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Clinical nutrition service capacity of 445 secondary or above hospitals in Sichuan, China: the 2021 annual survey

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ABSTRACT

Background and Objectives: To investigate the capacity of clinical nutrition services in secondary and tertiary hospitals in the Sichuan Province, China. **Methods and Study Design:** Convenience sampling was used. E-questionnaires were distributed to all eligible medical institutions in Sichuan through the official network of provincial and municipal clinical nutrition quality control centers. The data obtained were sorted in Microsoft Excel and analyzed by SPSS. **Results:** A total of 519 questionnaires were returned, of which 455 were valid. Only 228 hospitals were accessible to clinical nutrition services, of which 127 hospitals had independently set up clinical nutrition departments (CNDs). The ratio of clinical nutritionists to beds was 1:214. During the last decade, the rate of constructing new CNDs was maintained at approximately 5 units/year. A total of 72.4% of hospitals managed their clinical nutrition units as part of their medical technology departments. The specialist number ratio of senior, associate, intermediate and junior is approximately 1:4:8:10. There were 5 common charges for clinical nutrition. **Conclusions:** The sample representation was limited, and the capacity of clinical nutrition services may have been overestimated. Secondary and tertiary hospitals in Sichuan are currently in the second high tide of department establishment, with a positive trend of departmental affiliation standardization and a basic formation of a talent echelon.

Key Words: clinical nutrition, survey, discipline development, service capacity, hospital management

INTRODUCTION

Nutrition support practices are needed. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019 shows that dietary risks drive the third most deaths and disabilities combined in China. Compared to 2009, dietary risks contribute 15.3% more to total number of disability-adjusted life-years (DALYs) and elevate one place in the ranking of DALY drivers.^{1,2}

The structures and organizations of nutrition support practices vary significantly; thus, models of providing clinical nutrition services are different. In China, clinical dietitians/nutritionists are technicians, physicians, or physicians of traditional Chinese medicine (TCM) with a qualification in clinical nutrition.³ They work in independent clinical nutrition departments (CNDs), and serve nutritional screening, assessment/diagnosis, treatment, and education. CNDs also provide medical diets, enteral nutrition (EN), and

parenteral nutrition (PN).^{3, 4} In developed countries including the USA and Japan, the nutrition support team (NST) plays an important role in medical nutrition therapy.^{5, 6} Across the USA, 521 hospitals had established NST as early as 1983. In Japan, there were only 12 hospitals implementing NST in 2001, but by 2011, there were more than 1,600 large hospitals activated NST, accounting for more than 20% of Japan's 8,000 large hospitals.⁷ Very little is known on the current applying state of the CND and NST models.

CNDs are more popular in China due to historical and policy reasons. The history of CNDs in China dates to the early 1920s.⁸ At that time, CNDs existed in only a few church hospitals and were taken as departments right then. Since the foundation of the People's Republic of China in 1949, the former Ministry of Health (now called the National Health Commission, NHC) issued 13 related documents to guide and promote the development of clinical nutrition,^{4, 9-20} among which were 2 types and 5 versions of documents directly named after clinical nutrition, i.e., *Opinions on Strengthening Clinical Nutrition Work (1985/2008)* and *Guidelines for the Construction and Management of Clinical Nutrition Departments (Trial) (2009/2012/2022)*.

Benefiting from the *Accreditation Standards for Secondary Hospitals (2012/2017)* and *Accreditation Standards for Tertiary Hospitals (2011/2020)*, CNDs have rapidly developed as departments that were encouraged to be set up in tier-2 hospitals and must be set up in tier-3 hospitals. Chinese hospitals are classified into three tiers and nine levels: tier-1 (primary), tier-2 (secondary) and tier-3 (tertiary). Each tier is further subdivided into 3 subsidiary levels, i.e., A, B and C, based on hospital functions and roles, such as service, size, management, quality, safety, facility, research, medical technology, etc. By now, secondary and above hospitals are the major institutions to provide high-level clinical nutrition services to a region, and the leader to undertake advanced teaching and scientific research tasks in this field.

Requirements on the attribution, staff titles and quantity have been the focus of CND management and can be traced back to the late 1970s.^{20, 21} In 1978, the *Principles of Organization and Budgeted Posts of General Hospitals (Trial Draft)* clearly pointed out that CNDs ought to be subordinate to medical and technical departments in hospitals.²⁰ In 1979, the *Regulations on the Titles and Promotion of Health Technicians* state that titles of clinical dietitians included senior, associate, intermediate, junior etc.²¹ The ratio of clinical nutritionists to beds should have been 1:100-130 but has been revised to 1:150 since the introduction of the *National Nutrition Plan (2017-2030)*, which was published in 2017.^{20, 22}

To identify the current benchmarks of CNDs in China at this moment, map the clinical nutrition service capacity of each city in Sichuan, further improve the clinical nutrition quality

management and control work system, and guide the standardized construction and management of nutrition diagnosis and treatment, the Health Commission of Sichuan Province (HCSC) carried out surveys on clinical nutrition service capacity and entrusted the Clinical Nutrition Quality Control Centre of Sichuan Province (CNQCC-SC) to execute them.

