized Controlled Trial. *Journal of medical Internet research* 2020; **22**(7).

196. Wang L, He L, Tao Y, et al. Evaluating a Web-Based Coaching Program Using Electronic Health Records for Patients With Chronic Obstructive Pulmonary Disease in China: Randomized Controlled Trial. *Journal of medical Internet research* 2017; **19**(7): e264.

197. Wang LH, Guo YM, Wang ML, Zhao Y. A mobile health application to support self-management in patients with chronic obstructive pulmonary disease: a randomised controlled trial. *Clinical rehabilitation* 2020.

198. Wei L, Yang XY, Li J, et al. Effect of pharmaceutical care on medication adherence and hospital admission in patients with chronic obstructive pulmonary disease (COPD): a randomized controlled study. *Journal of Thoracic Disease* 2014; **6**(6): 656-62.

199. Xin CW, Xia ZN, Jiang C, Lin MM, Li GH. The impact of pharmacist-managed clinic on medication adherence and health-related quality of life in patients with COPD: a randomized controlled study. *Patient Prefer Adherence* 2016; **10**: 7.

200. Cao Y, Lin SH, Zhu D, et al. WeChat Public Account Use Improves Clinical Control of Cough-Variant Asthma: A Randomized Controlled Trial. *Medical science monitor : international medical journal of experimental and clinical research* 2018; **24**: 1524-32.

201. Kohler B, Kellerer C, Schultz K, et al. An Internet-Based Asthma Self-Management Program Increases Knowledge About Asthma Results of a Randomized Controlled Trial. *Deutsches Arzteblatt international* 2020; **117**(5): 64-+.

202. Ostojic V, Cvoriscec B, Ostojic SB, Reznikoff D, Stipic-Markovic A, Tudjman Z. Improving asthma control through telemedicine: A study of short-message service. *Telemedicine Journal and e-Health* 2005; **11**(1): 28-35.

203. Türk Y, Theel W, van Huisstede A, et al. Short-term and long-term effect of a high-intensity pulmonary rehabilitation programme in obese patients with asthma: a randomised controlled trial. *Eur Respir J* 2020; **56**(1).

204. van Gaalen JL, Beerthuizen T, van der Meer V, et al. Long-term outcomes of internet-based self-management support in adults with asthma: randomized controlled trial. *Journal of medical Internet research* 2013; **15**(9): e188.

205. Sundberg R, Tunsater A, Palmqvist M, Ellbjar S, Lowhagen O, Toren K. A randomized controlled study of a computerized limited education program among young adults with asthma. *Respiratory medicine* 2005; **99**(3): 321-8.

206. Lundell S, Holmner A, Rehn B, Nyberg A, Wadell K. Telehealthcare in COPD: a systematic review and meta-analysis on physical outcomes and dyspnea. *Respiratory medicine* 2015; **109**(1): 11-26.

207. Cannon D, Buys N, Sriram KB, Sharma S, Morris N, Sun J. The effects of chronic obstructive pulmonary disease self-management interventions on improvement of quality of life in COPD patients: A meta-analysis. *Respiratory medicine* 2016; **121**: 81-90.

208. Long H, Howells K, Peters S, Blakemore A. Does health coaching improve health-related quality of life and reduce hospital admissions in people with chronic obstructive pulmonary disease? A systematic review and meta-analysis. *Br J Health Psychol* 2019; **24**(3): 515-46.

209. Ridwan ES, Hadi H, Wu YL, Tsai PS. Effects of Transitional Care on Hospital Readmission and Mortality Rate in Subjects With COPD: A Systematic Review and Meta-Analysis. *Respir Care* 2019; **64**(9): 1146-56.

210. Simonelli C, Vitacca M, Vignoni M, Ambrosino N, Paneroni M. Effectiveness of manual therapy in COPD: A systematic review of randomised controlled trials. *Pulmonology* 2019; **25**(4): 236-47.

211. Sul AR, Lyu DH, Park DA. Effectiveness of telemonitoring versus usual care for chronic obstructive pulmonary disease: A systematic review and meta-analysis. *J Telemed Telecare* 2020; **26**(4): 189-99.

212. Jonkman NH, Westland H, Trappenburg JC, et al. Characteristics of effective self-management interventions in patients with COPD: individual patient data meta-analysis. *European respiratory journal* 2016; **48**(1): 55-68.

