Post-print: Construction of an Integrated Management Model for Elderly Multimorbidity in Medical Consortiums Based on PDSA Theory

Authors: Zhou Xuan, Zhang Dan

Date: 2023-09-12T00:00:00+00:00

Abstract

The continuously rising prevalence of comorbidities poses a formidable challenge to population health management. The World Health Organization recommends the development of integrated healthcare models to address the pressures associated with health management in comorbid patient populations. This study constructs an integrated management model for geriatric comorbidity within medical consortiums based on PDSA theory, aiming to continuously enhance management capabilities and effectiveness through iterative cycles of "Plan-Do-Study-Act" . This model comprises four key components: management team, management process, management tools, and management effectiveness. Building upon prior intervention research, the model integrates patient-centered care, multidisciplinary team approaches, and patient self-management interventions, and establishes a decision support platform leveraging big data technology to achieve life-course health management for patients with comorbidities.

Full Text

Construction of an Integrated Management Model for Geriatric Comorbidities under Medical Associations Based on PDSA Theory

ZHOU Xuan, ZHANG Dan*

Institute of Hospital Management, Tsinghua University, Shenzhen 518055, China

*Corresponding author: ZHANG Dan, Associate professor; E-mail: zhang.dan@sz.tsinghua.edu.cn

Abstract: The continuous increase in the prevalence of comorbidities poses severe challenges to population health management, and the World Health Organization (WHO) recommends developing integrated medical care models to

address the pressures of health management for patients with comorbidities. This paper constructs an integrated management model for geriatric comorbidities under medical associations based on PDSA theory, aiming to continuously improve management capabilities and effectiveness through the cyclical process of "Plan-Do-Study-Act." The model consists of four key elements: management team, management process, management tools, and management outcomes. Building upon previous intervention studies, the model integrates patient-centered care, multidisciplinary teams, and patient self-management, and establishes a decision support platform powered by big data technology to achieve whole-life-cycle health management for patients with comorbidities.

Key words: Multimorbidity; Multiple chronic health conditions; Aged; Integrated care model; PDSA; Medical combination; Self-management; Disease management

Comorbidity (multimorbidity) refers to the concurrent presence of multiple chronic or long-term conditions, including both physical and mental illnesses [1]. As life expectancy increases and the prevalence of chronic diseases rises, multimorbidity is becoming the norm, particularly among older adults [2]. Numerous studies have described the epidemiological status of geriatric comorbidity, and although results vary due to differences in populations and assessment methods, the global prevalence of geriatric comorbidity continues to rise [3]. A Chinese multicenter clinical report on geriatric diseases indicates that the prevalence of comorbidity among older adults in China is as high as 97.5% [4]. It is estimated that by 2050, over 2 billion people worldwide will be aged 60 or older, accounting for 21.1% of the global population [5]. Based on this trend, nearly one-fifth of the world' s population will be in a state of comorbidity. Geriatric comorbidity patients have complex underlying health conditions that require greater medical resources and health cost investments, and their treatment risks and probability of adverse outcomes are significantly higher than other patients, creating a heavy disease burden for society, families, and individuals [6] while posing severe challenges to population health management.

Health management for geriatric comorbidity patients has primarily evolved from chronic disease management, often adopting disease-oriented healthcare models [7]. However, due to the complex and variable patterns of comorbidity, interventions targeting single diseases tend to fragment healthcare services [8]; meanwhile, the combination of multiple treatment methods and mixed intervention goals can easily lead to unintended adverse consequences [9]. To ensure the integrity and continuity of medical services for geriatric comorbidity populations, the World Health Organization (WHO) recommends implementing integrated care models [10], aiming to achieve whole-life-cycle management for older populations through patient-centered integrated intervention approaches. Many countries and regions have conducted practices and explorations of integrated management models for geriatric comorbidity (Table 1) [11-16], but the effectiveness of these interventions remains unclear [17-19], and insufficient evidence has been provided regarding which intervention measures are associ-

ated with improved outcomes [20-21]. Thus, although integrated care models have become a global consensus, authoritative evidence for specific intervention methods and optimal management processes is still lacking.

Therefore, this paper, by summarizing domestic and international practical experiences, constructs an integrated management model for geriatric comorbidity suitable for China' s medical associations and medical communities based on PDSA theory to meet the complex healthcare needs of geriatric comorbidity patients.

1 Conceptualization of an Integrated Management Model for Geriatric Comorbidity Patients

The integrated management model for geriatric comorbidity is a patient-centered, geriatric-friendly comprehensive health management approach consisting of four key elements: management team, management process, management tools, and management outcomes (Figure 1 [Figure 1: see original paper]). This model positions primary healthcare institutions as healthcare providers while integrating tripartite resources to jointly establish a Geriatric Integrated Team (GIT) for decision-making support and social assistance. The management process includes six steps: comprehensive assessment, population risk stratification, personalized intervention plans, patient self-management, continuous follow-up monitoring, and standardized dynamic evaluation, with each PDSA cycle repeated after each stage. Additionally, the model relies on clinical electronic information systems to establish a clinical decision support system guided by both clinical data and expert guidelines, enabling a dual decision-making model with patient participation under information technology support. Ultimately, the model achieves three-dimensional improvement effects: (1) in healthcare accessibility, meeting the complex healthcare needs of geriatric comorbidity patients through effective interventions; (2) in healthcare quality, innovatively incorporating PDSA theory to assist the management team in continuous quality improvement of intervention effects; and (3) in healthcare efficiency, replacing acute medical services with preventive health management to achieve optimal allocation of medical resources.

