

BMJ Open Development of an interprofessional collaboration competency scale for children with medical complexity

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ABSTRACT

Objective To develop and validate an interprofessional collaboration competency scale for children with medical complexity (ICC-CMC). These children have the most complex healthcare needs, complicated chronic conditions, severe functional limitations and often need a considerable amount of healthcare resources.

Design Cross-sectional study.

Setting The self-administered ICC-CMC questionnaire was developed based on a literature review and 12 expert interviews.

Participants Participants were 2347 interprofessionals from the health, medical, welfare and education fields in seven prefectures in Japan.

Main outcome measure(s) We used Cronbach's alpha values to assess the internal consistency of the scale. Construct validity was confirmed with confirmatory factor analysis, and an existing scale was administered to assess criterion-related validity.

Results In total, 378 professionals provided valid responses. Exploratory and confirmatory factor analyses identified 12 items on three factors: 'sharing needs assessment skills', 'resource development skills' and 'creative networking skills'. The final model showed good fit on four indices (eg, goodness of fit index: 0.925). The Cronbach's alpha for the entire scale was 0.93 and was above 0.80 for each factor. The correlation coefficient between the existing scale and the ICC-CMC was 0.72 ($p < 0.001$).

Conclusions The ICC-CMC demonstrated acceptable internal consistency and validity. The scale has potential use in advancing professionals' individual practice and team performance in interprofessional collaboration. In addition, the ICC-CMC has the potential of improving satisfaction and outcomes for children with medical complexity and their families.

Strengths and limitations of this study

- This study develops and validates a novel interprofessional collaboration competency scale for children with medical complexity (the ICC-CMC).
- The data have clarified the confirmative concept of the ICC-CMC consisting of 'sharing needs assessment', 'resource development' and 'creative networking'.
- The participants of this study include 2347 representative interprofessionals from the health, medical, welfare and education fields for CMC in Japan.
- The study design was cross-sectional. Future research should seek to evaluate a predictive validity and to identify factors related to the ICC-CMC.

complicated chronic conditions and severe functional limitations, CMC often require a considerable amount of medications, services and family support to maintain a basic quality of life.² In Canada, CMC comprise <1% of the paediatric population but account for nearly one-third of paediatric healthcare spending and more than one-quarter of paediatric hospital readmissions.³ In Japan, the number of CMC is increasing because of the increased survival rate of infants born prematurely and improved intensive medical treatments and nursing care for acute illnesses.⁴ In 2011, around 111 000 children in Japan had child chronic diseases, representing a 2.8% increase in past 6 years.⁵ Moreover, in 2010, 68.4% of these children had severe physical disability, representing a 12% increase over 15 years.⁶ Therefore, CMC are a growing sector of the paediatric population and are becoming a key population of interest in health reform efforts in developed countries.

Regardless of underlying diagnoses, CMC share special healthcare needs, including: (1) intensive hospital-based and/or community-based services; (2) reliance on technology, polypharmacy and/or home care or congregate care to maintain a basic quality of life; (3) risk of frequent and prolonged hospitalisation, leading to high resource use; and (4)

INTRODUCTION

The Maternal and Child Health Bureau defines children with special healthcare needs as those with increased risk of a chronic physical, developmental, behavioural or emotional condition, who require healthcare and related services beyond that required by children in general.¹ Children with medical complexity (CMC) make a significant portion of this group. As well as complex healthcare needs,



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an elevated need for care coordination.⁷ In Japan, almost 70% of seriously ill children with a severe condition who have such needs are living in the community without supportive care.⁸ In addition, caregivers of technology-dependent children experience more anxiety, anger, sorrow, social isolation and depression compared with parents of able-bodied children.⁹ Despite improvements in medical technology, the widespread home use of medical equipment, and governmental facilitation of positive discharge from hospital, community-based support systems often cannot respond to demand. Problems include human resources shortfalls, absence of a care coordinator, difficulty of longitudinal and continuous involvement and an undeveloped legal system that does not connect health, medical, social and education professionals.¹⁰ Therefore, the coordination needs of children and parents remain unmet in many cases.¹¹ Interprofessional collaboration across a range of health, medical, welfare and education specialties is central in responding to the special health-care needs of CMC. Previous studies showed comprehensive care provided by multiple professionals reduced serious illness, emergency department visits, total hospital and clinic costs and improved children's social and emotional quality of life.^{12–14} This highlights that interprofessional collaboration is one of the important factors to enhance the well-being of CMC.