CNQCC-SC formally launched the surveys in 2013, 2016, and 2018,²³⁻²⁵ with 43, 78, and 53 hospitals participating in the studies, respectively. Results of this series of surveys are presented in Table 1. The clinical dietitian to bed ratio had changed from 1:394 to 1:299 between 2016 and 2018. This study was already the fourth investigation. From 2013 to 2021, an increasing number of indicators were added to questionnaires, especially important medical service quality control indicators designated by the NHC, such as nutritional screening and assessment. One of our aims was to identify, track and provide feedback on the current status of CND development. Another aim was to compare CNDs' service capacity to actual needs, understand and analyze constraints, and seek additional solutions.

MATERIALS AND METHODS

Survey respondents

All nutrition departments in secondary and tertiary hospitals in Sichuan Province were taken as the target objects for the survey.

Methods

From June to December 2021, commissioned by HCSC, CNQCC-SC obtained the list of medical institutions in the Sichuan Province through the official website,²⁶ from which 1,189 secondary or above medical institutions were selected and assigned to the 18 branch clinical nutrition quality control centers according to their 21 municipal administrative regions. Each subcenter was uniformly trained to instruct hospitals to complete the e-questionnaire through smartphones, WeChat, or websites.

Based on previous questionnaires, this e-questionnaire was revised by reviewing the literature and expert consultation, of which the contents included brief information of hospitals and their CNDs, the situation of nutrition diagnosis and treatment, the echelon of clinical nutrition professionals, and limitations of the discipline development. An additional file shows this e-questionnaire in more detail (see Supplementary Figure 1).

Quality control

Two investigators independently checked the data in the backend of the WJX (<https://www.wjx.cn>), thereby contacting the surveyed hospital or local quality control center to eliminate duplicate data, check abnormal data, and fill in missing data. Samples with omitted values were not included in subsequent analysis.

Statistics

Raw Excel data were downloaded from the backend of WJX, and the data were analyzed by SPSS 22.0 statistical software after data governance. If the data obeyed a normal distribution, the data were described in the form of $\bar{X}\pm S$, and if not, data were described in the form of M (p25, p75); Enumeration data are presented by the frequency, rate, proportion, or ratio.

Questionnaire distribution and return

A total of 1,189 electronic questionnaires were sent out, and 519 were returned. After deduplication, 455 valid questionnaires were received.

RESULTS

Basic hospital information

A total of 455 hospitals, whose locations were marked on Figure 1, replied with valid questionnaires, and only 228 (50.1%) had clinical nutrition service capacity. In other words, 228 hospitals had developed their CNDs regardless of whether they were independent or non-independent. Independent departments usually mean greater autonomy and more services. For instance, medical diets are unavailable in most hospitals with affiliated departments unless they outsource this job to a catering enterprise. Hospitals located in Chengdu, Deyang, Guangyuan, Yibin and Mianyang, just 5 out of 21 cities in Sichuan, already composed more than 50% of the 455 investigated hospitals. There were 84 (36.8%) Grade 3A hospitals, 73 (32.0%) Grade 3B hospitals and 27 (11.8%) Grade 2A hospitals, and no 2B hospitals. The number of general hospitals (159, 69.7%) that participated in this study was more than 2-fold that of specialized hospitals (69, 30.3%). Detailed information is presented in Table 2.

General information about CNDs

Among 228 hospitals with clinical nutrition capacity, 127 (55.7%) hospitals had independently set up CNDs, among which 95 (41.6%) had not outsourced medical catering services. Only 2 hospitals, Sichuan Province People's Hospital (1941) and West China

Hospital of Sichuan University (1946), created their CNDs before the 1990s. Then, the development tended to stagnate, and the rate of department establishment was less than 1 hospital per year. The first boom in the CND establishment occurred in 2003, with seven hospitals announcing that, but the growth was weak and a sharp decrease followed the next year. The second boom occurred in 2010, and since then, the CND construction speed has been maintained at approximately five new departments per year (Figure 2). To date, the majority (72.4%) of hospitals obey to what government regulates and have integrated CNDs into medical and technical departments. Hospitals without separate CNDs mostly like to attach virtual departments to the internal medicine departments. Detailed information is included in Table 3-4.