To achieve integrated management of medical resources, China has established a government-led regional medical system, in which large and medium-sized hospitals serve as regional medical centers and jointly form medical communities with primary healthcare institutions within the region. Through diversified cooperation forms such as resource integration, sharing of advanced medical facilities, mutual recognition of examination items, and expert business guidance, they provide safe, effective, tiered, and continuous medical services for regional populations [22], creating conditions for integrated management of geriatric comorbidity patients.

The PDSA cycle is a quality improvement method proposed by Deming in 1993 [23], which achieves continuous improvement through four steps: Plan, Do,

Study, and Act, commonly applied in medical quality management (see Appendix 1; scan the QR code on the article' s first page for appendix content) [24]. Disease management for geriatric comorbidity patients is influenced by multiple factors and presents dynamic changes, making the PDSA theory suitable for the management cycle of geriatric comorbidity as it enables continuous improvement.

Based on the core concept of population management [35], the management process begins with identifying the comorbidity population, followed by assessment, classification, intervention, and follow-up, with phased analysis and evaluation leading to plan adjustments before entering the next cycle (Figure 3). The model emphasizes achieving continuous quality improvement through the Plan-Do-Study-Act cycle. Therefore, analysis and evaluation at each stage are critical decision points, with regular summary and feedback based on plan implementation to adjust plans in real-time, promoting stable or improved patient health status and avoiding the shortcomings of previous short-term interventions where effects were difficult to sustain [36].

2.1 Plan

This phase includes three steps: comprehensive assessment, population risk stratification, and personalized intervention planning.

2.1.1 Comprehensive Assessment Assessment is the cornerstone of population health management; without accurate and comprehensive assessment, subsequent intervention planning cannot be supported. This research team draws on the Comprehensive Geriatric Assessment (CGA) method to comprehensively evaluate patients' disease conditions, physical function, mental health, and social status [37]. First, case managers establish health records for comorbidity patients willing to participate in management and synchronize basic health information through the interconnected information system within the medical association [38]. Due to the complex and variable nature of comorbidity patients involving multiple disciplines, longer consultation times and greater physician workload are required compared to single-disease patients, making screening forms and medical charts necessary for non-verbal communication. This research team utilizes rapid assessment software or various self-assessment questionnaires to help the management team quickly understand patients' comprehensive status, obtaining complete CGA results. Finally, case managers organize face-to-face interviews between patients, family members, and general practitioners to understand patients' urgent needs and intervention goals. This step is crucial, as the biggest failure point in previous interventions was the lack of patient participation in management [40]. When comorbidity patients face multiple parallel choices for primary intervention goals, respecting patients' personalized needs and preferences directly relates to their initiative and completion of self-management [41-42].

2.1.2 Population Risk Stratification Given China' s large comorbidity population base and scarce high-quality medical resources, one-on-one individual intervention at primary healthcare institutions is clearly not feasible. Therefore, community-based precision management according to comorbidity risk and complexity is essential. Current classification research for comorbidity patients focuses on comorbidity patterns, primarily using disease counting and cluster analysis [43]. However, distinguishing patients based solely on disease types is insufficient; disease complexity, severity, complications, and interactions between diseases are also important considerations. Thus, geriatric comorbidity populations are complex with weak similarities, making effective classification through single criteria difficult. This research team draws on GREMBOWSKI et al.'s [44] method of classifying patients by needs, defining complexity based on the misalignment between patient needs and services, forming a classification method that starts from patient needs and combines need prioritization. In specific classification, patients are first divided into six major categories based on primary needs: medication intervention, nutritional intervention, exercise rehabilitation intervention, complication intervention, risk factor intervention, and psychosocial intervention [45]. Patients requiring single intervention are defined as medium-low risk, while those requiring multiple interventions are high-risk patients. Medium-low risk patients are then incorporated into the decision support system for further verification and intervention mode allocation; high-risk patients should be assigned dedicated case managers for one-on-one full-process customized management. Studies show that repeated hospitalizations and high-risk comorbidity patients account for over one-quarter of chronic disease population medical expenses [46], and health management for these patients can significantly reduce medical costs [47]. Thus, although managing high-risk comorbidity groups consumes substantial medical resources, it remains cost-effective.

2.1.3 Personalized Intervention Plans Different risk-level patients determine intervention plans through different methods. Medium-low risk patients receive preliminary intervention plans directly from the decision support system, while high-risk patients, involving multiple parallel intervention strategies, require case managers to organize GIT team discussions to develop specific plans. Based on numerous chronic disease management guidelines, this research team found that intervention methods and management priorities differ significantly among physical chronic diseases, mental disorders, and geriatric syndromes. Therefore, four intervention types are classified by disease combination patterns [48]. Notably, most chronic diseases share similar health management strategies, so health determinant interventions, including disease health education and health behavior interventions, are implemented for each intervention type but are not elaborated in specific classifications.