213. Hofstede J, de Bie J, van Wijngaarden B, Heijmans M. Knowledge, use and attitude toward eHealth among patients with chronic lung diseases. *International journal of medical informatics* 2014; **83**(12): 967-74.

214. Mubarak N, Hatah E, Khan TM, Zin CS. A systematic review and meta-analysis of the impact of collaborative practice between community pharmacist and general practitioner on asthma management. *Journal of asthma and allergy* 2019; **12**: 109-53.

215. Chongmelaxme B, Lee S, Dhippayom T, Saokaew S, Chaiyakunapruk N, Dilokthornsakul P. The Effects of Telemedicine on Asthma Control and Patients' Quality of Life in Adults: A Systematic Review and Meta-analysis. *Journal of Allergy and Clinical Immunology-in Practice* 2019; **7**(1): 199-+.

216. Baishnab E, Karner C. Primary care based clinics for asthma. *Cochrane Database of Systematic Reviews* 2012; (4).

217. Hansen ESH, Pitzner-Fabricius A, Toennesen LL, et al. Effect of aerobic exercise training on asthma in adults: a systematic review and meta-analysis. *European Respiratory Journal* 2020; **56**(1).

218. Guyatt GH, Oxman AD, Kunz R, et al. GRADE guidelines: 7. Rating the quality of evidence-inconsistency. *J Clin Epidemiol* 2011; **64**(12): 1294-302.

219. Wang G, Wang F, Gibson PG, et al. Severe and uncontrolled asthma in China: a cross-sectional survey from the Australasian Severe Asthma Network. *Journal of Thoracic Disease* 2017; **9**(5): 1333-44.

220. Newham JJ, Presseau J, Heslop-Marshall K, et al. Features of self-management interventions for people with COPD associated with improved health-related quality of life and reduced emergency department visits: a systematic review and meta-analysis. *International journal of chronic obstructive pulmonary disease* 2017; **12**: 1705-20.

221. Lin JT, Xing B, Tang HP, et al. Hospitalization Due to Asthma Exacerbation: A China Asthma Research Network (CARN) Retrospective Study in 29 Provinces Across Mainland China. *Allergy Asthma & Immunology Research* 2020; **12**(3): 485-95.

222. Yang H, Wang HJ, Du LY, Wang Y, Wang XJ, Zhang RM. Disease knowledge and self-management behavior of COPD patients in China. *Medicine* 2019; **98**(8).

223. Song X, Hallensleben C, Zhang W, et al. Blended Self-Management Interventions to Reduce Disease Burden in Patients With Chronic Obstructive Pulmonary Disease and Asthma: Systematic Review and Meta-analysis. *J Med Internet Res* 2021; **23**(3): e24602.

224. Brakema EA, van der Kleij R, Poot CC, et al. Mapping low-resource contexts to prepare for lung health interventions in four countries (FRESH AIR): a mixed-method study. *Lancet Global Health* 2022; **10**(1): E57-E70.

