

Preplanned Studies

Construction and Application of A Quality Control Indicator System for the Sentinel Surveillance Project for Major Nutrition and Chronic Disease Issues — China, 2022–2025

Zhiwei Xia¹; Xin Xin²; Jingjing Pan²; Xiuying Liu¹; Li Zhang³; Kuke Ding³; Xiaozhe Tang^{3,†}

Summary

What is already known about this topic?

The National Health Commission established a sentinel surveillance project for major nutrition and chronic disease issues in 2022, with a four-tiered full-process quality control (QC) system, monitoring Healthy China Action 2030 indicators.

What is added by this report?

A 68-indicator QC system was developed through two Delphi expert consultation rounds. Application across 38 surveillance sites (2023–2025) showed 95.67% (2,472/2,584) overall compliance. Physical measurement was the weakest dimension. Regional disparities narrowed after targeted interventions.

What are the implications for public health practice?

This system identifies surveillance weaknesses, guides targeted improvements, and provides a replicable reference for QC in other population-based surveillance programs.

ABSTRACT

Introduction: The National Sentinel Surveillance Project for Specific Health Problems was launched in 2021 to monitor overweight, obesity, anemia, and Healthy China 2030 indicators in 101 counties. Ensuring surveillance quality requires a scientific quality control (QC) indicator system.

Methods: A QC indicator system was developed through a literature review and two rounds of Delphi expert consultation with 15 experts. Indicator screening was guided by mean importance scores, coefficients of variation, and feasibility ratings for each indicator. The analytic hierarchy process and expert scoring determined weights. The system was applied to 2,584 QC inspections at 38 sites (2023–2025). Data were analyzed using chi-square tests and the Cochran–Armitage trend test.

Results: The system comprised 6 first-level, 19

second-level, and 68 third-level indicators. Overall compliance was 95.67% (2,472/2,584), increasing from 94.24% (769/816) in 2023 to 96.53% (919/952) in 2025 ($\chi^2=5.42$, $P=0.02$). Compliance was highest for equipment and materials 98.54% (674/684) and lowest for physical measurement 92.76% (705/760) ($P<0.01$).

Conclusion: The QC indicator system is scientific and feasible. Physical measurement and questionnaire surveys require improvement, with weaknesses in northeastern provinces. This system is useful for evaluating similar surveillance programs.

In 2021, the National Health Commission launched the Sentinel Surveillance Project for Specific Health Problems, focusing on major nutrition and chronic disease issues in China. The project selected 101 sentinel districts/counties in 31 provincial-level administrative divisions (PLADs) and Xinjiang Uygur Autonomous Region starting in 2022. The annual sample of $\geq 170,000$ persons comprises four population groups (0–5, 6–17, 18–59, and ≥ 60 years). Surveillance includes questionnaires on Healthy China Action indicators, anthropometric measurements (height, weight, waist circumference), and on-site hemoglobin testing.

Data accuracy requires strict adherence to the four-level quality control (QC) system throughout the process. This process includes pre-implementation training, material preparation, on-site QC, and post-implementation data review. Other public health surveillance programs, such as those for chronic diseases and nutrition, common student diseases, and infectious diseases, emphasize that reliable QC systems are required for data utilization (1–3). Unlike single-domain surveillance programs, this cross-sectoral initiative under the Healthy China Action framework integrates monitoring requirements across chronic diseases, nutrition, maternal and child health, and

school health. It covers all age groups and involves multiple data collection modalities. Each domain has its own QC requirements based on different standards (1–4), which no single QC framework can address simultaneously. This study aimed to develop a scientific QC indicator system and evaluate its application using on-site QC data from 2023 to 2025.

Based on China's nutrition and chronic disease surveillance systems and common student disease surveillance QC indicator systems (3–4), combined with a literature review, a preliminary on-site QC framework was developed comprising six dimensions: organizational management, sampling implementation, physical measurement, questionnaire survey, on-site hemoglobin testing, and equipment/materials management.