1. **Single physical chronic disease + mental/psychological disorder**: One-third to one-half of chronic disease patients experience anxiety and depression symptoms, which exacerbate disease complexity [50];

mental/psychological disorders also reduce patient self-efficacy, leading to poorer self-management outcomes [51]. For patients with single physical disease combined with mental/psychological disorders, the primary task is introducing psychological intervention by mental health professionals while strengthening family connections and social support. After mental/psychological conditions improve, patients may be reclassified into other groups.

2. **Single physical chronic disease + geriatric syndrome**: This type involves numerous physical disease categories and geriatric syndrome types, so specific interventions focus on the main problem, emphasizing functional limitation patients based on population comorbidity characteristics. Two situations exist for functional limitations: those caused by physical diseases (e.g., stroke, fracture, postoperative rehabilitation) require rehabilitation training with professional physical therapists; those due to age-related functional decline should receive home-based medical bed services with regular home visits. For other comorbidity patients without self-care barriers (e.g., common chronic diseases of cardiovascular, respiratory, urinary, and digestive systems), a self-management-based disease management model should be uniformly developed, providing disease-related knowledge and self-management support. For geriatric syndromes, risk factor management should be integrated into daily health education, minimizing medication burden.

3. **Low-to-medium-risk multiple physical chronic diseases**: Managing multiple chronic physical diseases should focus on polypharmacy and adverse drug reactions, with pharmacists reviewing patient prescriptions [52] and assessing medication rationality and compliance to provide guidance. Since low-to-medium-risk patients' chronic diseases have early-stage, complication-free, and controllable characteristics, disease interventions should emphasize risk factor management.

4. **High-risk multiple physical chronic diseases**: For this type, medication intervention is also the primary task. However, due to significantly higher disease severity and functional impairment than low-to-medium-risk patients, management focuses on disease intervention and complication management [53]. These patients receive direct coordination by case managers who organize general practitioner teams to develop personalized management strategies and plans.

Finally, all drafted plans require face-to-face communication with patients and family members for adjustments based on objective conditions and personal circumstances, ultimately establishing clear timelines, intervention goals, management plans, and manuals [54]. Notably, since intervention plans must be re-evaluated after each PDSA cycle, patients may be reclassified into other groups when their disease combination patterns change.

2.2 Do

The second phase involves detailed implementation of management plans, with patient self-management as the main body, requiring continuous management monitoring by the minimum management team and multi-dimensional assistance from the external support team. In chronic disease treatment, patients are the primary responsible parties for their own health; disease control and stability depend on patient self-management and behavioral improvement [55]. Research confirms that self-management is the most effective management improvement model [2,54,56-58], with self-efficacy improvement being the key to successful self-management [59]. Self-efficacy refers to an individual's subjective assessment of their ability to complete a task. The "Knowledge-Attitude-Practice" model proposes that improving patient self-efficacy requires corresponding knowledge, attitudes, and external support [60]. Thus, self-management for comorbidity patients must first establish positive and correct attitudes; for example, many depressed patients consider comorbidity a normal part of aging and are unwilling to take positive action [61], making correct cognition of comorbidity management the primary task for promoting health behavior change. Additionally, the GIT team should cultivate patient self-management capacity. Case managers guide patients to participate in disease knowledge lectures, health behavior education, and regular monitoring guidance; simultaneously, a patient self-management platform is developed, allowing patients to access various health management knowledge online [62] and maintain interaction with general practitioners for medical consultation services [63]. Finally, capacity improvement and attitude change alone cannot sustain healthy behaviors, requiring continuous support through learning communities, social volunteers, family participation, and peer collaboration based on available patient resources [49,64-65].

2.3 Study

The third phase involves analysis and review of plan implementation, with analysis based on continuous follow-up monitoring of patient health. During patient self-management, primary healthcare institutions continuously monitor various indicators through wearable devices, home-based medical beds, interoperable examination systems, and electronic medical records. Case managers organize multiple forms of follow-up evaluation, divided into short-term monitoring and long-term assessment. Short-term monitoring observes patient subjective feelings and plan implementation through regular submission of short-term intervention self-assessment questionnaires via the self-management platform [66]. Questionnaire content includes: (1) baseline comparisons before and after intervention (disease assessment questionnaires, patient self-efficacy, disease-related knowledge, mental health scores, medication adherence scores, self-care ability scores, etc.); (2) participation experience and willingness assessment of intervention models; and (3) patient self-management assessment (intervention goal achievement rate, self-efficacy, self-management assessment questionnaires, etc.). Weekly or monthly identification and analysis of data fluctuations and abnor-

mal results are conducted, followed by general practitioner team meetings. For long-term assessment, case managers collect health outcomes, process outcomes (community and primary care and hospital service utilization), and cost outcomes at the end of each intervention cycle to evaluate intervention effectiveness and adjust subsequent intervention plans. Additionally, patients receiving care at other medical institutions during management should alert primary care physicians for joint assessment, with treatment information synchronized and updated on the management platform [63].