225. Wong SSL, Abdullah N, Abdullah A, et al. Unmet needs of patients with chronic obstructive pulmonary disease (COPD): a qualitative study on patients and doctors. *BMC family practice* 2014; **15**.
226. Brakema EA, van der Kleij R, Poot CC, et al. Mapping low-resource contexts to prepare for lung health interventions in four countries (FRESH AIR): a mixed-method study. *Lancet Glob Health* 2022; **10**(1): e63-e76.
227. Rivera E, Corte C, Steffen A, DeVon HA, Collins EG, McCabe PJ. Illness Representation and Self-Care Ability in Older Adults with Chronic Disease. *Geriatrics (Basel, Switzerland)* 2018; **3**(3).
228. Achstetter LI, Schultz K, Faller H, Schuler M. Leventhal's common-sense model and asthma control: Do illness representations predict success of an asthma rehabilitation? *Journal of health psychology* 2019; **24**(3): 327-36.
229. Hallensleben C, Meijer E, Biewenga J, et al. REducing Delay through edUcation on eXacerbations (REDUX) in patients with COPD: a pilot study. *Clinical eHealth* 2020; **3**: 63-8.
230. Szekendi MK, Vaughn J, Lal A, Ouchi K, Williams MV. The Prevalence of Inpatients at 33 U.S. Hospitals Appropriate for and Receiving Referral to Palliative Care. *J Palliat Med* 2016; **19**(4): 360-72.
231. Sandelowski M. Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Res Nurs Health* 2000; **23**(3): 246-55.
232. Koo HK, Park SW, Park JW, et al. Chronic cough as a novel phenotype of chronic obstructive pulmonary disease. *Int J Chron Obstruct Pulmon Dis* 2018; **13**: 1793-801.
233. Saunders B, Sim J, Kingstone T, et al. Saturation in qualitative research: exploring its conceptualization and operationalization. *Qual Quant* 2018; **52**(4): 1893-907.
234. Broadbent E, Petrie KJ, Main J, Weinman J. The Brief Illness Perception Questionnaire. *Journal of Psychosomatic Research* 2006; **60**(6): 631-7.
235. Lin YC, KM. Wang, TJ. Reliability and validity of the Chinese version of the brief illness perception questionnaire for patients with coronary heart disease. *J Orient Inst Technol* 2011; **2**(31): 145–55.
236. Meijer E, Gebhardt WA, Dijkstra A, Willemsen MC, Van Laar C. Quitting smoking: The importance of non-smoker identity in predicting smoking behaviour and responses to a smoking ban. *Psychology & health* 2015; **30**(12): 1387-409.
237. Meijer E, Van den Putte B, Gebhardt WA, et al. A longitudinal study into the reciprocal effects of identities and smoking behaviour: Findings from the. ITC Netherlands Survey. *Social Science & Medicine* 2018; **200**: 249-57.

238. Salinas GD, Williamson JC, Kalhan R, et al. Barriers to adherence to chronic obstructive pulmonary disease guidelines by primary care physicians. *International journal of chronic obstructive pulmonary disease* 2011; **6**: 171-9.

239. Gale NK, Heath G, Cameron E, Rashid S, Redwood S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *Bmc Medical Research Methodology* 2013; **13**.

240. Zhan ZY, Tian Q, Chen TT, et al. Temperature Variability and Hospital Admissions for Chronic Obstructive Pulmonary Disease: Analysis of Attributable Disease Burden and Vulnerable Subpopulation. *International journal of chronic obstructive pulmonary disease* 2020; **15**: 2225-35.

241. Wang J, Feng ZC, Dong ZX, et al. Does Having a Usual Primary Care Provider Reduce Polypharmacy Behaviors of Patients With Chronic Disease? A Retrospective Study in Hubei Province, China. *Frontiers in Pharmacology* 2022; **12**.

242. Liu Y, Zhong L, Yuan S, van de Klundert J. Why patients prefer high-level healthcare facilities: a qualitative study using focus groups in rural and urban China. *BMJ Glob Health* 2018; **3**(5): e000854.

243. Hurst JR, Buist AS, Gaga M, et al. Challenges in the Implementation of Chronic Obstructive Pulmonary Disease Guidelines in Low- and Middle-Income Countries An Official American Thoracic Society Workshop Report. *Annals of the American Thoracic Society* 2021; **18**(8): 1269-77.

244. Sigurgeirsdottir J, Halldorsdottir S, Arnardottir RH, Gudmundsson G, Bjornsson EH. Frustrated Caring: Family Members' Experience of Motivating COPD Patients Towards Self-Management. *International journal of chronic obstructive pulmonary disease* 2020; **15**: 2953-65.

245. Singh S, Surani S, McGuinness S, Eudicone J, Gilbert I, Subramanian S. Current practice patterns, challenges, and educational needs of asthma care providers in the United States. *Journal of Asthma* 2021; **58**(8): 1118-27.

246. Li P, Duan Z, Zhang Z, He Y, Li W, Jin W. Impacts of government supervision on hospitalization costs for inpatients with COPD: An interrupted time series study. *Medicine (Baltimore)* 2020; **99**(5): e18977.

247. Syamlal G, Bhattacharya A, Dodd KE. Medical Expenditures Attributed to Asthma and Chronic Obstructive Pulmonary Disease Among Workers - United States, 2011-2015. *Mmwr-Morbidity and Mortality Weekly Report* 2020; **69**(26): 809-14.