Fifteen experts were purposively selected from national and provincial Centers for Disease Control and Prevention (CDCs) and universities across four regions. Their disciplinary backgrounds included chronic disease epidemiology ($n=4$), nutrition ($n=4$), school health ($n=1$), biostatistics ($n=2$), public health management ($n=2$), and grassroots frontline staff ($n=2$). Five experts held associate senior titles and ten held senior titles, all with bachelor's degrees or above. Their experience included 5–10 ($n=4$), 10–20 ($n=9$), and over 20 years ($n=2$). Expert authority was assessed using a standardized matrix.

Two Delphi consultation rounds were conducted during the 2022 national project training sessions. In Round 1, experts used 5-point Likert scales to rate importance (1=not important to 5=very important), familiarity (1=very unfamiliar to 5=very familiar), judgment basis, and feasibility (1=very poor to 5=very good). Indicator retention criteria were as follows: 1) mean importance score ≥ 3.5 , 2) coefficient of variation (CV) $\leq 25\%$, and 3) feasibility rated as "good" or "very good" by $\geq 80\%$ of experts. Experts could suggest modifications or new indicators. Round 2 presented summarized results from Round 1, and the experts re-rated indicators using stricter criteria (CV $\leq 20\%$). The initial pool comprised 78 indicators. After Round 1, 8 indicators were deleted, 12 modified, and 5 added, yielding 75 indicators. After Round 2, 7 were deleted, 6 further modified, and 68 retained as the final system (Supplementary Table S1, available at <https://weekly.chinacdc.cn>). The Delphi rounds and retention criteria were consistent with other Delphi-based studies (5–9), which have typically employed two to three rounds with similar statistical thresholds.

First-level indicator weights were calculated using

the analytic hierarchy process (AHP) with consistency checked (CR < 0.1). Second- and third-level indicators were weighted using expert scoring based on importance and feasibility, followed by normalization.

Stratified by four geographic regions, one to five provincial-level administrative divisions (PLADs) were selected annually. In 2023 and 2024, 12 PLADs were selected annually. In 2025, the remaining 8 PLADs and 6 previously weak areas were included, totaling 14 PLADs. Over three years, full coverage of 31 PLADs and the Xinjiang Production and Construction Corps was achieved. One representative surveillance site was randomly selected from each sampled PLAD, yielding 38 total sites. Sampled PLADs did not overlap between 2023 and 2024. Annual training was provided to QC experts. Each year, from May to August, the National Project Management Office coordinated cross-supervision, with 120 expert person-times over three years, following the National Sentinel Surveillance Work Manual. QC verification covered on-site guidance, document reviews, data verification, personnel interviews, and spot checks.

Frequencies, composition ratios, and compliance rates described QC performance. Chi-square tests compared inter-group differences. Cochran–Armitage trend tests analyzed annual trends ($\alpha = 0.05$). SPSS (version 25.0; IBM Corp., Armonk, NY, USA) was used.

Both Delphi rounds had 100% (15/15) response rates. The mean expert authority coefficient was 0.85, and Kendall's W increased from 0.21 in Round 1 to 0.28 in Round 2 ($P < 0.01$). The mean importance score across indicators was 4.31 (standard deviation: 0.52), with CVs ranging from 9.80% to 18.50%. The final QC system comprised 6 first-level dimensions, 19 second-level indicators, and 68 third-level indicators (Supplementary Table S2, available at <https://weekly.chinacdc.cn>).

Of 2,584 inspections, 2,472 were qualified, yielding an overall compliance of 95.67% (2,472/2,584), increasing significantly from 94.24% (769/816) in 2023 to 96.53% (919/952) in 2025 ($P = 0.02$) (Table 1). Cumulative compliance rates were 96.11% (915/952), 95.88% (652/680), 95.22% (777/816), and 94.11% (128/136) in western, central, eastern, and northeastern China, respectively ($P = 0.63$). However, eastern China showed steady yearly improvement ($P = 0.04$), and northeastern China (2024–2025) increased from 89.71% (61/68) to 98.53% (67/68) ($P = 0.03$), highlighting the effectiveness of targeted supervision (Table 2).

TABLE 1. Comparison of compliance rates for on-site quality control evaluations across four geographic regions in China, 2023–2025 [*n* (%)].