Regarding intervention effectiveness evaluation, the model expects to achieve improvements in three dimensions: quality, efficiency, and accessibility. Whether these expected effects are achieved requires rigorous and comprehensive evaluation. Since complex intervention measures are adopted, single-dimension, fixed-period assessments are insufficient to fully reflect management effects and potential problems. Therefore, following BERWICK et al.' s [67] three major goals for healthcare system transformation—healthcare quality improvement, health outcome improvement, and healthcare cost reduction—the model' s effectiveness is evaluated through both short-term and long-term continuous assessment. Notably, cost-benefit analysis requires special attention, as long-term implementation of a comorbidity intervention model must be financially sustainable; focusing solely on quality may lead to financial unsustainability.

2.4 Action

The fourth phase involves standardization and dynamic adjustment of plans based on evaluation results and continuous monitoring. Quantitative and qualitative assessment results from the previous phase are used to improve and refine intervention methods [68]. Data indicators from the information platform provide the basis for developing standardized management pathways for comorbidity populations, while public health expert teams distill evidence from basic research to guide standardized management in the next cycle. Additionally, feedback from patients and communities helps understand non-medical providers' views and experiences of the intervention model, providing improvement directions for building a patient-centered, geriatric-friendly population health management model. Both quantitative clinical data and qualitative patient evaluations serve as evidence to guide the improvement of intervention plans in the next cycle, ultimately achieving continuous improvement through this cyclical process.

3 Reflections and Discussion

This study details an integrated management model for geriatric comorbidity under medical associations constructed based on PDSA theory, summarizing previous intervention research experiences to form a complex intervention model integrating patient-centered care, multidisciplinary collaboration, patient self-management, and systematic platform reconstruction, expanding comorbidity

management to the entire population and whole life cycle, forming a truly context-appropriate comorbidity intervention model.

3.1.1 Team Integration

The GIT team is not limited to internal medical association members but represents a tripartite resource integration management team focusing on primary healthcare institutions, supported by higher-level hospitals, and radiating to the entire society. First, case managers serve as the communication hub for GIT team coordination, acting as patients' direct contact persons who identify and analyze patient conditions to determine intervention teams and types, directly deciding resource allocation. Second, the minimum management team in the "1+1+N" format serves as an independent decision-making unit, autonomously deciding whether to integrate other professional teams. Finally, the general practice management team and specialist clinical team have complementary service positioning; the general practice team independently triages patients and determines when specialist assistance is needed, while the specialist team is responsible for training general practice medical staff. This forms a good two-way communication mechanism, aligning incentives within the medical association and achieving effective referral and two-way referral.

3.1.2 Data Integration

The two pillars of decision-making evaluation are evidence guidance and data-driven support, with data-driven support being fundamental for model cyclical operation and continuous improvement. Data information runs through patients' entire life cycles, serving both patient and medical ends, covering personal health records, electronic medical records, community health education participation, and various evaluation information. Without big data collection and presentation, the system cannot achieve deep learning and intelligent decision-making. Therefore, substantial upfront investment is required to build a comorbidity management information system, including multi-platform interoperability, ensuring online delivery of comprehensive patient services, and developing intelligent decision-making algorithms.

3.1.3 Intervention Integration

The geriatric comorbidity integrated management model aims to form a patient-centered, population-based complex intervention model. First, patient and family member participation is emphasized during intervention planning and management goal setting, integrating patients' personalized needs and preferences into intervention measures. Second, based on population needs classification and risk stratification, four complex intervention types are defined, with high-risk patients receiving individual case management and need-oriented personalized self-management plans. Simultaneously, disease health education and lifestyle interventions for all chronic disease groups are implemented, achieving a "prevention-treatment-rehabilitation" trinity of chronic disease management

covering risk factor management, complication control, and other intervention types.

3.2 PDSA Enables Continuous Improvement of Management Models

In recent years, the increasing number of comorbidity patients has created a significant gap between community healthcare supply and population health service demand, urgently requiring standardized comorbidity management models to guide primary healthcare institutions in organizing relevant personnel for population health management. However, past practical experiences from various countries and regions show that conceptual management models are difficult to concretely implement, while detailed intervention plans are often influenced by economic, cultural, and medical level factors, resulting in non-generalizable intervention effects that are difficult to replicate on a large scale. Based on this, this research team provides personalized care for patients through PDSA cycles, with timely feedback and adjustment at each stage to transform according to expected goals. The four stages of PDSA are interlinked and cyclical, promoting continuous quality improvement and standardization of comorbidity management under data-driven support [69]. Such a comorbidity management model with strong self-adjustment capabilities can be applied to any scenario and situation, eventually becoming suitable for any population through continuous adjustment and improvement.