248. Wallace AE, Kaila S, Bayer V, et al. Health Care Resource Utilization and Exacerbation Rates in Patients with COPD Stratified by Disease Severity in a Commercially Insured Population. *Journal of Managed Care & Specialty Pharmacy* 2019; **25**(2): 205-17.

249. Wilkinson TMA, Donaldson GC, Hurst JR, Seemungal TAR, Wedzicha JA. Early therapy improves of chronic obstructive outcomes of exacerbations pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 2004; **169**(12): 1298-303.

250. Brakema EA, van der Kleij RM, Poot CC, et al. A systematic approach to context-mapping to prepare for health interventions: development and validation of the SETTING-tool in four countries. *BMJ Glob Health* 2021; **6**(1).

251. Chaudoir SR, Dugan AG, Barr CH. Measuring factors affecting implementation of health innovations: a systematic review of structural, organizational, provider, patient, and innovation level measures. *Implement Sci* 2013 **8**: 22.

252. Schmeer K. Stakeholder Analysis Guidelines 1999. https:// www. who. int/ workforcealliance/ knowledge/ toolkit/ 33. pdf.

253. Liu Y, Zhong LW, Yuan SS, van de Klundert J. Why patients prefer high-level healthcare facilities: a qualitative study using focus groups in rural and urban China. *Bmj Global Health* 2018; **3**(5).

254. Committee NHaFP. Statistical yearbook for health and family planning in China; 2017.

255. Jiang YS, Ying XH, Zhang Q, et al. Managing patient complaints in China: a qualitative study in Shanghai. *Bmj Open* 2014; **4**(8).

256. Chen YW, Ni J, Yu DG. Application developers' product offering strategies in multi-platform markets. *European Journal of Operational Research* 2019; **273**(1): 320-33.

257. Ilioudis C, Pangalos G. Development of an Internet Security Policy for health care establishments. *Medical Informatics and the Internet in Medicine* 2000; **25**(4): 265-73.

258. Galba T, Solic K, Lukic I. An Information Security and Privacy Self-Assessment (ISPSA) Tool for Internet Users. *Acta Polytechnica Hungarica* 2015; **12**(7): 149-62.

259. Fusch PI, Ness LR. Are We There Yet? Data Saturation in Qualitative Research. *Qualitative Report* 2015; **20**(9): 1408-16.

260. Nigel L. What's the average survey response rate? . 09-08-2021 2021. https://pointerpro.com/blog/average-survey-response-rate/ (accessed 08-07 2022).

261. Kane S. Sample Size Calculator. July 24, 2019. 2019. https://clincalc.com/stats/samplesize.aspx. May 26, 2022.).

262. Llorens-Vernet P, Miró J. The Mobile App Development and Assessment Guide (MAG): Delphi-Based Validity Study. *JMIR Mhealth Uhealth* 2020; **8**(7): e17760.

263. Long H, Howells K, Peters S, Blakemore A. Does health coaching improve health-related quality of life and reduce hospital admissions in people with chronic obstructive pulmonary disease? A systematic review and meta-analysis. *Br J Health Psychol* 2019; **24**(3): 515-46.

264. Zhang MM, Zhang CX, Sun QW, Cai QC, Yang H, Zhang YJ. Questionnaire survey about use of an online appointment booking system in one large tertiary public hospital outpatient service center in China. *Bmc Medical Informatics and Decision Making* 2014; **14**.

265. Shukla AD, Gao GD, Agarwal R. How Digital Word-of-Mouth Affects Consumer Decision Making: Evidence from Doctor Appointment Booking. *Management Science* 2021; **67**(3).

266. Suk MY, Kim B, Lee SG, You CH, Kim TH. Evaluation of Patient No-Shows in a Tertiary Hospital: Focusing on Modes of Appointment-Making and Type of Appointment. *International Journal of Environmental Research and Public Health* 2021; **18**(6).

267. Crico C, Renzi C, Graf N, et al. mHealth and telemedicine apps: in search of a common regulation. *Ecancermedicalscience* 2018; **12**.

268. Chen CL, Yang TT, Chiang ML, Shih TF. A privacy authentication scheme based on cloud for medical environment. *Journal of medical systems* 2014; **38**(11): 143.

269. Chen QY, Wu Y. Effects of respiratory function exercise combined with detailed nursing on patients with chronic obstructive pulmonary disease. *International Journal of Clinical and Experimental Medicine* 2022; **15**(3): 112-7.