Regions	2023		2024		2025		Total		χ^2_{trend}	<i>P</i>
	Items	Compliance Items	Items	Compliance Items	Items	Compliance Items	Items	Compliance Items		
Eastern	272	253 (93.01)	136	130 (95.59)	408	394 (96.57)	816	777 (95.22)	4.42	0.04
Central	272	254 (93.38)	272	268 (98.53)	136	130 (95.59)	680	652 (95.88)	2.72	0.01
Western	272	262 (96.32)	340	325 (95.59)	340	328 (96.47)	952	915 (96.11)	0.02	0.89
Northeastern*	–	–	68	61 (89.71)	68	67 (98.53)	136	128 (94.11)	4.75	0.03
Total	816	769 (94.24)	816	784 (96.08)	952	919 (96.53)	2,584	2,472 (95.67)	5.42	0.02
χ^2		3.30		11.97		1.16		1.71		
<i>P</i>		0.19		0.01		0.76		0.63		

Note: χ^2_{trend} and *P* were obtained from the Cochran–Armitage trend test comparing compliance rates across four geographic regions of China, 2023–2025. Eastern China (Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan); Central China (Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan); Western China (Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang); and Northeastern China (Liaoning, Jilin, Heilongjiang). *P*<0.05 indicates a statistically significant difference. – means no data.

* Northeastern China was evaluated in 2024–2025 only.

TABLE 2. Comparison of compliance rates among six quality control dimensions of the sentinel surveillance project for major nutrition and chronic disease issues — China, 2023–2025 [*n* (%)].

Domain	2023	2024	2025	Total	χ^2_{trend}	<i>P</i>
Organizational management	91 (94.79)	93 (96.88)	106 (94.64)	290 (95.39)	0.01	0.93
Sampling	82 (97.62)	84 (100.00)	95 (96.94)	261 (98.12)	0.16	0.69
Physical measurement	221 (92.08)	217 (90.42)	267 (95.36)	705 (92.76)	2.27	0.13
Questionnaire survey	67 (93.06)	70 (97.22)	77 (91.67)	214 (93.86)	0.18	0.67
Hemoglobin testing	99 (91.67)	105 (97.22)	124 (98.41)	328 (95.91)	6.52	0.01
Equipment and materials	209 (96.76)	215 (99.54)	250 (99.21)	674 (98.54)	4.54	0.03
Total	769 (94.24)	784 (96.08)	919 (96.53)	2,472 (95.67)	5.42	0.02
χ^2	7.99	28.48	15.33	34.81		
<i>P</i>	0.15	< 0.01	0.01	< 0.01		

Note: χ^2_{trend} and *P* were obtained from the Cochran–Armitage trend test comparing compliance rates across six quality control dimensions from 2023 to 2025 in China.

P<0.05 indicates a statistically significant difference.

The six dimensions differed significantly. Compliance was highest for equipment and materials 98.54% (674/684) and lowest for physical measurement 92.76% (705/760) (*P*<0.01). Hemoglobin testing and equipment and materials management trended upward (*P*<0.05) (Table 2). Regionally (Table 3), eastern China exhibited weaknesses in questionnaires 90.28% (65/72) and physical measurement 90.83% (218/240). Western China showed deficiencies in physical measurement 93.21% (261/280), questionnaires 95.24% (80/84), and hemoglobin testing 95.24% (120/126). Physical measurement compliance was lowest in northeastern China 82.50% (33/40) and highest in central China 96.50% (193/200); all *P*<0.05.

DISCUSSION

The methodological rigor of this study includes two Delphi rounds, 100% (15/15) response rate, authority coefficient of 0.85, Kendall's *W* ranging from 0.21 to 0.28, and importance scores across all indicators. These metrics are consistent with or exceed recent Delphi-based studies (5–9).

A hybrid weighting strategy was selected because the six first-level dimensions are conceptually distinct and few in number, making AHP pairwise comparisons feasible. Lower-level indicators are operationally specific, and expert scoring allows for more direct and practical weight assignment. This two-tiered approach balances methodological rigor with operational

TABLE 3. Comparison of on-site quality control compliance rates by six quality control dimensions across four geographic regions of China [*n* (%)].