To promote and improve interprofessional collaboration for CMC, it is necessary to clarify interprofessional collaboration competency and assess the practices considered for the next step in collaboration. Interprofessional collaboration competency is measurable and refers to the underlying characteristics, including knowledge, skill and attitude, required of professionals¹⁵ in the process wherein professionals from different areas have the same objectives and work together. Various interprofessional collaboration scales are available to generate one's or team's self-reflection. Kenaszchuk *et al*¹⁶ developed a multigroup measurement scale for interprofessional collaboration, but this scale is created from on a nursing-centred questionnaire, and physicians and nurses are item targets, not for other health professionals. Heinemann *et al*¹⁷ developed a measure of attitudes towards healthcare teams among team members and/or trainees and their supervisors, but this was designed for clinically based team-training programmes for medical and health professions students and residents, instead of community-based interprofessional teams. Sakai *et al*¹⁸ developed an exhaustive measurement of interprofessional collaborative competency; however, medical professions in hospital setting are item target, not for interprofessional consisting of home care professionals. Therefore, existing measurements are developed for clinical-based, medical professional group, typically physicians and nurses, cross-sectional and specific interprofessional collaboration competency not suitable for CMC. Interprofessional collaboration for CMC requires community-based, multiple interprofessional collaborative relationships, longitudinal and comprehensive competencies.

We developed and validated a new interprofessional collaboration competency scale for CMC (ICC-CMC). This study clarified the reality of interprofessional collaboration competency, and if used as a practical assessment in developing community care systems, the ICC-CMC may contribute to improvement of collaboration and quality of life for children and their families.

We defined 'interprofessional collaboration' as a process wherein professionals from different areas (health, medical care, welfare, education and government) have the same objectives and work together to ensure the quality of life for CMC.^{19–21} 'Competency' (defined as the underlying characteristics including knowledge, skill and attitude required of professionals) reflects factors that can be changed and developed.¹⁵

METHODS

Phase 1: developing the instrument

First, we developed a pool of items verbatim based on a literature review. Studies on concepts of collaboration and collaboration scales^{22–29} and collaboration in children's home care were searched in PubMed and Ichushi-Web, using collaboration, cooperation, continuity of care, integration, linkage, interprofessional, multiprofessional, team, home care, community care, measurement and scale for search terms; therefore, 37 articles were identified. Item inclusion criteria were based on the process of interprofessional collaboration for CMC (rather than the structure), adaptation of the given item for multiple professionals (rather than for particular professionals) and practical usefulness. Throughout the process, 34 items were developed for originally scale.

Next, the item pool was reviewed by 10 professionals and 4 researchers to assess content validity, face validity and practical usefulness via interviews²⁹ or questionnaires. Participating professionals included paediatric physicians, a paediatric nurse and a discharge nurse, home visiting nurses, a public health nurse, a social worker and teachers with over 5 years of experience in job performance and collaboration with interprofessionals for more than five CMC cases. To achieve a variety of perspectives on measurement, we considered the balance of professionals and recruited professionals from different disciplines or institutions. The researchers were from the Department of Community Health Nursing or Home Care Nursing who had proven records of measurement development. We excluded items assessed as 'not important' by more than one expert. Moreover, we expressed the wording of items clearly based on the expert opinion (eg, professional→other professional), for example, expressing the topic clearly, using 'other professional' rather than 'multiprofessional' to clarify the focus, ensuring item relevance for both child and family and selecting wording that better assessed collaboration in double-barrelled questions. The initial ICC-CMC was refined to 30 items on four preliminary domains: sharing information, understanding

function, coordinating support objectives and securing networks.

Phase 2: validating the instrument

Participants

This survey involved 2347 professionals from 1459 institutions in seven prefectures in Japan. Inclusion criteria were: (1) experience of interprofessional collaboration for CMC in the past year and (2) one of the defined professional groups (representative person) from each institution or section. Selected professional groups were: paediatric physician (paediatric department in a hospital/child welfare institution), paediatric nurse (paediatric department in a hospital, discharge centre in a hospital or child welfare institution), home visiting nurse (home visiting care station), public health nurse (community health centre), social worker (community health centre), school nurse (special school) and nursery teacher (child welfare institution).