3.3 Evidence- and Data-Based Decision Support Systems

Research shows that establishing an information system platform can not only expand service scope but also promote multi-team collaboration around complex health problems [70]. Therefore, a whole-life-cycle health management platform supported by big data technology is needed to establish health management profiles for elderly comorbidity populations by aggregating individual patient micro-data, fully utilizing information technology to assist medical decision-making. The system is divided into a user end providing comprehensive patient services and a medical end supporting GIT team decision-making. On the medical end, this research team has built a dual decision support system guided by evidence and driven by data, using continuous deep learning through neural networks to continuously optimize patient decision pathways [71]. Specifically, the system uses various expert guidelines or disease clinical pathways as algorithmic foundations, utilizing big data integration from the patient comorbidity management platform to establish intelligent decision trees, achieving standardized algorithm-driven treatment. On the user end, the health management platform provides comprehensive services for patients. First, as a data input port, it continuously monitors patient health data through multiple means while receiving feedback, providing online assessment and consultation services. Second, the platform has an extensive resource library, providing high-quality health consultation and lifestyle information by linking to knowledge lectures of interest to older adults. Finally, the system can also assist and guide pa-

tient self-management through health risk questionnaires, daily task check-ins, regular follow-up reminders, and real-time experience feedback to implement comorbidity intervention plans [72]. In summary, the information platform, mediated by big data technology, establishes a bridge for communication between patients and medical providers, various medical institutions, achieving patient-centered, integrated medical resource population-wide, whole-life-cycle comorbidity management.

Finally, the success of intervention models requires not only scientifically rigorous team structure and management processes but also support from environment, policy, medical insurance, culture, training, and social capital investment. When implementing intervention models in practice, a series of supporting measures must be ensured to truly activate the PDSA system.

This paper proposes a geriatric comorbidity management model based on the PDSA model, providing highly generalized plans and principle guidance for intervention management of patients with chronic comorbidities. However, in specific patient intervention management, measures and classifications need further refinement to truly achieve patient-centered personalized management. Currently, the project remains in the intervention implementation stage; testing and refining this model in practice will be conducted, with results compared against this model after project completion to explore its application effects under China' s national conditions.

Author Contributions: ZHANG Dan proposed the research idea, designed the research plan, and was responsible for final version revision and overall responsibility for the paper. ZHOU Xuan conducted the research, implemented the research process, collected data, performed statistical analysis, created charts, and drafted the paper. All authors confirmed the final manuscript.

References: [1] ALMIRALL J, FORTIN M. The coexistence of terms to describe the presence of multiple concurrent diseases[J]. J Comorb, 2013, 3: 4-9. DOI:10.15256/joc.2013.3.22. [2] FROST R, RAIT G, WHEATLEY A, et al. What works in managing complex conditions in older people in primary and community care? A state-of-the-art review[J]. Health Soc Care Community, 2020, 28(6): 1915-1927. DOI:10.1111/hsc.13085. [3] ZHOU X, ZHANG D. Multimorbidity in the elderly: a systematic bibliometric analysis of research output[J]. Int J Environ Res Public Health, 2021, 19(1): 353. DOI:10.3390/ijerph19010353. [4] CAO F, WANG YB, XUE WG, et al. A Chinese multicenter clinical report on geriatric diseases[J]. Chin J Mult Organ Dis Elderly, 2018, 17(11): 801-808. [5] CHATTERJI S, BYLES J, CUTLER D, et al. Health, functioning, and disability in older adults—present status and future implications[J]. Lancet, 2015, 385(9967): 563-575. DOI:10.1016/S0140-6736(14)61462-8. [6] GLYNN LG, VALDERAS JM, HEALY P, et al. The prevalence of multimorbidity in primary care and its effect on health care utilization and cost[J]. Fam Pract, 2011, 28(5): 516-523. DOI:10.1093/fampra/cmr013. [7] LUGTENBERG M, BURGERS JS, CLANCY C, et al. Current guidelines have limited applicability to patients

with comorbid conditions: a systematic analysis of evidence-based guidelines[J]. PLoS One, 2011, 6(10): e25987. DOI:10.1371/journal.pone.0025987. [8] RIJKEN M, HUJALA A, VAN GINNEKEN E, et al. Managing multimorbidity: profiles of integrated care approaches targeting people with multiple chronic conditions in Europe[J]. Health Policy, 2018, 122(1): 44-52. DOI:10.1016/j.healthpol.2017.10.002. [9] WHITE B. Improving chronic disease care in the real world: a step-by-step approach[J]. Fam Pract Manag, 1999, 6(9): 38-43. [10] WHO. Global Strategy on People Centered Integrated Health Services, 2015[EB/OL]. [2023-05-02]. https://www.who.int/. [11] ONDER G, PALMER K, NAVICKAS R, et al. Time to face the challenge of multimorbidity. A European perspective from the joint action on chronic diseases and promoting healthy ageing across the life cycle (JA-CHRODIS)[J]. Eur J Intern Med, 2015, 26(3): 157-159. DOI:10.1016/j.ejim.2015.02.020. [12] MATEO-ABAD M, FULLAONDO A, MERINO M, et al. Impact assessment of an innovative integrated care model for older complex patients with multimorbidity: the CareWell Project[J]. Int J Integr Care, 2020, 20(2): 8. DOI:10.5334/ijic.4711. [13] FERNÁNDEZ MOYANO A, MACHÍN LÁZARO JM, MARTÍN ESCALANTE MD, et al. Care models for polypathological patients[J]. Rev Clin Esp, 2017, 217(6): 351-358. DOI:10.1016/j.rce.2017.03.003. [14] HÉBERT R, DURAND PJ, DUBUC N, et al. PRISMA: a new model of integrated service delivery for the frail older people in Canada[J]. Int J Integr Care, 2003, 3: e08. DOI:10.5334/ijic.73. [15] JOHN JR, TANNOUS WK, JONES A. Changes in health-related quality of life before and after a 12-month enhanced primary care model among chronically ill primary care patients in Australia[J]. Health Qual Life Outcomes, 2020, 18(1): 288. DOI:10.1186/s12955-020-01539-1. [16] LAI YF, LEE SYF, XIONG J, et al. Challenges and opportunities in pragmatic implementation of a holistic hospital care model in Singapore: a mixed-method case study[J]. PLoS One, 2021, 16(1): e0245650. DOI:10.1371/journal.pone.0245650. [17] SMITH SM, WALLACE E, O' DOWD T, et al. Interventions for improving outcomes in patients with multimorbidity in primary care and community settings[J]. Cochrane Database Syst Rev, 2021, 1(1): CD006560. DOI:10.1002/14651858.CD006560.pub4. [18] DAMERY S, FLANAGAN S, COMBES G. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews[J]. BMJ Open, 2016, 6(11): e011952. DOI:10.1136/bmjopen-2016-011952. [19] DAMBHA-MILLER H, SIMPSON G, HOBSON L, et al. Integrated primary care and social services for older adults with multimorbidity in England: a scoping review[J]. BMC Geriatr, 2021, 21(1): 674. DOI:10.1186/s12877-021-02618-8. [20] TORTAJADA S, GIMÉNEZ-CAMPOS MS, VILLAR-LÓPEZ J, et al. Case management for patients with complex multimorbidity: development and validation of a coordinated intervention between primary and hospital care[J]. Int J Integr Care, 2017, 17(2): 4. DOI:10.5334/ijic.2493. [21] MOLINO CG, ROMANO-LIEBER NS, RIBEIRO E, et al. Non-communicable disease clinical practice guidelines in Brazil: a systematic assessment of methodological quality and transparency[J]. PLoS One, 2016, 11(11): e0166367. DOI:10.1371/journal.pone.0166367. [22] YANG LC, BAO LH, TIAN YJ, et