Professional profile

The 127 hospitals with independent CNDs included 877 clinical nutritionists with an average of 3 (1, 4) people per department and a range of 1 to 78. There were 13, 102, and 386 specialists, averaging 0 (0, 0), 0 (0, 1) and 3 (2,4) per hospital, with a doctorate, master's degree and bachelor's degree or lower. Respectively, 191, 134, 32, 132, 5 professionals, namely 1 (0, 2), 1 (0, 2), 0 (0, 0), 1 (0, 2), 0 (0, 0) on average, had a background in nutrition, clinical medicine/Chinese medicine, preventive medicine (excluding nutrition), nursing, pharmacy. They worked as nutritional technicians (223), nurses (203), clinical practitioners (195), public health practitioners (89), enteral nutrition formulators (31), and parenteral nutrition formulators (4). Each hospital was equipped with 0 (0, 1), 1 (0, 2), 1 (0, 2), 1 (0, 1), 0 (0, 0), and 0 (0, 0) persons for the above-mentioned types of work. Their titles, senior (20), associate (80), intermediate (169), and junior (206), averagely 0 (0, 0), 0.5 (0, 1), 1 (0, 2), 1 (0, 2) for each hospital, were distributed in the shape of a pyramid with a pointed top and a wide bottom.

Operational activities

In 2020, on average, one hospital would conduct 732 person-times of nutrition clinics, 410 person-times of nutrition consultations, and 1,516 person-times of nutrition rounds/follow-ups. In total, 562 outpatient units were performed each week, with an average volume of 2.5 units/week. One unit represents 4 hours of opening time for the clinic. In our province, two hospitals, Chengdu Longquanyi District Maternal and Child Health Hospital and Chengdu Minowa Women's and Children's Hospital, had their nutrition clinics opened to 14 units/week.

From the perspective of clinical practices, the average number of visits (person-times / per hospital) was 4,572 in nutritional screening, 869 in nutritional monitoring, 4,955 in dietary instruction, 36,333 in medical diet serving, 4,650 in enteral nutrition treatment, 173 in parenteral nutrition formula recommendations, and 29 in parenteral nutrition preparation (Table 5). To date, up to 10 types of medical diets have been available, with diabetic diets, low-fat diets, low-salt diets, and low-protein diets being more commonly accessible. These four types of medical diets could be obtained in 80, 45, 45, and 31 hospitals.

Software and hardware

We could give nutrition advice through the hospital information system (HIS), make online nutrition consultation records, use recipe preparation software to design individual diet therapies, and order medical meals through apps. However, the software to hospital ratio did not reach 1:1, but ranged from 1:0.1-0.5. For hardware, each hospital could have an area of 44.1 m² for medical diet preparation, 14.0 m² for enteral nutrition preparation, 6.0 m² for parenteral nutrition preparation. Food models have been used commonly, but few hospitals were equipped with body composition analyzers (BIAs) or metabolic carts.

Fees and charges

There were 107 types of clinical nutrition fees in those 228 capable hospitals, of which more common ones (shared by ≥ 10 hospitals, Table 6) included nutrition assessment, dialectical diet, nutrition consultation, body composition analysis, enteral nutrition (EN) preparation, and nutrition counselling, with an average price of 22.6 CNY (Chinese Yuan), 28.8 CNY, 16.0 CNY, 96.6 CNY, 45.5 CNY, and 9.8 CNY, respectively.

Self-assessment of constraints to development

The results of the self-assessments of factors of 228 hospitals limiting the development of their clinical nutrition service capacity showed that talent teams, hardware facilities, software facilities, treatment and fee issues, and the patients' willingness to access nutrition management ranked 1st, 2nd, 3rd, 4th, and 5th, while clinical department recognition and hospital policy support tied for the 6th place. The remaining 227 hospitals, who participated in this survey but had not yet established any CND, self-assessed that the talent teams, hardware facilities, software facilities, treatment and fee issues, patients' willingness to access nutrition management, clinical department recognition, and hospital policy support ranked in order from 1st to 7th. The Top4 factors were similar between these two groups.

DISCUSSION

Although CNDs in Sichuan are still at a primary stage, the development of their service capacity is in a swift rise and parallels with the direction of national policies

Most of the subordination of CNDs in Sichuan has been unified

The latest National CNQCC survey in 2018 showed that 78.5% of CNDs were medically attributed, while 11.39% were logistically attributed.²⁷ The proportion of CNDs logistically attributed in Sichuan (9.4%) was less than the national average, but its medical attribution (87.4%) was higher by 8.9% as shown in Table 5. The differences between national and provincial levels are possibly because 81.9% of CNDs in Sichuan were established after 2010, at a time when hospital accreditations began and CNDs started to be essential due to accreditation standards for tier-2 and tier-3 hospitals.

The echelon of clinical dietitians in Sichuan had basically taken shape

This survey showed a clinical dietitian to bed ratio of 1:214 in Sichuan Province in 2021 (Table 1). It was a significant improvement from 1:299 in 2018, but still far from the target value of 1:150 as presented in the National Nutrition Plan (2017-2030).²² The contribution rate of the increase in the number of primary and intermediate clinical dietitians to the upward trend was 91.3% and 67.5% respectively, and the total contribution rate of junior high and senior professionals was less than 30%. Data from the National NCQCC showed that the ratio of senior, associate, intermediate, and junior clinical dietitians in tertiary hospitals was about 1:1.6:1:0.3, which is between an olive shape and an inverted triangle, and suggested that we should be alert to the shrinking of the professional workforce in clinical nutrition and the lack of back-up strength.²⁷ The same ratio of Sichuan, calculated from the results of professional profile, was 1:4:8:10 in secondary and above hospitals and 1:3.6:7.3:9.4 in tertiary hospitals, thereby suggesting that Sichuan's talent team had basically taken shape and had a rapid growth potential. However, there was still an urgent need to strengthen the leading force and enrich the middle and reserve forces.