Data were collected in seven prefectures that house Japan's major cities (Hokkaido, Tokyo, Kanagawa, Aichi, Osaka, Hyogo and Fukuoka). These prefectures cover nearly half of Japan's population and include more service-offering institutions than other prefectures. Institutions were selected from publicly available information lists by either complete or systematic random sampling. We mailed informed consent letters and the ICC-CMC questionnaire to administrators and eligible participants at each institution. Participants were invited to complete the self-administered, anonymous questionnaire voluntarily. Of the potential participants, 411 (17.9%) responded, and 378 (92.0%) questionnaires with valid responses (excluding no answering of demographic characteristics) were available for analysis.

Measures

We collected participants' demographic characteristics including gender, age, main qualification, years of work experience, affiliated institution and years of experience in CMC support. The importance of each ICC-CMC item was investigated using a four-point Likert-type scale. Participants rated each item as: 'Not important: 0', 'Not important to a certain extent: 1', 'Important to a certain extent: 2' or 'Important: 3'. An additional response option was 'I don't know'.

Participants were asked to recall one CMC case example in which they experienced interprofessional collaboration and self-assess collaboration practice based on that example. Each item was assessed on a four-point Likert-type scale: 'Disagree: 0', 'Disagree to a certain extent: 1', 'Agree to a certain extent: 2' and 'Agree: 3'. We also asked participants to record CMC demographic characteristics including gender, age, basic disease, medical care and professionals involved in the collaboration.

To assess the construct validity of the ICC-CMC, participants also completed Fukui's scale (self-assessed), which is a measure of the face-to-face cooperation level among home healthcare providers²⁶ on the hypothesis

that ICC-CMC and Fukui's scale are relevant. This scale consists of 21 items (eg, I understand what other professionals can do) on seven subscales, with responses on a five-point Likert-type scale (from disagree=1 to agree=5). The total score ranges from 21 to 105, with higher scores indicating greater face-to-face cooperation among home healthcare providers. This scale had a Cronbach's alpha of 0.94 and has been shown to be valid and correlated with the level of interprofessional collaboration in the community and participation in interprofessional collaboration meetings. We used this scale because the content was relevant to the ICC-CMC in terms of care recipient, involvement of professionals from various fields and development in community settings.

Statistical analysis

All analyses were conducted with IBM SPSS Statistics 20.0 and Amos 20.0 (Chicago, Illinois, USA). The total sample (n=378) was randomly divided into two split samples for cross-validation: group 1 (n=162) for performing item and exploratory factor analyses and group 2 (n=216) for performing confirmatory factor analysis. Item and exploratory factor analyses were conducted to investigate the reliability and convergent validity of the ICC-CMC. The criteria for item analysis included pass efficiency (average score <1.0 point), rates of response difficulty (unknown and non-respondents: $\geq 5\%$), distribution (ratings of 'Important to a certain extent'/'Important' by <90% of the sample), good-poor analysis (no significant difference between the highest scoring and lowest scoring groups) and item-total analysis (correlation coefficient:<0.3).

After the item analyses, we examined the remaining items with exploratory factor analysis (principal factor analysis) with promax rotation as a first step. The optimal number of factors was determined using eigenvalues and a scree plot. Item loadings needed to exceed 0.40. Factor reliability was determined using Cronbach's alpha ≥ 0.70 ,³⁰ and construct validity was verified with confirmatory factor analysis. Model fit was examined with the goodness of fit index (GFI), adjusted GFI (AGFI), comparative fit index (CFI) and root mean square error of approximation (RMSEA).³¹ Construct validity was also examined by the correlation between the ICC-CMC and Fukui's scale.

Patient and public involvement

Patients and or the public were not involved in setting the research question and were not involved in the design or conduct of the study.

RESULTS

Respondent characteristics

In total, 53.3% of respondents were nurses and 87.8% were female (table 1). Participants were from home visiting care stations (28.8%), hospitals (25.7%) and community health centres (18.0%). About half of the interprofessional collaboration examples (CMC cases) reported by participants were male, with a mean age of

Table 1 Demographic characteristics of participants and CMC for which participants experienced interprofessional collaboration