Region	Organizational management	Sampling	Physical measurement	Questionnaire survey	Hemoglobin testing	Equipment and materials	Total	χ^2	<i>P</i>
Eastern	92 (95.83)	84 (100.00)	218 (90.83)	65 (90.28)	104 (96.30)	214 (99.07)	777 (95.22)	26.42	<0.01
Central	74 (92.50)	65 (92.86)	193 (96.50)	57 (95.00)	87 (96.67)	176 (97.78)	652 (95.88)	6.18	0.26
Western	108 (96.43)	98 (100.00)	261 (93.21)	80 (95.24)	120 (95.24)	248 (98.41)	915 (96.11)	14.94	0.01
Northeastern	16 (100.00)	14 (100.00)	33 (82.50)	12 (100.00)	17 (94.44)	36 (100.00)	128 (94.11)	9.84	0.02
Total	290 (95.39)	261 (98.12)	705 (92.76)	214 (93.86)	328 (95.91)	674 (98.54)	2,472 (95.67)	34.81	<0.01
χ^2	2.61	9.71	11.32	1.97	0.83	1.21	1.71	—	—
<i>P</i>	0.46	0.04	0.01	0.54	0.86	0.78	0.63	—	—

Note: χ^2 and *P* were obtained from the chi-square tests comparing the compliance rates among six quality control dimensions across four geographic regions of China. Data are cumulative across 2023–2025. Eastern China (Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan); Central China (Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan); Western China (Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang); and Northeastern China (Liaoning, Jilin, Heilongjiang).

P<0.05 indicates a statistically significant difference.

“—” means no data.

feasibility and has been used in previous Delphi-based indicator studies (10).

The QC system was established in 2022, with a baseline compliance rate of 94.24% (769/816). This indicates strong initial QC from the outset. Compliance rates continued to increase through training and repeated implementation, providing a valuable reference for large-scale surveillance QC. The 8.82-percentage-point increase in northeastern China has practical public health significance. This demonstrates that applying the QC system in weak areas can effectively promote QC and ensure more reliable data.

Physical measurement had the lowest three-year average compliance. Reasons include high operator turnover, limited staffing, suboptimal field conditions, and inadequate privacy protection. Common problems were insufficient privacy during waist circumference measurement and improper weight instruments calibration. Other issues included insufficient inter-departmental collaboration, unjustified invalid sampling entries, failure to refrigerate hemoglobin QC solution, and insufficiently detailed secondary review of questionnaires.

Five recommendations are proposed. First, strengthen physical measurement training, incorporating daily calibration, standardized procedures, and privacy protection into mandatory assessments. Uniformly provide privacy screens and standard weights. Second, improve the full-process questionnaire review mechanism with double review and standardized informed consent. Third, enhance regional collaboration by leveraging high-performing PLADs for routine on-site guidance. Fourth, refine

hierarchical QC assessment by designating persistently low-compliance items and PLADs as annual priority targets. Fifth, given high operator turnover as a key contributor to low physical measurement compliance, incorporate this work into institutional performance evaluation systems, including awards and recognition for frontline staff. Personnel stability (i.e., proportion of trained staff who participate in subsequent surveys) should be added as a supplementary indicator in the organizational management dimension.

The findings of this report are subject to at least three limitations. First, on-site supervision involved point-in-time evaluations, which may not fully reflect routine daily work levels owing to the Hawthorne effect. Future QC efforts could mitigate this with remote real-time monitoring, including photo and audio documentation, combined with unannounced inspections. Observer bias was minimized using standardized checklists (68 indicators) and annual expert training. Second, indicators were primarily designed for nutrition and chronic disease surveillance and may require adaptation for other health domains. Future studies could apply this system to other population-based surveillance programs to test its generalizability (6,9). Third, the 15-expert Delphi panel may not fully reflect the views of grassroots frontline staff across regions.

Establishing a standardized QC evaluation indicator system and conducting annual cross-regional mutual inspections can accurately assess program strengths and implementation difficulties. Continuous QC evaluations are essential for improving surveillance data quality. This system provides a reference for QC methods in other population surveillance programs.

Conflicts of interest: No conflicts of interest.