270. Hu JL, Ruan H, Li QG, et al. Barriers and Facilitators to Effective Procedural Pain Treatments for Pediatric Patients in the Chinese Context: A Qualitative Descriptive Study. *Journal of Pediatric Nursing-Nursing Care of Children & Families* 2020; **54**: 78-85.

271. Vax S, Farkas M, Russinova Z, Mueser KT, Drainoni ML. Enhancing organizational readiness for implementation: constructing a typology of readiness-development strategies using a modified Delphi process. *Implement Sci* 2021; **16**(1): 61.

272. Huang K, Yang T, Xu J, et al. Prevalence, risk factors, and management of asthma in China: a national cross-sectional study. *Lancet* 2019; **394**(10196): 407-18.

273. Fang L, Gao P, Bao H, et al. Chronic obstructive pulmonary disease in China: a nationwide prevalence study. *Lancet Respir Med* 2018; **6**(6): 421-30.

274. Zhu B, Pang R, Chevallier J, Wei YM, Vo DT. Including intangible costs into the cost-of-illness approach: a method refinement illustrated based on the PM(2.5) economic burden in China. *Eur J Health Econ* 2019; **20**(4): 501-11.

275. Seemungal TA, Donaldson GC, Paul EA, Bestall JC, Jeffries DJ, Wedzicha JA. Effect of exacerbation on quality of life in patients with chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 1998; **157**(5 Pt 1): 1418-22.

276. Bao HL, Jia GH, Cong S, et al. Phenotype and management of chronic obstructive pulmonary disease patients in general population in China: a nationally cross-sectional study. *Npj Primary Care Respiratory Medicine* 2021; **31**(1).

277. Abukwaik AW, Mansukhani R, Bridgeman MB. Long-Acting Bronchodilator Use in the Management of Stable COPD. *Ann Pharmacother* 2018; **52**(6): 562-70.

278. Helvaci A, Metin ZG. The effects of nurse-driven self-management programs on chronic obstructive pulmonary disease: A systematic review and meta-analysis. *Journal of Advanced Nursing* 2020; **76**(11): 2849-71.

279. Ruparel M, Quaife SL, Dickson JL, et al. Prevalence, Symptom Burden, and Underdiagnosis of Chronic Obstructive Pulmonary Disease in a Lung Cancer Screening Cohort. *Annals of the American Thoracic Society* 2020; **17**(7): 869-78.

280. Wan GS, Wei XL, Yin H, Qian ZW, Wang TT, Wang LN. The trend in primary health care preference in China: a cohort study of 12,508 residents from 2012 to 2018. *Bmc Health Services Research* 2021; **21**(1).

281. Chan AW, Tetzlaff JM, Altman DG, et al. SPIRIT 2013 Statement: Defining Standard Protocol Items for Clinical Trials. *Annals of Internal Medicine* 2013; **158**(3): 200-+.

282. Hoffmann TC, Glasziou PP, Boutron I, et al. [Better Reporting of Interventions: Template for Intervention Description and Replication (TIDieR) Checklist and Guide]. *Gesundheitswesen* 2016; **78**(3): 175-88.

283. Louangrath PI. Sample Size Calculation for Continuous and Discrete Data. *International Journal of Research & Methodology in Social Science* 2019; **5**: 44-56.

284. Wilcox S, Parra-Medina D, Felton GM, Poston MB, McClain A. Adoption and implementation of physical activity and dietary counseling by community health center providers and nurses. *J Phys Act Health* 2010; **7**(5): 602-12.

285. Weiner B, Dorsey C, Halko H, Stanick C, Powell B, Lewis C. Psychometric assessment of three newly developed implementation outcome measures. *Implementation Science* 2018; **13**.

286. Mirza S, Clay RD, Koslow MA, Scanlon PD. COPD Guidelines: A Review of the 2018 GOLD Report. *Mayo Clin Proc* 2018; **93**(10): 1488-502.

287. Ali L, Wallström S, Barenfeld E, et al. Person-centred care by a combined digital platform and structured telephone support for people with chronic obstructive pulmonary disease and/or chronic heart failure: study protocol for the PROTECT randomised controlled trial. *BMJ Open* 2020; **10**(7): e036356.