	n or Mean±SD	% or (range)
Participants		
Gender (n = 378)		
Female	332	87.8
Male	46	12.2
Age (n=368)	45.7±9.1	(24.0–68.0)
Main qualification (n=377)		
Physician	48	12.7
Nurse	201	53.3
Public health nurse	62	16.4
Midwife	5	1.3
Social worker	8	2.1
Care worker	2	0.5
Psychiatric social worker	1	0.3
Physiotherapist	5	1.3
Occupational therapist	2	0.5
Nursery teacher	16	4.2
School nurse	13	3.4
Others	14	3.7
Years of work experience (n=377)	20.8±9.6	(1.0–43.0)
Affiliated institution (n=378)		
Hospital (paediatric department)	60	15.9
Hospital (discharge centre)	37	9.8
Home visiting care station	109	28.8
Community health centre	68	18.0
Special school	26	6.9
Child welfare institution	55	14.6
Others	23	6.1
Years of experience in CMC support (n=362)	8.0±7.5	(0.1–33.0)
CMC		
Gender (n=374)		
Male	190	50.8
Female	184	49.2
Age (n=366)	6.0±5.4	(0.2–28.0)
Basic disease (n=371)		
Chromosomal abnormality/congenital malformation	121	32.6
Hypoxic encephalopathy/neonatal asphyxia	111	29.9
Congenital metabolic disease	14	3.8

Continued

Table 1 Continued

	n or Mean±SD	% or (range)
Cardiac disease	17	4.6
Kidney disease	2	0.5
Respiratory disease	17	4.6
Gastrointestinal disease	7	1.9
Nervous disease/muscle disease	37	10.0
Blood disease/neoplastic disease	5	1.3
Others	40	10.8
Medical care (n=378) (Multiple answers)		
Suction from mouth and nose	246	65.1
Suction from tracheostomy tube	224	59.3
Inhalation	104	27.5
Ventilator therapy	178	47.1
Oxygen therapy	161	42.6
Tube feeding	308	81.5
Parenteral nutrition	14	3.7
Medical therapy	195	51.6
Colostomy device	11	2.9
Urethral catheterisation	42	11.1
Pressure ulcer care	50	13.2
Rehabilitation	202	53.4
Others	38	10.1
Number of collaborated professionals (n=378)	7.1±3.4	(1.0–20.0)

*Missing data were excluded from each analysis.
CMC, children with medical complexity.

6.0±5.4 years. The most common basic disease was chromosomal abnormality/congenital malformation (32.6%), and 81.5% required tube feeding. The mean number of collaborating professionals per case was 7.1±3.4.

Distribution of each scale item

Table 2 shows the item analysis results. Five items (9, 19, 22, 24 and 30) met the exclusion criteria for item difficulty, and two items (28 and 30) met the exclusion criteria for population distribution. This resulted in six items being excluded, leaving 24 items for factor analysis.

Factor analysis

Factor analysis results are shown in table 3. The eigenvalues and scree plot suggested a two or three factor model. We repeated exploratory factor analysis with promax rotation until the factor loadings exceeded 0.40, the difference in factor loadings between each factor became clear and the factors became theoretically

Table 2 Item analyses for the interprofessional collaboration scale for children with medical complexity

Item		Importance			Self-assessment			P values	Exclusion
		Pass efficiency*	Item difficulty† (%)	Population distribution‡ (%)	Kurtosis	Skewness	Good-poor analysis§		
1	I share information with other professionals about the child's and family's understanding of the disease and symptoms.	2.9±0.3	0.6	100.0	3.3	-2.3	0.000	0.775	0.000
2	I share information with other professionals about how the child and family perceive their current living conditions.	2.9±0.4	1.2	100.0	1.9	-2.0	0.000	0.810	0.000
3	I share information with other professionals about how the child and family wish to spend their future life.	2.9±0.4	1.9	99.4	6.2	-2.6	0.000	0.769	0.000
4	I share the content of consultations with the child and family with other professionals.	2.7±0.5	1.9	98.1	0.1	-1.1	0.000	0.709	0.000
5	I share the latest information relevant to the child and family with other professionals.	2.7±0.5	1.2	96.9	1.4	-1.5	0.000	0.794	0.000
6	I share the expected changes in the child and family with other professionals.	2.7±0.5	1.9	99.4	0.7	-1.2	0.000	0.760	0.000
7	I understand the perspective of each professional involved with the child and family.	2.6±0.5	4.9	98.0	-0.1	-1.0	0.000	0.727	0.000
8	I understand the abilities of each professional involved with the child and family.	2.7±0.5	1.9	99.4	-0.3	-1.1	0.000	0.707	0.000
9	I understand the position of the institutions to which each professional involved with the child and family belongs.	2.4±0.6	6.2	92.9	-0.6	-0.6	0.000	0.689	0.000 ×
10	I understand the community medical resources necessary for the child and family.	2.9±0.4	1.2	98.7	6.4	-2.6	0.000	0.690	0.000
11	I understand the community welfare resources necessary for the child and family.	2.8±0.4	0.6	98.1	6.0	-2.5	0.000	0.644	0.000
12	I understand the community education resources necessary for the child and family.	2.7±0.5	1.2	96.2	2.1	-1.7	0.000	0.432	0.000
13	I have explained the available community resources and details of services to the child and family.	2.8±0.5	1.9	98.1	2.3	-1.8	0.000	0.690	0.000
14	I have established support goals for the child and family with other professionals.	2.7±0.5	1.9	98.1	0.5	-1.2	0.000	0.821	0.000
15	I am engaging in dialogue with other professionals about support objectives/planning for the child and family.	2.7±0.5	1.2	99.4	-0.3	-1.1	0.000	0.803	0.000
16	I make efforts to agree with other professionals about support objectives/planning for the child and family.	2.6±0.6	1.2	95.6	2.0	-1.5	0.000	0.810	0.000
17	I clearly recognise the responsibilities of each professional on the team involved with the child and family.	2.6±0.5	1.2	98.1	-0.3	-0.9	0.000	0.824	0.000
18	I clearly recognise the presence of a coordinator on the team involved with the child and family.	2.6±0.6	3.7	95.5	0.2	-1.1	0.000	0.718	0.000