al. Discussion on constructing a two-way referral mechanism under the medical association model[J]. Chin Hosp, 2015, 19(7): 33-35. [23] TAYLOR MJ, MCNICHOLAS C, NICOLAY C, et al. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare[J]. BMJ Qual Saf, 2014, 23(4): 290-298. DOI:10.1136/bmjqs-2013-001862. [24] REED JE, CARD AJ. The problem with Plan-Do-Study-Act cycles[J]. BMJ Qual Saf, 2016, 25(3): 147-152. DOI:10.1136/bmjqs-2015-005076. [25] DEHAVEN MJ. Multimorbidity, chronic disease, and community health science[J]. J Eval Clin Pract, 2017, 23(1): 219-221. DOI:10.1111/jep.12632. [26] MANNUCCI PM, NOBILI A, INVESTIGATORS REPOII. Multimorbidity and polypharmacy in the elderly: lessons from REPOSI[J]. Intern Emerg Med, 2014, 9(7): 723-734. DOI:10.1007/s11739-014-1124-1. [27] ABOUEID S, BOURGEAULT I, GIROUX I. Nutrition care practices of primary care providers for weight management in multidisciplinary primary care settings in Ontario, Canada - a qualitative study[J]. BMC Fam Pract, 2018, 19(1): 69. DOI:10.1186/s12875-018-0760-3. [28] ARNOLD M. Polypharmacy and older adults: a role for psychology and psychologists[J]. Prof Psychol, 2008, 39(3): 283-289. DOI:10.1037/0735-7028.39.3.283. [29] WYTSMA-FISHER K, MUSTATA S, COWAN T, et al. A physical activity intervention feasibility study for kidney inpatients: a basic research protocol[J]. Can J Kidney Health Dis, 2021, 8: 2054358120987052. DOI:10.1177/2054358120987052. [30] GÖHNER A, BITZER EM, DREHER E, et al. Integrated care management for older people with chronic diseases in domesticity: evidence from Cochrane reviews[J]. Z Gerontol Geriatr, 2021, 54(1): 54-60. DOI:10.1007/s00391-020-01796-1. [31] MCCANN E. Building a community-academic partnership to improve health outcomes in an underserved community[J]. Public Health Nurs, 2010, 27(1): 32-40. DOI:10.1111/j.1525-1446.2009.00824.x. [32] SMITH SM, SOUBHI H, FORTIN M, et al. Managing patients with multimorbidity: systematic review of interventions in primary care and community settings[J]. BMJ, 2012, 345: e5205. DOI:10.1136/bmj.e5205. [33] MIKLAVCIC JJ, FRASER KD, PLOEG J, et al. Effectiveness of a community program for older adults with type 2 diabetes and multimorbidity: a pragmatic randomized controlled trial[J]. BMC Geriatr, 2020, 20(1): 174. DOI:10.1186/s12877-020-01568-0. [34] CARTER BL, BOSWORTH HB, GREEN BB. The hypertension team: the role of the pharmacist, nurse, and teamwork in hypertension therapy[J]. J Clin Hypertens, 2012, 14(1): 51-65. DOI:10.1111/j.1751-7176.2011.00542.x. [35] STRUIJS JN, DREWES HW, HEIJINK R, et al. How to evaluate population management? Transforming the Care Continuum Alliance population health guide toward a broadly applicable analytical framework[J]. Health Policy, 2015, 119(4): 522-529. DOI:10.1016/j.healthpol.2014.12.003. [36] MACIEJEWSKI ML, BAYLISS EA. Approaches to comparative effectiveness research in multimorbid populations[J]. Med Care, 2014, 52(Suppl 3): S23-S30. DOI:10.1097/MLR.0000000000000060. [37] CHEN XJ, YAN J, WANG JY, et al. Chinese expert consensus on the application of comprehensive geriatric assessment for the elderly[J]. Aging Med (Milton), 2018, 1(2): 100-105. DOI:10.1002/agm2.12019. [38] NGANGUE PA, FORGUES C,