Acknowledgments: The authors sincerely thank the frontline CDC staff at all levels across China and all experts who participated in this QC evaluation for their strong support.

Ethical statement: The overall project was approved by the Ethics Review Committee of the Chinese Center for Disease Control and Prevention (Approval No. 2022(J)01).

Funding: This study was funded by the National Sentinel Surveillance Special Project for Specific Health Issues.

doi: [10.46234/ccdcw2026.177](https://doi.org/10.46234/ccdcw2026.177)

Corresponding author: Xiaozhe Tang, tangxz@chinacdc.cn.

¹ Institute for School Health, Beijing Center for Disease Control and Prevention, Beijing, China; ² Office of Beijing Center for Disease Control and Prevention, Beijing, China; ³ Chinese Center for Disease Control and Prevention & Chinese Academy of Preventive Medicine, Beijing, China.

Copyright © 2026 by Chinese Center for Disease Control and Prevention & Chinese Academy of Preventive Medicine. All content is distributed under a Creative Commons Attribution Non Commercial License 4.0 (CC BY-NC).

Submitted: June 07, 2026

Accepted: August 17, 2026

Issued: August 28, 2026

REFERENCES

1. Wang LM, Zhang M, Zhou MG, Jiang Y, Li YC, Huang ZJ, et al.

- Study on construction and application of technology system of chronic diseases and risk factor surveillance in China. *Chin J Epidemiol* 2021;42(7):1154 – 9. <https://doi.org/10.3760/cma.j.cn112338-20210104-00002>.
2. National Health Commission of the People's Republic of China. Report on the nutrition and chronic diseases status of Chinese residents 2020. Beijing: People's Medical Publishing House. 2020. <https://book.kongfz.com/22528/10302734363>. (In Chinese).
3. Cui MJ, Long L, Ma Q, Xing Y. Construction of quality control evaluation indicators for common diseases surveillance among students. *Chin J Sch Health* 2025;46(6):894 – 8. <https://doi.org/10.16835/j.cnki.1000-9817.2025171>.
4. Xing LH, Pan YN, Jia Q, Niu Y, Xu ML, Jing HQ. Study on external quality control evaluation index system of epidemiological investigation. *Soft Sci Health* 2019;33(6):27 – 31. <https://doi.org/10.3969/j.issn.1003-2800.2019.06.006>.
5. Wang L, Zhang YM, Chi Y. Construction of outcome quality evaluation indicators for home hospice care in older patients with terminal cancer in China: a Delphi study. *Clin Interv Aging* 2026;21: 599036. <https://doi.org/10.2147/CIA.S599036>.
6. Ding H, Wu D, Lyu H, Zhang X, Fan YX, Tian J. Developing a quality index and an evaluation indicator system for the National Food Safety Standard Framework in China. *J Public Health Policy* 2026;47(1):99 – 112. <https://doi.org/10.1057/s41271-026-00620-1>.
7. Yan LC, Pu HX, Shi XY, Yu Q, Wang ZY, Hu YJ, et al. Construction of key quality indicators for aged care facilities in China: a two-tier Delphi study. *J Clin Nurs* 2024;33(2):752 – 67. <https://doi.org/10.1111/jocn.16917>.
8. Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: how to decide its appropriateness. *World J Methodol* 2021;11(4):116 – 29. <https://doi.org/10.5662/wjm.v11.i4.116>.
9. Ogbeide SA, Bayles B. Using a Delphi technique to define primary care behavioral health clinical supervision competencies. *J Clin Psychol Med Settings* 2024;31(1):108 – 21. <https://doi.org/10.1007/s10880-023-09964-2>.
10. Zhang SJ, Li J, Ma QQ, Mu DD. Development of the evaluation indicator system for quality control and early warning effect of syndromic surveillance of infectious diseases in students by Delphi method. *Pract Prev Med* 2021;28(4):506 – 9. <https://doi.org/10.3969/j.issn.1006-3110.2021.04.027>.

SUPPLEMENTARY MATERIALS

Supplementary Table S1 provides the complete 68-item QC indicator framework across six domains (A–F): Organizational Management (8 items), Sampling Implementation (7 items), Physical Measurements (20 items), Questionnaire Surveys (6 items), Hemoglobin Testing (9 items), and Equipment and Materials (18 items).