Continued

Table 2 Continued

Item		Importance				Self-assessment				P values	Exclusion
		Pass efficiency*	Item difficulty† (%)	Population distribution‡ (%)	Kurtosis	Skewness	Good-poor analysis§	Item-total correlation¶ (r)			
19	I clearly recognise the presence of a leader on the team involved with the child and family.	2.4±0.7	5.6	90.1	0.0	-0.8	0.000	0.685	0.000	x	
20	I understand specific details of the services offered by each professional involved with the child and family.	2.6±0.5	1.9	99.4	-1.1	-0.7	0.000	0.793	0.000		
21	I periodically review support objectives/planning for the child and family with other professionals.	2.6±0.6	3.1	95.5	0.3	-1.1	0.000	0.750	0.000		
22	I do not hesitate to contact other professionals regarding the child and family.	2.5±0.6	6.8	92.0	0.6	-1.1	0.000	0.689	0.000	x	
23	I consult with other professionals instead of leaving an issue involving the child and family unresolved.	2.7±0.5	1.2	98.1	0.3	-1.2	0.000	0.707	0.000		
24	I express my respect or provide a positive assessment to other professionals involved with the child and family.	2.5±0.7	5.6	91.5	-0.3	-0.9	0.000	0.676	0.000	x	
25	During normal periods, I operate via a framework that permits information sharing between the professionals involved the child and family.	2.7±0.6	1.2	96.2	0.7	-1.3	0.000	0.787	0.000		
26	During emergencies, I operate via a framework that permits immediate contact and response between the professionals involved with the child and family.	2.6±0.6	0.6	95.1	2.2	-1.6	0.000	0.672	0.000		
27	I create opportunities to meet face to face with other professionals involved with the child and family.	2.5±0.6	2.5	93.1	0.8	-1.2	0.000	0.792	0.000		
28	I have opportunities to periodically meet with other professionals involved with the child and family.	2.3±0.8	1.2	84.4	0.1	-0.9	0.000	0.700	0.000	x	
29	I create opportunities to meet with other professionals involved with the child and family and to discuss the challenges in collaboration.	2.4±0.7	2.5	91.1	0.7	-1.0	0.000	0.760	0.000		
30	I work with the other professionals involved with the child and family while incorporating new information.	2.2±0.7	7.4	85.4	-0.1	-0.6	0.000	0.667	0.000	x	

Exclusion criteria for the item analyses.

The values which fit the exclusion criteria were written in bold.

*Average score: under 1.0 point.

†Percentage of 'don't know' and 'N/A': greater than 5% of the sample.

‡Percentage of 'Important to a certain extent' and 'Important': lower than 90% of the sample.

§Difference of the average score between most high-scoring group and most low-scoring group: no significant difference ($p \geq 0.05$).

