A Collaborative Care Model Based on "Specialty-General Practice" Family Doctor Contract Service for Whole-Course Management of a Diabetic Foot Case: Practice and Literature Review (Postprint)

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Abstract

Background

Diabetic foot represents one of the most serious chronic complications of diabetes mellitus, characterized by high disability rates and a substantial disease burden that necessitates multidisciplinary collaboration and long-term standardized management for effective prevention and treatment. Currently, primary healthcare institutions in China face significant challenges in diabetic foot management, including insufficient specialist resources and a lack of continuous care capabilities.

Objective

This article explores the feasibility of promoting and applying a co-care management model anchored in "specialist-general practitioner" characteristic family doctor contract services for managing diabetic patients and their complications in community settings. This exploration is conducted through analysis of the successful management pathway and diagnostic-therapeutic process of a type 2 diabetes mellitus patient with diabetic foot who presented for initial diagnosis at a community facility.

Methods

We conducted a systematic analysis of the entire treatment and management pathway for a diabetic foot patient under the new "specialist-general practitioner" characteristic family doctor contract service model. Concurrently,

Chinese literature databases including CNKI, Wanfang Data, and VIP were searched using Chinese keywords (diabetic foot, community), and PubMed was searched using the English keywords "Diabetic foot and Management, Diabetic foot and Administration, Community diabetic foot" for relevant literature from 2004 to 2024. Existing community management models and approaches for diabetic foot were analyzed and compared to highlight the effectiveness and advantages of the co-care management model anchored in "specialist-general practitioner" characteristic family doctor contract services.

Results

Following co-care management based on the "specialist-general practitioner" characteristic family doctor contract service, the patient' s gangrenous toes were preserved, foot infection was cured, and simultaneously, blood glucose, blood lipids, and blood pressure all achieved control targets. Combined with literature search results, current community diabetic foot management models both domestically and internationally remain predominantly in the exploratory stage. These include community-based management models, hospital-community linkage management models, hospital-community-family management models, Internet+hospital-community-family intelligent nursing models, self-management models, multidisciplinary team management, remote diagnosis and guidance models utilizing computer software, smartphones, tablet applications, and webcams, artificial intelligence diabetic foot ulcer prediction models, and interprofessional diabetic foot management teams.

Conclusion

The co-care management model anchored in "specialist-general practitioner"characteristic family doctor contract services demonstrates significant effectiveness in managing community diabetic foot patients. Compared with current domestic and international diabetic foot management models, this model features a simpler team structure, clear division of labor among members, emphasis on individualized service, and higher operational efficiency, warranting promotion and application in community health service centers.

Full Text

Preamble

Whole-Course Management of Diabetic Foot Based on a "Specialist-General Practitioner" Co-care Model: A Case Report and Literature Review

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Abstract

Background: Diabetic foot (DF) represents one of the most severe chronic complications of diabetes, characterized by high disability rates and substantial disease burden. Its prevention and treatment require multidisciplinary collaboration and long-term standardized management. Currently, primary healthcare institutions in China often face challenges such as insufficient specialist resources and lack of continuous care in DF management.

Objective: This study explores the feasibility of implementing a co-care management model based on "Specialist-General Practitioner" family medicine team contractual services for managing diabetes and its complications in community settings, through analysis of a successful management pathway for a type 2 diabetes patient with DF initially diagnosed in the community.

Methods: We documented and analyzed the entire treatment and management pathway of a DF patient under the new "Specialist-General Practitioner" family medicine contractual service model. Simultaneously, we conducted a literature search from 2004 to 2024 using Chinese keywords "糖尿病足，社区" (diabetic foot, community) in CNKI, Wanfang, and VIP databases, and English keywords "Diabetic foot and Management," "Diabetic foot and Administration," "Community diabetic foot" in PubMed. We analyzed and compared existing community-based DF management models to highlight the effectiveness and advantages of our co-care approach.

Results: Under the "Specialist-General Practitioner" co-care model, the patient' s gangrenous toes were preserved and foot infection cured, while blood glucose, lipids, and pressure all reached target control levels. Literature review revealed that community-based DF management models both domestically and internationally remain largely exploratory, including community-based management, hospital-community linkage, hospital-community-family models, Internet+ hospital-community-family intelligent nursing, self-management, multidisciplinary team management, remote consultation using computer software/smartphones/tablets/webcams, AI-based DF ulcer prediction, and interprofessional DF management teams.

Conclusion: The "Specialist-General Practitioner" co-care model demonstrates significant effectiveness for community DF management. Compared with existing models, this approach features a simpler team structure, clearly defined member roles, emphasis on individualized services, and higher operational efficiency, making it worthy of promotion in community health service centers.