NGUYEN T, et al. Patients, caregivers and health-care professionals' experience with an interdisciplinary intervention for people with multimorbidity in primary care: a qualitative study[J]. Health Expect, 2020, 23(2): 318-327. DOI:10.1111/hex.13035. [39] TADEU ACR, E SILVA CAETANO IRC, DE FIGUEIREDO SIJ, et al. Multimorbidity and consultation time: a systematic review[J]. BMC Fam Pract, 2020, 21(1): 152. DOI:10.1186/s12875-020-01219-5. [40] PIÑEIRO-FERNÁNDEZ JC, FERNÁNDEZ-RIAL Á, SUÁREZ-GIL R, et al. Evaluation of a patient-centered integrated care program for individuals with frequent hospital readmissions and multimorbidity[J]. Intern Emerg Med, 2022, 17(3): 789-797. DOI:10.1007/s11739-021-02876-9. [41] VAN DONGEN JJ, VAN BOKHOVEN MA, DANIËLS R, et al. Developing interprofessional care plans in chronic care: a scoping review[J]. BMC Fam Pract, 2016, 17(1): 137. DOI:10.1186/s12875-016-0535-7. [42] VERMUNT N, ELWYN G, WESTERT G, et al. Goal setting is insufficiently recognised as an essential part of shared decision-making in the complex care of older patients: a framework analysis[J]. BMC Fam Pract, 2019, 20(1): 76. DOI:10.1186/s12875-019-0966-z. [43] MU XM. Research on mining and prevention strategies of comorbidity patterns in elderly chronic diseases[D]. Jilin: Jilin University, 2021. [44] GREMBOWSKI D, SCHAEFER J, JOHNSON KE, et al. A conceptual model of the role of complexity in the care of patients with multiple chronic conditions[J]. Med Care, 2014, 52(Suppl 3): S7-S14. DOI:10.1097/MLR.0000000000000045. [45] BUNKER JM, REDDEL HK, DENNIS SM, et al. A pragmatic cluster randomized controlled trial of early intervention for chronic obstructive pulmonary disease by practice nurse-general practitioner teams: study Protocol[J]. Implement Sci, 2012, 7: 83. DOI:10.1186/1748-5908-7-83. [46] CHANG ET, ZULMAN DM, ASCH SM, et al. An operations-partnered evaluation of care redesign for high-risk patients in the Veterans Health Administration (VHA): study protocol for the PACT Intensive Management (PIM) randomized quality improvement evaluation[J]. Contemp Clin Trials, 2018, 69: 65-75. DOI:10.1016/j.cct.2018.04.008. [47] BODENHEIMER T, WAGNER EH, GRUMBACH K. Improving primary care for patients with chronic illness[J]. JAMA, 2002, 288(15): 1909. DOI:10.1001/jama.288.15.1909. [48] BARÉ M, HERRANZ S, ROSO-LLORACH A, et al. Multimorbidity patterns of chronic conditions and geriatric syndromes in older patients from the MoPIM multicentre cohort study[J]. BMJ Open, 2021, 11(11): e049334. DOI:10.1136/bmjopen-2021-049334. [49] MORRIN L, BRITTEN J, DAVACHI S, et al. Alberta Healthy Living Program—a model for successful integration of chronic disease management services[J]. Can J Diabetes, 2013, 37(4): 254-259. DOI:10.1016/j.jcjd.2013.04.001. [50] CIMPEAN D, DRAKE RE. Treating co-morbid chronic medical conditions and anxiety/depression[J]. Epidemiol Psychiatr Sci, 2011, 20(2): 141-150. DOI:10.1017/s2045796011000345. [51] FISHER EB, CHAN JCN, NAN HR, et al. Co-occurrence of diabetes and depression: conceptual considerations for an emerging global health challenge[J]. J Affect Disord, 2012, 142 Suppl: S56-S66. DOI:10.1016/S0165-0327(12)70009-5. [52] HALLI-TIERNEY AD, SCARBROUGH C, CARROLL D. Polypharmacy: evaluating risks and deprescribing[J]. Am Fam Physi-