¶Correlation coefficient between the item and the total score of all the items (but with exception of the item): less than 0.3.

most explicable. Twelve items were removed, leaving 12 items on three factors for the final version of the ICC-CMC. Factor 1 ('sharing needs assessment skills') included four items central to interprofessional support covering: child's and family's values; consciousness and beliefs for the past, present and future, as presented by

an understanding of the disease and symptoms; perceptions of current living conditions and future life wishes; and consultation content. Sharing this information with other professionals with different perspectives allows individuals to realise new aspects of the child and family's situation and to understand and assess the child

Table 3 Factor analyses of the interprofessional collaboration scale for children with medical complexity (final version)

		Factor 1 0.928	Factor 2 0.885	Factor 3 0.893	All 0.933
Cronbach's alpha coefficient					
Initial version scale item					
no.	Item / (Factor)	(Sharing needs assessment skills)	(Resource development skills)	(Creative networking skills)	Communality
3	I share information with other professionals about how the child and family wish to spend their future life.	0.949	-0.008	-0.055	0.818
2	I share information with other professionals about how the child and family perceive their current living conditions.	0.851	0.024	0.064	0.835
4	I share the content of consultations with the child and family with other professionals.	0.845	-0.043	0.005	0.677
1	I share information with other professionals about the child's and family's understanding of the disease and symptoms.	0.764	-0.064	0.186	0.755
11	I understand the community welfare resources necessary for the child and family.	0.069	0.980	-0.142	0.898
10	I understand the community medical resources necessary for the child and family.	0.147	0.810	-0.046	0.774
13	I have explained the available community resources and the details of services to the child and family.	0.024	0.785	0.105	0.747
12	I understand the community educational resources necessary for the child and family.	-0.244	0.695	0.156	0.423
16	I make efforts to agree with other professionals about support objectives/planning for the child and family.	0.056	-0.029	0.881	0.821
21	I periodically review support objectives/planning for the child and family with other professionals.	-0.057	0.013	0.864	0.690
27	I create opportunities to meet face to face with other professionals involved with the child and family.	0.217	0.027	0.591	0.609
17	I clearly recognize the responsibilities of each professional on the team involved with the child and family.	0.201	0.175	0.532	0.658
Cumulative contribution (%)		57.04	67.42	72.55	
Factor correlation coefficients (r)					
Factor 1		1.00			
Factor 2		0.62	1.00		
Factor 3		0.73	0.56	1.00	

*Principal factor analysis with promax rotation.

and family more comprehensively. Factor 2 ('resource development skills') included four items that covered recognition of the importance of necessary or available community resources and services for medical care, welfare and education (eg, professional's skill, institution and system) and actively collecting information. This means that individuals appraise and explain the readily available resources, as well as those that need development for practical use. Factor 3 ('creative networking skills') included four items that represented how individuals: create opportunities to meet with other professionals to achieve the child's/family's goals; develop consensus with other professionals about support objectives/planning; clarify the role/responsibility of each team member and periodically review support objectives/planning as a team member; and identify new objectives with other involved professionals. These processes cover the individual's contribution to sustainable and creative team practices.

The factor loadings were greater than 0.5 for each factor. The cumulative contribution of the three factors explained 72.55% of the variance. The correlation coefficients among the three factors were 0.56–0.73 (table 3).

Internal consistency and validity of the final scale

Cronbach's alpha coefficients were 0.93 for factor 1, 0.89 for factor 2, 0.89 for factor 3, and 0.93 for the total scale (table 3), showing the scale had sufficient internal consistency.

The three factors were entered as three latent factors in a confirmatory factor analysis model. The model fit showed GFI=0.93, AGFI=0.88, CFI=0.97 and RMSEA=0.076 and nearly satisfied the appropriate

Table 4 Construct validity of the interprofessional collaboration scale for children with medical complexity

Factors	Mean±SD (Scores)	Correlation with Fukui's scale* (Pearson's correlation coefficients)
Sharing needs assessment skills†	8.6±3.1	0.63***
Resource development skills†	8.1±2.9	0.60***
Creative networking skills†	6.9±3.5	0.67***
Total 12 items‡	23.6±8.3	0.72***

*Pearson's correlation coefficients between the total score of Fukui's scale (n=162); ***p<0.001.

†Total score range: 0–12.

‡Total score range: 0–36 (sum of subscale scores).

criteria in all subjects; that is, construct validity was demonstrated (figure 1).

There were moderate correlations between the three ICC-CMC factors and Fukui's scale: 0.63 for factor 1, 0.60 for factor 2, 0.67 for factor 3 and 0.72 for the total scale (p<0.001) (table 4).