Keywords: Diabetic foot; Diabetes complications; Family physician contractual services; Diabetes joint care; Community management; Case reports

Introduction

Diabetes-induced metabolic disorders can cause vascular endothelial damage and microvascular inflammation, leading to vascular pathologies that result in diabetic foot (DF), diabetic nephropathy, diabetic retinopathy, and other complications [1-5]. China currently has one of the fastest-growing diabetes prevalence rates globally, with approximately 11% of the population affected [6]. Among adult diabetic patients over 50, the annual incidence of DF is 8.1%, with an annual amputation rate of 5.1% and mortality rate of 14.4% if not promptly controlled, severely impacting quality of life [7]. Early screening, assessment, and prevention can reduce DF incidence and progression to some extent.

Current community-based diabetes management in primary healthcare institutions primarily follows guidelines issued by the National Health Commission since 2009 [8], which has spawned various management models widely implemented at the grassroots level. However, diabetes complication management involves multiple disciplines, and coordinating multidisciplinary treatment (MDT) at community health service centers remains exploratory. This article presents a case of type 2 diabetes with DF managed through the "Specialist-General Practitioner" co-care model at Gaobeidian Community Health Service Center, while reviewing and comparing community DF management approaches from the past two decades both domestically and internationally, to explore the feasibility of promoting this model for diabetes complication management in community settings.

1. Case Report

Patient: Male, 64 years old. Presented with "elevated blood glucose for 25 years, left toe gangrene with infection for over 1 month."

History: Twenty-five years prior, routine physical examination revealed elevated fasting glucose, leading to a diagnosis of type 2 diabetes at a higher-level hospital. The patient received pharmacological treatment (specifics unknown) with fasting glucose controlled at 8-10 mmol/L; postprandial glucose was not monitored. Subsequent intermittent medication adjustments yielded suboptimal glycemic control. At presentation, he was taking acarbose and sitagliptin phosphate, with fasting glucose fluctuating between 8-10 mmol/L and 2-hour postprandial glucose between 11-13 mmol/L. Two months prior, he developed left lower extremity pain after walking 100 meters. One month prior, skin breakdown with infection occurred on the left fifth toe, which progressively worsened

despite self-administered topical medications, prompting presentation to our center.

Past Medical History: Hypertension grade 3 for 6 years, controlled with extended-release nifedipine. Smoked for 40 years (average 16 cigarettes/day) without cessation. Diet was carbohydrate-dominant with minimal physical activity. Personality was introverted; family relationships were harmonious. Medication adherence was poor with low attention to glucose control, often requiring his wife's supervision for medication and glucose monitoring. Father and brother both had diabetes and were deceased.

Physical Examination: Temperature 36.2°C, pulse 68 beats/min, respiration 18 breaths/min, blood pressure 126/62 mmHg (1 mmHg=0.133 kPa). Height 1.73 m, weight 71 kg. Cardiopulmonary and abdominal examinations were unremarkable. Key findings: Left femoral, popliteal, dorsalis pedis, and posterior tibial pulses were non-palpable; no pitting edema in bilateral anterior tibia; no calf muscle tenderness; no abnormal vascular bruits. Left dorsal foot showed redness and swelling; distal left fifth toe gangrene with local blackening and surrounding erythema; small amount of purulent discharge between third and fourth toes; bilateral toe, plantar, marginal, and heel skin was thickened, rough, desquamated, with pruritus [Figure 2: see original paper]. Diabetic peripheral neuropathy examination showed positive temperature, pressure, and pinprick sensation; negative vibration sense and ankle reflexes.

Preliminary Diagnosis: (1) Type 2 diabetes; (2) Type 2 diabetic foot gangrene; (3) Soft tissue infection; (4) Type 2 diabetic peripheral neuropathy; (5) Type 2 diabetic peripheral vascular disease; (6) Hyperlipidemia; (7) Iliac artery occlusion?; (8) Hypertension grade 3, high-risk group; (9) Tinea pedis [9].

Laboratory Findings: Complete blood count: WBC 12.1$×10^{9}$/L, neutrophils 74.7%; Urinalysis: glucose 2+; Random glucose 13.44 mmol/L; HbA1c 9.13%.

DF Assessment: Wagner grade 4 [10], Fontaine ischemia stage IV.

Treatment Plan:

1. **Contractual Family Physician Enrollment:** The patient was enrolled in the "Specialist-General Practitioner" family medicine contractual service model [Figure 1: see original paper]. The team general practitioner directly connected with a tertiary hospital endocrinology specialist for online consultation to optimize the glycemic regimen and recommended referral to vascular surgery.