Supplementary Table S2 summarizes the QC indicator system, including six first-level dimensions, AHP weights, representative second-level indicators, and the number of third-level indicators per dimension.

The tool was validated by experts in epidemiology, nutrition, public health, and information technology to ensure systematic, comprehensive, and scientific validity. This framework was developed through literature review and two rounds of Delphi expert consultation (2022) and applied to on-site QC inspections across 38 surveillance sites in China from 2023 to 2025.

SUPPLEMENTARY TABLE S1. Quality control indicator system for the sentinel surveillance project for major nutrition and chronic disease issues — China, 2023–2025.

First-level dimension (AHP weight)	Representative second-level indicators	Number of third-level indicators
Organizational management (0.16)	Work plan, training, supervision, and data review	8
Sampling implementation (0.19)	Sampling frame, sample size, and age/sex distribution	7
Physical measurement (0.14)	Equipment calibration, measurement environment, operation procedure, and privacy protection	20
Questionnaire survey (0.15)	Informed consent, interview method, primary review, and secondary review	6
On-site hemoglobin testing (0.17)	Quality control slides, sample testing time, and record completeness	9
Equipment and materials management (0.19)	Equipment type, calibration status, supplies, and records	18

Note: Weights of first-level dimensions were calculated via AHP pairwise comparison. Second-level and third-level indicators were weighted by integrated expert scoring based on indicator importance and operational feasibility.
Abbreviation: AHP=analytic hierarchy process.

SUPPLEMENTARY TABLE S2. The 68-item quality control indicator framework for the sentinel surveillance project for major nutrition and chronic disease issues — China, 2022–2025.

Domain	Item	Description	Domain	Item	Description
Organizational Management	A1	Provincial CDC established monitoring working group for guidance and coordination	Questionnaire Surveys	D1	Staff explained project purpose, significance, potential risks and benefits, survey content, completion requirements, and precautions to respondents
	A2	Provincial CDC organized training and assessment for surveillance site staff		D2	Respondents signed informed consent forms
	A3	Provincial CDC arranged on-site quality control visits within its jurisdiction		D3	Food frequency questionnaire completed by interviewer inquiry
	A4	Provincial-level designated personnel responsible for project data review		D4	Staff conducted primary review of completed questionnaire information
	A5	Prefectural-level designated personnel responsible for project data review		D5	Site supervisor conducted secondary review of questionnaire information
	A6	Prefectural or county-level CDC organized training and assessment for surveillance site staff		D6	Survey site well-organized, with reasonable setup and adequate preparation
	A7	Surveillance site developed and implemented quality control plan	Hemoglobin Testing	E1	Quality control slides and blind samples tested before testing began
	A8	Surveillance site designated personnel responsible for full-process quality control		E2	Quality control slides and quality control solution tested as required during testing
Sampling	B1	Sampling frame information (townships, administrative villages, schools, maternal and child health institutions) completely entered into monitoring system		E3	Standardized training and assessment provided to testing personnel before testing
	B2	No invalid sampling processes occurred in the monitoring system		E4	Samples tested within 40 seconds after blood collection
	B3	Sample size met requirement		E5	Blood samples completely absorbed onto test strip
	B4	Age distribution and sex ratio of sampled population complied with requirements		E6	Original records of hemoglobin testing complete
	B5	Survey respondents consistent with sampled individuals; if not, reasons justified		E7	Quality control slide measurements met requirements
	B6	All documents and related information generated during sampling organized and archived		E8	Hemoglobin quality control solution stored at low temperature
	B7	Sampling schedule met progress requirements		E9	Urine laboratory testing quality control records available
Physical Measurements	C1	Supine length measuring board met metrological certification (graduation 0.1 cm, headboard swing ≤ 0.5 cm)	Equipment and Materials	F1	Supine length measuring board
	C2	Measurement environment: quiet, spacious, level and firm floor, room temperature ≤ 25 °C		F2	Stadiometer
	C3	Infants removed shoes, hats, and thick clothing		F3	Scale