288. Kabir MF, Schulman D, Abdullah A. Promoting Relational Agent for Health Behavior Change in Low and Middle - Income Countries (LMICs): Issues and Approaches. *Journal of Medical Systems* 2019; **43**(7).

289. Williams J, Allen L, Wickramasinghe K, Mikkelsen B, Roberts N, Townsend N. A systematic review of associations between non-communicable diseases and socioeconomic status within low- and lower-middle-income countries. *Journal of Global Health* 2018; **8**(2).

290. Wang C, Zhang JC, Hu CP, Wang YB. Prevalence and Risk Factors for Cognitive Frailty in Aging Hypertensive Patients in China. *Brain Sciences* 2021; **11**(8).

291. Wu CK, Smit E, Xue QL, Odden MC. Prevalence and Correlates of Frailty Among Community-Dwelling Chinese Older Adults: The China Health and Retirement Longitudinal Study. *Journals of Gerontology Series a-Biological Sciences and Medical Sciences* 2018; **73**(1): 102-8.

292. Beidas RS, Dorsey S, Lewis CC, et al. Promises and pitfalls in implementation science from the perspective of US-based researchers: learning from a pre-mortem. *Implementation Science* 2022; **17**(1).

293. Baker R, Camosso-Stefinovic J, Gillies C, et al. Tailored interventions to address determinants of practice. *Cochrane Database Syst Rev* 2015; **2015**(4): Cd005470.

294. Cui XN, Zhou XZ, Ma LL, et al. A nurse-led structured education program improves self-management skills and reduces hospital readmissions in patients with chronic heart failure: a randomized and controlled trial in China. *Rural and Remote Health* 2019; **19**(2).

295. Zhou M, Zhao L, Kong N, Campy KS, Qu S. What Caused Seriously Shortage of Chinese Nurses? *Iran J Public Health* 2018; **47**(7): 1065-7.

296. Frédéric M. Nurses per 1,000 inhabitants in selected countries 2019. 2022. https://www.statista.com/statistics/283124/selected-countries-nurses-per-1-000-inhabitants/ (accessed July 17 2022).

297. Jiang H, Li H, Ma L, Gu Y. Nurses' roles in direct nursing care delivery in China. *Appl Nurs Res* 2015; **28**(2): 132-6.

298. Xu XY, Li XM, Xu DM, Wang WQ. Psychiatric and Mental Health Nursing in China: Past, Present and Future. *Archives of Psychiatric Nursing* 2017; **31**(5): 470-6.

299. Chan AW, Tetzlaff JM, Altman DG, et al. SPIRIT 2013 Statement: defining standard protocol items for clinical trials. *Revista Panamericana De Salud Publica-Pan American Journal of Public Health* 2015; **38**(6): 506-14.

300. Hoffmann TC, Glasziou PP, Boutron I, et al. [Better Reporting of Interventions: Template for Intervention Description and Replication (TIDieR) Checklist and Guide]. *Gesundheitswesen* 2016; **78**(3): e174.

301. Mounier-Jack S, Mayhew SH, Mays N. Integrated care: learning between high-income, and low- and middle-income country health systems. *Health Policy Plan* 2017; **32**(suppl_4): iv6-iv12.

302. Sheikh K, Agyepong I, Jhalani M, et al. Learning health systems: an empowering agenda for low-income and middle-income countries. *Lancet* 2020; **395**(10223): 476-7.

303. Andrade C. The Inconvenient Truth About Convenience and Purposive Samples. *Indian Journal of Psychological Medicine* 2021; **43**(1): 86-8.

304. Chen HT, Wu SP, Zhang XY. COVID-19 in China: From epidemiology to treatment (Review). *Experimental and Therapeutic Medicine* 2020; **20**(6).

305. Taylor SJC CD, Homer K, et al. . Development of the new self-management intervention. . Improving the self-management of chronic pain: COping with persistent Pain, Effectiveness Research in Self-management (COPERS) Southampton (UK: NIHR Journals Library; : (Programme Grants for Applied Research,; 2016 Sep. .

306. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev* 1977; **84**(2): 191-215.

307. A E. The Basic Clinical Theory of Rational Emotive Therapy. New York; 1977.

308. Collaborative WGftC. Association of Patient Belief About Success of Antibiotics for Appendicitis and Outcomes: A Secondary Analysis of the CODA Randomized Clinical Trial. *JAMA Surg* 2022.