Sichuan keeps producing new blood of clinical nutrition to the west and all over the country

In western China, there were a total of 32 undergraduate/master's/doctoral degrees granting universities/colleges for medical nutrition. Furthermore, 25% of the degree granting universities/colleges were located in Sichuan Province, second only to that of the East (55 degree granting universities/colleges).²⁸ The CNQCC-SC was one of the earliest centers

among all provinces.²⁹ The standardized training for inpatient dietitians,³⁰⁻³² the only one in China, like the specialist qualification for registered dietitians in the USA,³³ has been implemented in Sichuan for nearly 10 years. Therefore, in terms of training capacity, Western China has a medium advantage and is a key area for future development.

High frequency communication makes every nutrition clinic or check-up/follow-up a suitable demand exploitation place.

The ratio of person-times of annual nutrition clinics, inpatient nutrition consultations and nutrition check-ups/follow-ups in Sichuan was 1.8:1:3.7. The annual number of visits to the nutrition clinic exceeded 150,000 person-times, and the nutrition check-ups/follow-ups explicated 300,000, which is far beyond the number of inpatient nutrition consultations (Table 5). The non-first visit workload, i.e., deducting nutrition clinics and inpatient nutrition consultations from the number of nutrition visits/follow-ups, remained at nearly 90,000 person-times. It was suggested that clinical nutrition professionals currently interface with patients' nutritional therapy needs mainly in nutrition clinics and active check-ups/follow-ups.

It could be a viable strategy for new CNDs to start up and young CNDs to make steady progress by proactively seeking hospital policy support and adhering to medical diets.

In terms of self-assessed constraints to development, established and non-established CND hospitals disagreed only on hospital policy support, thereby indicating that proactively seeking hospital policy support may be a successful experience in the operation and maintenance of established units.

In terms of clinical practice, although 58.4% of hospitals outsourced their medical catering operations, the volume of meals served for medical catering was still more than twice the volume of all other practices combined. Among other services, dietary guidance, enteral nutrition therapy, and nutrition screening are in the forefront with an operation volume of around one million person-times. Therefore, we need to re-examine the advantages of medical diets in terms of the accumulation of departmental survival materials, the concretization of dietary prescriptions and the broad base of the public. New and young CNDs were recommended to consider medical diets and enteral nutrition related practices as a preferred development orientation.

Charging items of clinical nutrition were scattered in Sichuan, but the most used items remain consistent with officially announced items in other province

In the past 5 years, Guangxi, Henan, Tianjin, Hubei, Guangzhou, Hebei, and Beijing have updated the clinical nutrition fee items, most of which were jointly issued by 2-3 bureaus,

namely the local Health and Welfare Commission with the Development and Reform Commission, the Department of Human Resources and Social Security, the Price Bureau, or the Medical Insurance Bureau.³⁴⁻⁴⁰ In total, 44 items were extracted from published documents, among which 13 items were held by no less than two provinces, and 6 overlapped with this survey: disease health education (1.9-2.59 CNY)/health consultation (4.6-6.48 CNY), dialectical diet guidance (9.2-13.2 CNY or hospital independent pricing), body composition analysis (45-50 CNY), nutritional screening and assessment (60-200 CNY), and in-hospital consultation (20-80 CNY).

It was found that Sichuan has a relatively lower cost in labor consuming items, such as the abovementioned health education/consultation, screening and assessment, and in-hospital consultation. Moreover, a total of 107 chargeable items were found among the 228 surveyed hospitals. Only 5 of these items were used by more than 4% of the hospitals, thus indicating that the charging items of clinical nutrition in Sichuan were highly fragmented. The issued charging items shared by ≥ 2 provinces contained all the items shared by ≥ 10 hospitals in this survey (Table 6), which indicated that the charging concentration trend in Sichuan was consistent with that of others, and suggested that a mature environment for the introduction of clinical nutrition treatment fee items was established in Sichuan.