DISCUSSION

This study develops an original scale to assess interprofessional collaboration competency for CMC. We extracted 12 items on three factors that measured interprofessional collaboration competency for CMC (table 5). The

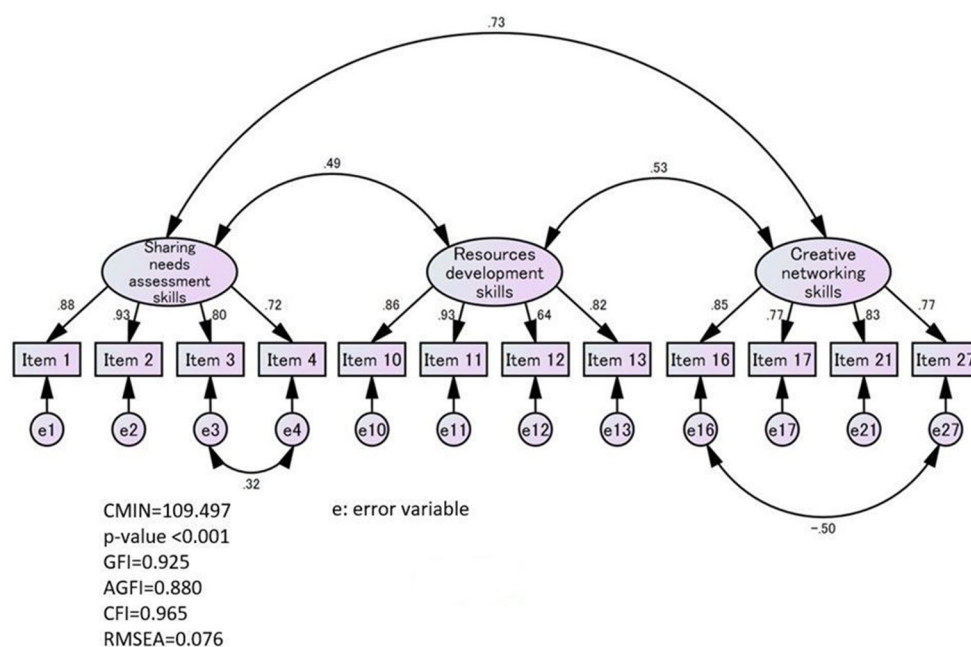


Figure 1 Confirmatory factor analysis for the interprofessional collaboration competency scale for children with medical complexity (n=216). AGFI, adjusted goodness of fit index; CFI, comparative fit index; CMIN, Chained Multilateral Index Number; GFI, goodness of fit index; RMSEA, root mean square error of approximation.

Table 5 English and Japanese versions of the interprofessional collaboration competency scale for children with medical complexity

‘Interprofessional collaboration competency scale for children with medical complexity’*

Sharing needs assessment skills	1	I share information with other professionals about the child’s and family’s understanding of the disease and symptoms.
	2	I share information with other professionals about how the child and family perceive their current living conditions.
	3	I share information with other professionals about how the child and family wish to spend their future life.
	4	I share the content of consultations with the child and family with other professionals.
Resource development skills	5	I understand the community medical resources necessary for the child and family.
	6	I understand the community welfare resources necessary for the child and family.
	7	I understand the community education resources necessary for the child and family.
	8	I have explained the available community resources and the details of services to the child and family.
Creative networking skills	9	I make efforts to agree with other professionals about support objectives/planning for the child and family.
	10	I clearly recognize the responsibilities of each professional on the team involved with the child and family.
	11	I periodically review support objectives/planning for the child and family with other professionals.
	12	I create opportunities to meet face-to-face with other professionals involved with the child and family.

在宅で療養する小児における多職種連携能力評価尺度」†

情報共有力	1	子ども・家族が病気・病状をどのように理解しているかを他職種と共有している
	2	子ども・家族が現在の生活状況をどのように受け止めているかを他職種と共有している
	3	今後の過ごし方に関する子ども・家族の希望を他職種と共有している
	4	子ども・家族からの相談内容を他職種と共有している
資源開発力	5	子ども・家族が必要としている地域の医療資源がわかる
	6	子ども・家族が必要としている地域の福祉資源がわかる
	7	子ども・家族が必要としている地域の教育資源がわかる
	8	子ども・家族が利用できる地域の資源・サービス内容を説明している
創造的ネットワーキング力	9	子ども・家族の支援方針・支援計画について他職種と合意を図っている
	10	子ども・家族に関わるチームにおける各専門職の役割分担を明確に認識している
	11	他職種と定期的に子ども・家族の支援方針・支援計画について見直しをしている
	12	子ども・家族に関わる他職種と顔を合わせて話す機会を持っている

statistical evaluation of the scale was adequate, and the reliability and validity were demonstrated.