309. Subramaniam S, Dhillon JS, Ahmad WFW. Behavioral Theory-Based Framework for Prediabetes Self-Care System-Design Perspectives and Validation Results. *International Journal of Environmental Research and Public Health* 2021; **18**(17).

310. Bravo P, Edwards A, Barr PJ, et al. Conceptualising patient empowerment: a mixed methods study. *Bmc Health Services Research* 2015; **15**.

311. Werbrouck A, Swinnen E, Kerckhofs E, Buyl R, Beckwee D, De Wit L. How to empower patients? A systematic review and meta-analysis. *Translational Behavioral Medicine* 2018; **8**(5): 660-74.

312. van Vugt M, de Wit M, Cleijne W, Snoek FJ. Use of Behavioral Change Techniques in Web-Based Self-Management Programs for Type 2 Diabetes Patients: Systematic Review. *Journal of Medical Internet Research* 2013; **15**(12).

313. Michie S, Wood CE, Johnston M, Abraham C, Francis JJ, Hardeman W. Behaviour change techniques: the development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). *Health Technol Assess* 2015; **19**(99): 1-188.

314. Zhang M, Wu J, Zhang X, et al. [Prevalence and control of hypertension in adults in China, 2018]. *Zhonghua Liu Xing Bing Xue Za Zhi* 2021; **42**(10): 1780-9.

315. Davy C, Bleasel J, Liu HM, Tchan M, Ponniah S, Brown A. Factors influencing the implementation of chronic care models: A systematic literature review. *Bmc Family Practice* 2015; **16**.
316. Gray CS, Miller D, Kuluski K, Cott C. Tying eHealth Tools to Patient Needs: Exploring the Use of eHealth for Community-Dwelling Patients With Complex Chronic Disease and Disability. *Jmir Research Protocols* 2014; **3**(4).
317. Renzi E, Baccolini V, Migliara G, et al. The Impact of eHealth Interventions on the Improvement of Self-Care in Chronic Patients: An Overview of Systematic Reviews. *Life-Basel* 2022; **12**(8).
318. Li L, Yu F, Shi DQ, et al. Application of virtual reality technology in clinical medicine. *American Journal of Translational Research* 2017; **9**(9): 3867-80.
319. Colombo V, Aliverti A, Sacco M. Virtual reality for COPD rehabilitation: a technological perspective. *Pulmonology* 2022; **28**(2): 119-33.
320. Davidson AR, Kelly J, Ball L, Morgan M, Reidlinger DP. What do patients experience? Interprofessional collaborative practice for chronic conditions in primary care: an integrative review. *BMC Prim Care* 2022; **23**(1): 8.
321. Saint-Pierrea C, Herskovic V, Sepulveda M. Multidisciplinary collaboration in primary care: a systematic review. *Family Practice* 2018; **35**(2): 132-41.
322. Ke X, Zhang L, Tang W. Evolutionary Trends in Integrated Care in 2000-2020 in China: A Scientometric Review Using CiteSpace. *Int J Integr Care* 2022; **22**(3): 22.
323. Tomaschek R, Lampart P, Scheel-Sailer A, Gemperli A, Merlo C, Essig S. Improvement Strategies for the Challenging Collaboration of General Practitioners and Specialists for Patients with Complex Chronic Conditions: A Scoping Review. *Int J Integr Care* 2022; **22**(3): 4.
324. Organization WH. Primary health care. 2021. https://www.who.int/news-room/fact-sheets/detail/primary-health-care (accessed 02-11 2022).
325. Shi JW, Jiang CH, Tan DX, et al. Advancing Implementation of Evidence-Based Public Health in China: An Assessment of the Current Situation and Suggestions for Developing Regions. *Biomed Research International* 2016; **2016**.
326. Zhou SD, Ma JX, Dong XJ, et al. Barriers and enablers in the implementation of a quality improvement program for acute coronary syndromes in hospitals: a qualitative analysis using the consolidated framework for implementation research. *Implementation Science* 2022; **17**(1).
327. Barber SL, Borowitz M, Bekedam H, Ma J. The hospital of the future in China: China's reform of public hospitals and trends from industrialized countries. *Health Policy and Planning* 2013; **29**(3): 367-78.