CNDs today are marked by changes unseen in decades and preparation is required in advance

We used to regard CNDs as medical-technical departments, but now CNDs can be clinical departments with actual wards. In 1985, the former Ministry of Health of China issued the opinions on strengthening Clinical Nutrition work, which indicated that the CND should be one of the medical-technical departments.¹⁹ In 2009, the *Guidelines for the Construction and Management of Clinical Nutrition Departments (Trial)* expanded the connotation of the CND to departments carrying out nutrition treatment under the leadership of the medical dean.¹⁶ In 2016, Professor Diana Cardenas stated that clinical nutrition is an independent discipline with medical attributes.⁴¹ Furthermore, in 2019, Professor Shi Hanping put forward that nutritional status was a basic vital sign of patients.⁴² Subsequently, in 2021, the American Society for Parenteral and Enteral Nutrition (ASPEN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) claimed that nutritional diagnosis and treatment were human rights that are closely linked to the right to food and health, and all individuals should have access to evidence-based medical nutrition therapy. In the same year, NHC revised the old edition in 2009, reformulated the *Guidelines for the Construction and Management of Clinical Nutrition*

Departments (draft for consultation) and published its trial in 2022, in which CNDs were considered departments that can own wards and independently serve nutrition therapies.^{4, 43}

Limitations

The representativeness of 455 investigated hospitals is limited mainly because of the convenience sampling method and a high non-response rate. The survey sample size increased to 455 hospitals from 43 hospitals in 2016, 53 hospitals in 2018, and 77 hospitals in 2020. However, a convenience sampling method was still used, and the response rate was as low as 38.3%. Another reason would include bias from the location distribution. Only 7 municipal CNQCCs successfully invited more than half of their local secondary and tertiary hospitals. The other 14 centers failed to achieve this goal, and no hospitals were enrolled from Bazhong, Aba, and Ganzi. The final reason may be from local economy status and tertiary hospital proportion. The cumulative sample size composed of the Top10 cities in terms of GDP in 2020 was 67.3% (306/455), and tertiary hospitals accounted for over 50.0% of the investigated 455 hospitals. Therefore, the capacity of clinical nutrition services in hospitals above the second level in Sichuan Province may have been overestimated.

Conclusions

Hospitals at the second level and above in Sichuan are currently in the second climax of CND establishment and show a positive trend of departmental affiliation standardization. Their talent echelon has been basically formed. Medical diets and enteral nutrition were the focus of their clinical nutrition service capacity. Standard clinical nutrition fee items are approaching maturity in Sichuan.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare no conflict of interest.

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Table 1. Series of surveys on clinical nutrition service capacity (2013-2021)

Year	2013	2016	2018	2021
Total Number of Hospitals	43	78	53	228
Hospital Grade (n)				
3A	32	32	32	84
3B	5	26	18	73
2A	5	19	3	44
2B	1	1	0	27
Hospital Type (n)				
General hospitals	37	60	44	159
Specialist hospitals	6	18	9	69
CND Attribution (n)				
Medical treatment	12	48	43	111
Logistics	12	18	5	15
Professional Work (n)				
Enteral nutrition (EN)	/	53	38	110
Parenteral nutrition (PN)	/	11	1	71
Medical diet	/	46	15	76
Nutrition clinics	/	53	41	116
Nutritional testing	/	21	16	72
Tiles of Clinical Dietitians (%)				
Senior	/	2.2%	2.9%	3.7%
Associate	/	13.0%	17.6%	14.8%
Intermediate	/	28.1%	29.8%	31.2%
Junior	/	16.9%	38.0%	38.1%
Nutritional risk screening rates (%)	/	/	4.1	34.2
Positive nutritional risk screening rate (%)	/	/	26.2	21.8
EN preparation (person-times/year)	/	/	2406	4650
Average dietitian to bed ratio		1:394	1:299	1:214

/: null; n: number of hospitals

Table 2. Characteristics of hospitals with clinical nutrition service capacity

Location (City)	No. of hospitals	Administrative Level			Economic Type			Beds	
		County	Municipal	Provincial	Public	Private	Mixed	Fixed beds	Open beds
Chengdu	45	19	18	8	40	4	1	800 (500.5, 1275)	983 (507.5, 1546)
Deyang	20	11	9	0	15	5	0	400 (256, 550)	405 (328, 800)
Guangyuan	19	9	10	0	16	3	0	450 (150, 760)	520 (158, 842)
Yibin	19	16	3	0	18	1	0	500 (250, 550)	470 (300, 696)
Mianyang	18	13	4	1	17	1	0	505 (160, 857.5)	605 (250, 1083.5)
Leshan	15	9	6	0	10	4	1	270 (150, 500)	300 (180, 598)
Nanchong	14	9	4	1	12	2	0	300 (197.5, 1203)	310 (107.3, 1375)
Liangshan	12	7	5	0	12	0	0	400 (165, 517.5)	412.5 (263, 981.5)
Dazhou	10	7	3	0	7	3	0	400 (115, 962.5)	500 (115, 1050)
Zigong	9	4	5	0	9	0	0	850 (375, 1400)	1056 (560, 1981)
Luzhou	8	4	2	2	8	0	0	740 (552.5, 2575)	792 (650, 2221)
Neijiang	7	3	4	0	7	0	0	1100 (600, 1200)	1200 (600, 1600)
Guangan	6	5	1	0	6	0	0	495 (375, 820)	525 (417.5, 910)
Meishan	6	4	2	0	6	0	0	250 (175, 675)	350 (225, 712)
Suining	6	4	2	0	5	1	0	700 (469.5, 1200)	700 (462.5, 1385)
Panzhihua	5	0	5	0	5	0	0	900 (460.5, 1386.5)	1073 (415.5, 1650)
Ziyang	5	3	2	0	5	0	0	799 (550, 1000)	1000 (801, 1750)
Yaan	4	2	2	0	4	0	0	510 (499.3, 1255)	537.5 (491.8, 1426.3)
Total No.	228	129	87	12	202	24	2	510 (253, 990)	600 (300, 1104.5)