2. **Medication Optimization:** Per the tertiary endocrinology specialist' s advice, insulin degludec/aspart 10 U morning and evening was initiated, combined with metformin 500 mg twice daily and sitagliptin 100 mg once daily. The general practitioner optimized other medications: amoxicillin-clavulanate 1.2 g IV twice daily for foot infection; antihypertensive switched to irbesartan 150 mg daily (ACEI/ARB preferred for

diabetes with hypertension [11]); atorvastatin 20 mg daily and aspirin 100 mg daily for peripheral vascular disease and possible iliac occlusion; mecobalamin 0.5 mg three times daily for neuropathy; ciclopirox olamine cream 2 g twice daily for tinea pedis.

3. **Co-care Management:** The general practitioner referred the patient to the team co-care manager (a specially trained community nurse) for non-pharmacological guidance: dietary prescription (light physical activity) of 1,975 kcal/day (22 food exchange portions at 90 kcal each) with salt limited to 5 g/day and oil to 25 g/day; home aerobic exercise with dumbbells/resistance bands with pictorial guidance; diabetes health education for patient and wife to improve adherence; foot assessment revealing preference for barefoot walking and cloth shoes, leading to recommendations for cotton socks and breathable athletic shoes with $ $2 cm sole height; smoking cessation counseling; establishing WeChat/phone contact with the wife for supervision of medication, insulin injection, exercise, glucose monitoring, and dietary reporting; providing the general practitioner' s contact card for emergencies.

Referral and Hospitalization: The general practitioner used the primary care referral platform to transfer the patient to Beijing Chaoyang Hospital Vascular Surgery. CT angiography showed bilateral lower extremity atherosclerosis with multiple focal moderate-to-severe stenoses in left anterior tibial, posterior tibial, and peroneal arteries. The patient underwent lower extremity angiography, iliac artery balloon angioplasty with stenting, and femoral puncture closure. Post-procedure angiography showed patent left iliac artery with improved flow velocity. During hospitalization, the co-care manager conducted online glucose tracking and dietary monitoring, feeding information back to the general practitioner, who provided insulin dosage recommendations relayed to the patient.

Post-discharge Community Re-management: After discharge, the co-care manager facilitated the patient's return to community-based management. First, comprehensive assessment of liver/kidney function, lipids, glucose, insulin function, urinary microalbumin, ECG, echocardiography, and fundus examination revealed fundus arteriosclerosis, adding "fundus arteriosclerosis" to the diagnosis. Second, treatment targets were established: HbA1c <7%, LDL-C <1.4 mmol/L with >50% reduction from baseline [12], blood pressure $ $130/80 mmHg. Third, the treatment plan was adjusted: (1) Insulin increased to 14 U morning and evening; added beraprost sodium 40 mg three times daily post-stenting [5]; sulfadiazine zinc cream 100 mg twice daily for persistent warmth on left dorsal foot despite normalized infection markers. (2) Non-pharmacological: Dietary monitoring revealed preference for porridge at breakfast and noodles at lunch/dinner; recommendations included switching to milk for breakfast and buckwheat/potato/yam for dinner; continued resistance band/dumbbell exercises; wife continued supervision of medication, smoking cessation, exercise, glucose monitoring, and dietary adjustments; co-care manager performed wound dressing every other day while assessing foot skin and temperature; invited pa-

tient and family to diabetes club activities for reinforced education, improving awareness and adherence.

Outcome: After 2 weeks of regular treatment, fasting glucose stabilized at 6-7 mmol/L, 2-hour postprandial glucose at 7-8 mmol/L, foot skin normalized, and gangrene healed [Figure 3: see original paper]. Short-term follow-up plan: Reassess diabetic peripheral neuropathy/vascular disease and foot skin status at 3 months [10], with repeat HbA1c and lipid panel.

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2. Discussion

2.1 Application of the "Specialist-General Practitioner"Co-care Model in This Case

In 2023, the General Office of the CPC Central Committee and State Council issued the "Opinions on Further Improving the Medical and Health Service System" [13], establishing primary healthcare institutions as the main platform for family physician contractual services with general practitioners as the core, effective specialist-generalist collaboration, and integrated medical-preventive care. Since April 2023, our center has implemented the "Specialist-General Practitioner" model in our diabetes clinic. This model centers on a "Specialist-General Practitioner" team, providing closed-loop, high-quality management through diabetes contractual service packages. Team composition and roles: "Specialist" refers to endocrinology experts from Chaoyang Hospital; "General Practitioner" refers to community GPs; and "Co-care Manager" refers to community nurses specially trained in diabetes and complication management.