cian, 2019, 100(1): 32-38. [53] LOEB DF, BAYLISS EA, CANDRIAN C, et al. Primary care providers' experiences caring for complex patients in primary care: a qualitative study[J]. BMC Fam Pract, 2016, 17: 34. DOI:10.1186/s12875-016-0433-z. [54] KASTNER M, HAYDEN L, WONG G, et al. Underlying mechanisms of complex interventions addressing the care of older adults with multimorbidity: a realist review[J]. BMJ Open, 2019, 9(4): e025009. DOI:10.1136/bmjopen-2018-025009. [55] BRAILLARD O, SLAMA-CHAUDHRY A, JOLY C, et al. The impact of chronic disease management on primary care doctors in Switzerland: a qualitative study[J]. BMC Fam Pract, 2018, 19(1): 159. DOI:10.1186/s12875-018-0833-3. [56] TSILIGIANNI I, GOODRIDGE D, MARCINIUK D, et al. Four patients with a history of acute exacerbations of COPD: implementing the CHEST/Canadian Thoracic Society guidelines for preventing exacerbations[J]. NPJ Prim Care Respir Med, 2015, 25: 15023. DOI:10.1038/npjpcrm.2015.23. [57] RIJKEN M, BEKKEMA N, BOECKXSTAENS P, et al. Chronic Disease Management Programmes: an adequate response to patients' needs?[J]. Health Expect, 2014, 17(5): 608-621. DOI:10.1111/j.1369-7625.2012.00786.x. [58] O' TOOLE L, CONNOLLY D, BOLAND F, et al. Effect of the OPTIMAL programme on self-management of multimorbidity in primary care: a randomised controlled trial[J]. Br J Gen Pract, 2021, 71(705): e303-e311. DOI:10.3399/bjgp20X714185. [59] JAMIESON NJ, HANSON CS, JOSEPHSON MA, et al. Motivations, challenges, and attitudes to self-management in kidney transplant recipients: a systematic review of qualitative studies[J]. Am J Kidney Dis, 2016, 67(3): 461-478. DOI:10.1053/j.ajkd.2015.07.030. [60] WANG SM. Theory and practice of community injury prevention and safety promotion[M]. Shanghai: Fudan University Press, 2010. [61] RUSTAD JK, MUSSELMAN DL, NEMEROFF CB. The relationship of depression and diabetes: pathophysiological and treatment implications[J]. Psychoneuroendocrinology, 2011, 36(9): 1276-1286. DOI:10.1016/j.psyneuen.2011.03.005. [62] FULTON TR, PENNEY BC, TAFT A. Exploring a chronic care model in a regional healthcare context[J]. Healthc Manage Forum, 2001, 14(2): 6-24. DOI:10.1016/S0840-4704(10)60361-2. [63] BAUER MS. The collaborative practice model for bipolar disorder: design and implementation in a multi-site randomized controlled trial[J]. Bipolar Disord, 2001, 3(5): 233-244. DOI:10.1034/j.1399-5618.2001.30502.x. [64] SOUBHI H, BAYLISS EA, FORTIN M, et al. Learning and caring in communities of practice: using relationships and collective learning to improve primary care for patients with multimorbidity[J]. Ann Fam Med, 2010, 8(2): 170-177. DOI:10.1370/afm.1056. [65] GOEHNER A, KRICHELDORFF C, BITZER EM. Trained volunteers to support chronically ill, multimorbid elderly between hospital and domesticity - a systematic review of one-on-one intervention types, effects, and underlying training concepts[J]. BMC Geriatr, 2019, 19(1): 126. DOI:10.1186/s12877-019-1128-3. [66] ROSATI S, ZEMA M, CASTAGNERI C, et al. Modelling and analysis of four telemedicine Italian experiences[J]. Annu Int Conf IEEE Eng Med Biol Soc, 2017, 2017: 2634-2637. DOI:10.1109/EMBC.2017.8037398. [67] BERWICK DM, NOLAN TW, WHITTINGTON J. The triple aim: care, health, and cost[J]. Health

Aff (Millwood), 2008, 27(3): 759-769. DOI:10.1377/hlthaff.27.3.759. [68] BYRNE J, XU G, CARR S. Developing an intervention to prevent acute kidney injury: using the Plan, Do, Study, Act (PDSA) service improvement approach[J]. J Ren Care, 2015, 41(1): 3-8. DOI:10.1111/jorc.12090. [69] YANG ZH, MA XB, CHEN Y, et al. Effects of a quality improvement program to reduce central venous catheter-related infections in hemodialysis patients[J]. Am J Med Sci, 2021, 361(4): 461-468. DOI:10.1016/j.amjms.2020.10.018. [70] GARG T, ANZUONI K, LANDYN V, et al. The AGING Initiative experience: a call for sustained support for team science networks[J]. Health Res Policy Syst, 2018, 16(1): 41. DOI:10.1186/s12961-018-0324-y. [71] NG CJ, LEE YK, ABDULLAH A, et al. Shared decision-making: a dual-layer model to tackling multimorbidity in primary care[J]. J Eval Clin Pract, 2019, 25(6): 1074-1079. DOI:10.1111/jep.13163. [72] KASTNER M, MAKARSKI J, HAYDEN L, et al. Effectiveness of an eHealth self-management tool for older adults with multimorbidity (KeepWell): protocol for a hybrid effectiveness-implementation randomised controlled trial[J]. BMJ Open, 2021, 11(2): e048350. DOI:10.1136/bmjopen-2020-048350.

(Received: May 13, 2023; Revised: August 3, 2023) (Editor: MAO Yamin)

Note: Figure translations are in progress. See original paper for figures.