Table 3. Affiliated departments of non-independent clinical nutrition departments

Affiliated Departments	No. of hospitals	Proportion (%)	Affiliated Departments	No. of hospitals	Proportion (%)
Internal medicine	24	23.8	Outpatient	4	4.0
Health care	16	15.8	Medical technology	3	3.0
Logistics	16	15.8	Surgery	2	2.0
Administration	14	13.9	Paediatrics	1	1.0
Obstetrics and Gynaecology	9	8.9	Geriatrics	1	1.0
Physical examination	5	5.0	Critical care	1	1.0
Chinese medicine	4	4.0	Hospital infection control	1	1.0

Table 4. Subordination of independent clinical nutrition departments

Subordination of independently set-up CNDs	No. of hospitals (n=127)	Proportion (%)
Clinical departments	19	15.0
Medical and technical departments	92	72.4
Logistics departments	12	9.4
Administration departments	3	2.4
Others	1	0.8

† Japanese, Thai, Korean, Philippine

‡ Defined as having three of three policies in place

Table 5. Characteristics of clinical nutrition departments

CND characteristics and details	Average No.	Total No.
Professional activities per year		
Nutrition clinics (pts)	732 ± 2851	166983
Nutrition consultations (pts)	410 ± 1301	93565
Nutrition rounds/follow-ups (pts)	1516 ± 5631	345547
Nutritional screening (pts)	4572 ± 12987	1042497
Nutritional monitoring (pts)	869 ± 4077	198109
Dietary instruction (pts)	4955 ± 36396	1129737
Medical diet serving (pts)	36333 ± 443590	8283856
Enteral nutrition treatment (pts)	4650 ± 49944	1060209
Parenteral nutrition formula recommendations (pts)	173 ± 920	39421
Parenteral nutrition preparation (pts)	29 ± 260	6605
Hardware facilities		
Medical diet preparation room (m ²)	43.3 ± 167.7	10049.0
Enteral nutrition preparation room (m ²)	13.6 ± 23.4	3193.7
Parenteral nutrition preparation room (m ²)	6.0 ± 60.6	1371.0
Body composition analyzer (sets)	0 (0, 1)	87
Metabolic carts (pcs)	0 (0, 0)	8
Food models (pcs)	1 (0, 23)	3910
Software facilities		
Hospital information system (HIS) (sets)	0 (0, 1)	76
Nutrition consultation e-recording system (sets)	0 (0, 1)	106
Recipe preparation software (sets)	0 (0, 1)	65
Medical Diet service system (sets)	0 (0, 0)	12

pts: person-times; pcs: pieces

Table 6. Costs of nutritional treatment

Charging Items (shared by ≥ 5 hospitals)	No. of hospitals	Average price (CNY)	Price range (Min-Max, CNY)
Nutrition assessment	44	22.6 \pm 34.4	0.0 - 220.0
Dialectical diet [†]	43	28.8 \pm 31.9	0.0 - 101.0
Nutrition consultation	42	16.0 \pm 7.8	0.0 - 40.0
Body composition analysis	29	96.6 \pm 36.8	0.0 - 181.0
EN preparation	19	45.5 \pm 101	0.0 - 326.0
Nutrition counselling	13	9.8 \pm 4.6	2.0 - 18.0
Nutrition screening	8	18.3 \pm 18.4	0.0 - 49.0
Diet instruction (e.g., recipes)	7	30.3 \pm 16.1	5.0 - 49.0
Energy metabolism measurement	5	224.0 \pm 32.9	199.0 - 260.0

[†]a widely used synonym of nutrition assessment in the field of Traditional Chinese Medicine Food Therapy