In this case, the endocrinology specialist optimized the glycemic regimen, provided macro-level disease control, recommended referral, and facilitated rapid admission to vascular surgery through the primary care referral platform—critical for preserving the gangrenous toes. The specialist also conducts regular outreach clinics to address team management challenges and provides on-demand training, enhancing primary care capacity. The general practitioner coordinates communication between specialist and patient, obtains clinical data directly or via the co-care manager, monitors glucose/blood pressure/lipid targets, develops short/long-term plans, and ensures management continuity for unresolved issues. The co-care manager conducts follow-ups (online/offline), provides education on glucose management, foot care, insulin injection, hypoglycemia prevention, footwear, and smoking cessation, monitors indicators, and reports abnormal findings to the GP. This seamless, efficient team coordination enabled rapid glucose control and toe preservation while building harmonious patient-physician relationships.

2.2 Review of Existing DF Management Models

Using Chinese keywords "糖尿病足，社区" in CNKI, Wanfang, and VIP, and English keywords "Diabetic foot and Management," "Diabetic foot and Administration," "Community diabetic foot" in PubMed (2004-2024), we found community DF management models remain largely exploratory. Domestic models focus primarily on nursing, including community-based closed-loop management [7], internal community grading management [14-16], hospital-community linkage [17-19], hospital-community-family supervisor trinity information management [20], "hospital-community-family" DF ulcer rehabilitation management [21], Internet+ hospital-community-family intelligent nursing [22], and self-management [23]. International models include multidisciplinary nursing teams [24], tertiary hospital multidisciplinary clinics [25], community GP/nurse-based software-simulated multidisciplinary management [26], community pharmacy/pharmacist-led foot care interventions [27-28], remote consultation using computer software/smartphones/tablets/webcams [29-32], "hospital-community-family" DF ulcer rehabilitation [33], DF self-management interventions [34-36], AI-based DF ulcer prediction [37-38], and interprofessional DF management teams [39-40]. Representative models from the past five years are summarized in .

2.3 Advantages of the "Specialist-General Practitioner"Co-care Model

Compared with international multidisciplinary team models, the "Specialist-General Practitioner" model more conveniently covers community populations with simpler team composition, clear focus, tight vertical integration, and easier deployment of high-quality medical resources to the grassroots level. Compared with domestic models by Jiang Fangjie [7] and Wang Yanyan [17], our model has more detailed staffing and clearer role division with more convenient implementation. Compared with Bai Lifang' s model [19], ours avoids electronic record transfer limitations, balances medical-nursing responsibilities, and assigns returning patients to specific co-care teams rather than generically to any community staff with $ $5 years experience, enabling more refined patient triage. Bai' s model also vaguely mentions remote home consultation without specifying who consults or how, whereas our model provides clear upward referral pathways.

As shown in [Figure 1: see original paper], our model achieves referral and consultation through three pathways: (1) Emergency cases—GP directly contacts tertiary specialist for consultation/referral; (2) Non-emergency cross-department referrals—GP uses primary care platform to schedule appointments with clear referral reasons; (3) Non-emergency same-department cases—patient contacts GP, who fulfills contractual "referral/consultation" services by connecting with specialists. This chronic disease case with severe complications had clear referral indications. On the visit day, the GP directly connected with the tertiary specialist for online consultation, optimized treatment, and facilitated upward referral. During hospitalization, the co-care manager maintained online follow-up, dynamically feeding information back to the GP. Post-discharge, prompt

community re-evaluation and continued management created a closed-loop, vertically integrated system.

Furthermore, since its pilot implementation in our diabetes clinic in 2023, this model has significantly improved glucose control, HbA1c achievement rates, blood pressure targets, follow-up rates, and patient adherence compared with traditional GP autonomous contracting in 2022, demonstrating remarkable efficacy in diabetes complication management that warrants broader community promotion.

Conclusion

As diabetes complication incidence and complexity continue rising, primary healthcare capacity faces increasing challenges. Our "Specialist-General Practitioner" co-care model, supported by a tertiary hospital medical group, provides scientific, standardized management for such patients. This model effectively facilitates upward referral pathways, implements the tiered diagnosis and treatment mechanism of "first contact in community, serious illness to hospital, rehabilitation back to community," ensures timely referral for those in need, and enables resource sharing between tertiary hospitals and community centers for discipline development and clinical training, ensuring stable or rehabilitated patients can be effectively managed upon return. For patients, this provides efficient, high-quality medical services at their doorstep, enhancing satisfaction and achieving the transition from "contracting because I have to"to "contracting because I want to."

In summary, the "Specialist-General Practitioner" co-care model demonstrates significant effectiveness in DF management with a simple team structure, clear role division, individualized services, and high efficiency, making it worthy of promotion in community health service centers.

Author Contributions

FENG Xiaokai: Conceptualization and design. WANG Shujuan, LI Na, and LIU Yujiang: Data collection. WANG Shujuan: Data organization, literature review, table/figure preparation, and manuscript writing. FENG Xiaokai, GAO Juan, and ZHAO Jihua: Quality control, review, and overall supervision.

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