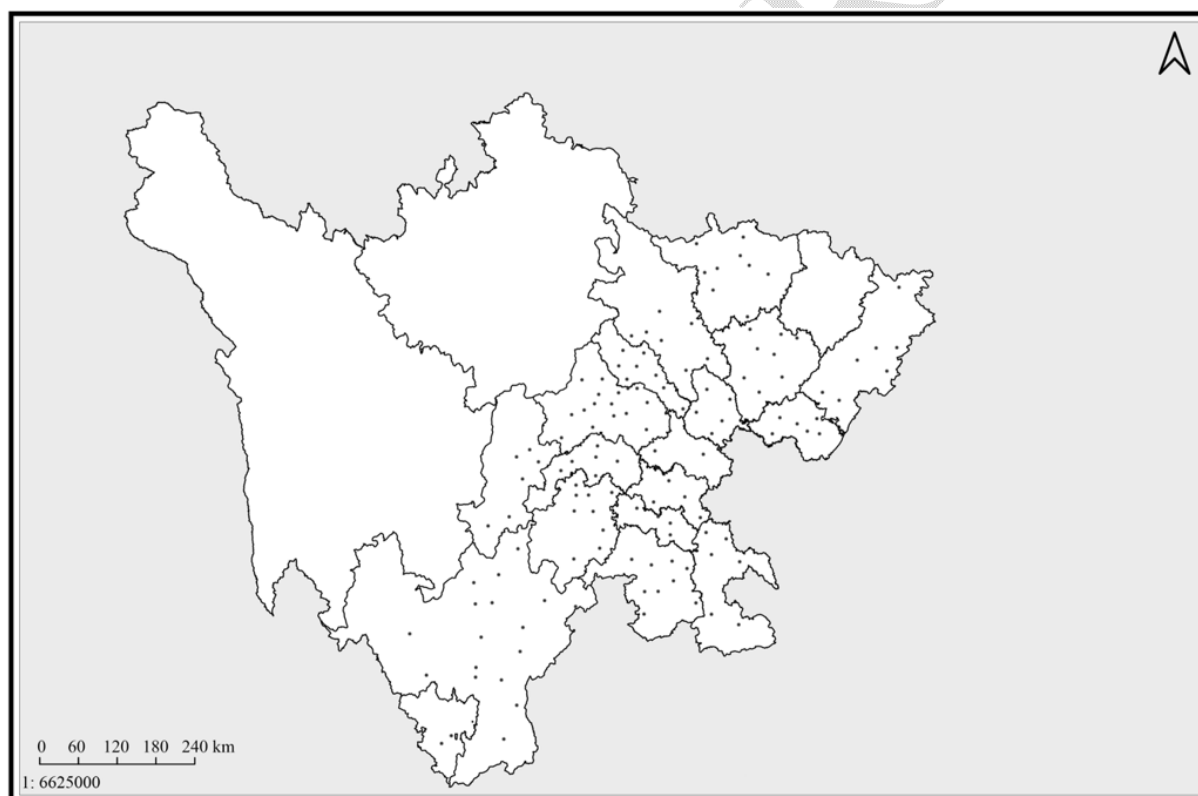


Figure 1. Location map of the 455 investigated hospitals in Sichuan, China. [†]Created from the Online dynamic map platform of the Sichuan Bureau of Surveying, Mapping and Geoinformation (<http://scsm.mnr.gov.cn/nbzdt.htm>). No modification of map boundaries.

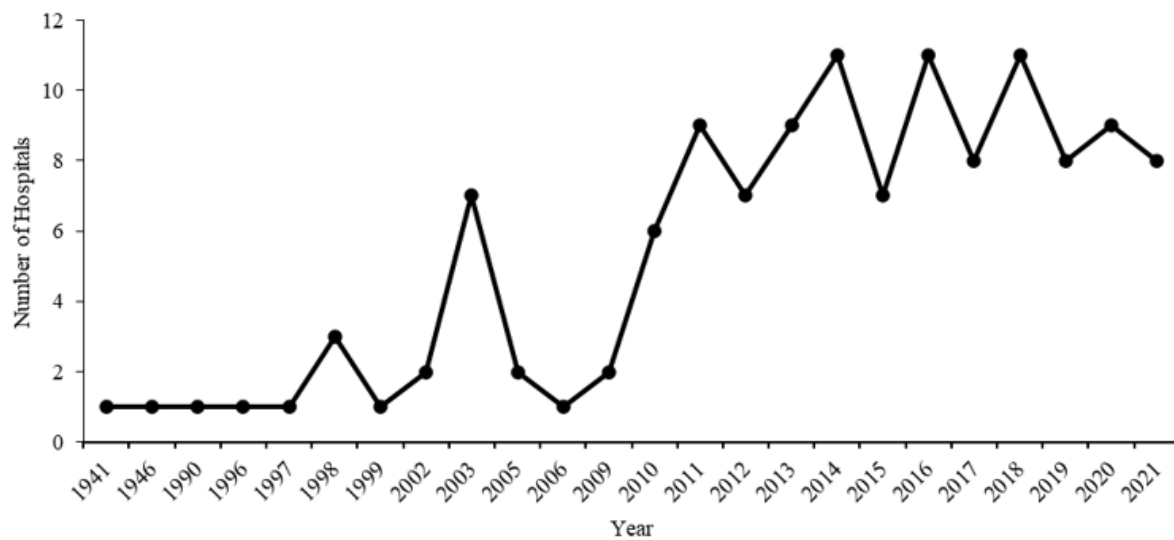


Figure 2. CND creating speed changes in clinical nutrition departments

Q1: Hospital name	_____	Q2: Hospital location:	_____ City
Q3: Hospital grade:	<input type="checkbox"/> 3A; <input type="checkbox"/> 3B; <input type="checkbox"/> 2A; <input type="checkbox"/> 2B		
Q4: Hospital type:	<input type="checkbox"/> Comprehensive hospital; <input type="checkbox"/> Specialty hospital, _____ (Please fill in detail)		
Q5: Administrative level	<input type="checkbox"/> Provincial and ministerial level; <input type="checkbox"/> Prefectural and municipal level; <input type="checkbox"/> County level		
Q6: Economic type:	<input type="checkbox"/> Public hospital; <input type="checkbox"/> Private hospital; <input type="checkbox"/> Mixed hospital		
Q7: Fixed beds:	_____	Q8: Open beds:	_____
Q9: Is the clinical nutrition department (CND) of your hospital set up independently?	<input type="checkbox"/> Yes; <input type="checkbox"/> No, CND is affiliated to _____ department		
Q10: In which year was your CND established? You can add text notes.	_____		
Q11: Subordination:	<input type="checkbox"/> Clinical department; <input type="checkbox"/> Medical and technical department; <input type="checkbox"/> Logistics department; <input type="checkbox"/> Others		
Q12: How many professional and technical personnel engaged in clinical nutrition work?	_____		
Q14: How many people have the following educational degrees?	Doctorate: _____; Master: _____; Undergraduate: _____; Others: _____		
Q15: Majors	Nutrition: _____; Clinical medicine (including Traditional Chinese Medicine): _____; Public health (excluding public nutrition): _____; Nursing: _____; Pharmacology: _____; Others: _____		
Q16: Titles	Senior: _____; Associate: _____; Intermediate: _____; Junior: _____; Others: _____		
Q17: Personnel classification	Public health physician: _____; Clinical medicine physician: _____; nutritional technician: _____; nutritional nurse: _____; enteral nutrition formulator: _____; parenteral nutrition formulator: _____; Others: _____ (Please fill in working roles and its personnel size)		
Q18: Clinical nutrition practices	Nutrition clinics (person-times): _____; Nutrition consultation (person-times): _____; Nutrition check-ups/follow-ups(person-times): _____; others: _____ (Please fill in practices type name and its person-times)		
Q19: How many nutrition clinic units (a half day = 1 unit) do you have?	_____		
Q20: Have you outsourced the medical diet?	<input type="checkbox"/> Yes; <input type="checkbox"/> No		
Q21: Clinical nutrition working load	Nutritional screening (person-times): _____; Nutritional monitoring (person-times): _____; Dietary instruction (person-times): _____; Medical diet serving (person-times): _____; Enteral nutrition treatment (person-times): _____; Parenteral nutrition formula recommendations (person-times): _____; parenteral nutrition preparation (person-times); Others: _____ (Please fill in practices type name and its person-times)		
Q22: Hardware facilities	Medical diet preparation room (m ²): _____; Enteral nutrition preparation room (m ²): _____; Parenteral nutrition preparation room (m ²): _____; Body composition analyzer (sets): _____; Metabolic carts (pcs): _____; Food models (pcs): _____; Others: _____ (Please fill in hardware name and its number)		
Q23: Do you serve medical diet?	<input type="checkbox"/> Yes; <input type="checkbox"/> No		
Q24: What kinds of medical diet do you have?	<input type="checkbox"/> Diabetes diet; <input type="checkbox"/> Low protein diet; <input type="checkbox"/> Low fat diet; <input type="checkbox"/> liver disease diet; <input type="checkbox"/> Medium chain triglyceride diet; <input type="checkbox"/> Low purine diet; <input type="checkbox"/> Low salt diet; <input type="checkbox"/> Other diet		

Supplementary Figure 1. Clinical nutrition service capacity questionnaire. [†]The Chinese edition of this questionnaire could be available at <https://www.wjx.top/vj/YDy9Q23.aspx#>

Q25: Software facilities	<input type="checkbox"/> Hospital information system (HIS) (sets); <input type="checkbox"/> Nutrition consultation e-recording system (sets); <input type="checkbox"/> Recipe preparation software (sets); <input type="checkbox"/> Medical Diet service system (sets); <input type="checkbox"/> Others _____ (please specify); <input type="checkbox"/> None of the above		
Q26: Charging items	Item name 1: _____; price 1: _____	Item name 2: _____; price 2: _____	Item name 3: _____; price 3: _____
	Item name 4: _____; price 4: _____	Item name 5: _____; price 5: _____	Item name 6: _____; price 6: _____
Q27: Rank the following constraints to development	____human resources team ____hardware facilities ____software facilities ____consultation and charging issues ____patients' willingness to access nutrition management ____clinical department recognition ____hospital policy support ____Others _____ (please specify)		

Supplementary Figure 1. Clinical nutrition service capacity questionnaire. †The Chinese edition of this questionnaire could be available at <https://www.wjx.top/vj/YDy9Q23.aspx#>