Originality of the ICC-CMC

Similar to previous interprofessional collaboration scales,^{16–18} the ICC-CMC is based on professionals’ self-reflection. However, the ICC-CMC has originality in that it measures interprofessional collaboration for CMC, a population with complex and chronic needs (eg, requiring community-based, longitudinal, comprehensive and creative competencies). Competencies can be developed by study or experience³² and grow with specialised work experience.¹⁵ Competency as evaluated by the ICC-CMC can also be developed by study or experience and increases with specialised work experience. This predicts positive outcomes for CMC in the future.¹⁵

The structure of the ICC-CMC

‘Sharing needs assessment skills’ (factor 1) refers to skills in understanding and assessing the child and family more comprehensively by sharing information with other professionals who offer different perspectives. A best practice statement in multiagency and interdisciplinary practice is that the child and family are central to the provision of valuable information from the expertise of other health professionals.^{33,34} Moreover, the Interprofessional

Education Collaborative Expert Panel³⁵ arranges ‘patient and family centred’ treatment around four competencies that make it clear that children and their families are the central focus of interprofessional collaboration. CMC have intensive needs across different domains from hospital to the community and encompassing different sectors (eg, health, welfare and education) as their multiple health problems and needs interact.³⁶ Interprofessional collaboration is necessary to determine and integrate the needs of CMC and their families, develop overarching goals and create comprehensive, proactive care plans.³⁶

‘Resource development skills’ (factor 2) refers to the skills needed to appraise and develop the resources necessary for CMC and their families. Resources can be formal or informal and include medical homes for CMC, various individuals involved with care coordination and support groups.³⁷ However, the resources and services available for CMC in Japan are limited. There are various multi-disciplinary frameworks or complex care programmes for CMC in the USA that were developed by professionals in the field through trial and error and have demonstrated improved outcomes.³⁸ Similarly, efforts are currently underway to expand resources for CMC in parts of Japan. The results of the present study suggest that it is desirable for interprofessionals to identify new resource needs of

CMC and their families, as well as to understand obvious resources and put them into practical use. Kivimaki and Elovainio²⁷ extracted ‘cooperation in developing and applying ideas’ as an item to measure the climate for innovation in social and healthcare disciplines. For the innovative community, thinking of and developing new resource ideas is a necessary collaboration competency, rather than waiting for the structure of the support system to improve.

‘Creative networking skills’ (factor 3) refers to skills needed to create a sustainable and creative team in the community. A previous study of interprofessional collaboration competency identified similar factors: ‘actions for accomplishing team goals’ and ‘attitudes and behaviors that improve team cohesion’.¹⁸ Creative networking skills may be facilitated through discussion with children, families and professionals, as well as use of tools such as the Goal Attainment Scale, care mapping³⁴ or information communication technology. Moreover, creative actions that foster a sense of professionals and communities working together as a team will create a community-based network for other CMC and all children in the community.

Our confirmatory factor analysis suggested that the three concepts we identified were related to each other. These components are also part of the interprofessional collaboration process. The ICC-CMC clarifies the current reality of interprofessional collaboration competency and implies the mutual relationships among the concepts.

Practical implications

In future, the ICC-CMC may be useful for self-evaluation of interprofessional collaboration competency to improve individual practice or collaboration. Currently, there is no way for team members to assess each other’s competency in interprofessional collaboration. However, use of the ICC-CMC as a tool to discuss mutual self-assessment may benefit teams in developing specific collaboration improvement strategies. Moreover, if the scale is used in the wider community, it may also assess the actual conditions of interprofessional collaboration beyond institutions and inform a strategy for discussing and promoting community-wide collaboration. These benefits will enhance the well-being of CMC, their families and the wider community and contribute to community building for all children.

Limitations

The present study has several limitations. First, the response rate was slightly lower at about 18% compared with the 20%–30% that is generally found with mailed questionnaires for experts for CMC. As low response rates can introduce bias into survey results, it is necessary to test for non-response effects to maximise validity for further study. Second, as the study design was cross-sectional, it could not be revealed an association between ICC-CMC and collaboration practices or outcomes for CMC and their families. Therefore, a longitudinal design is needed

to determine the predictive validity of the ICC-CMC. Lastly, the ICC-CMC is developed for self-evaluation on their ability. Self-evaluations are more detailed, accessible and easy to administer and interpret in general. However, they are limited by the fact that individuals are likely to reveal their positive side only. Therefore, there is value in combining the other methods to ensure optimum understanding of the expert’s competency in the future.

CONCLUSION

The ICC-CMC has 12 items on three domains: ‘sharing needs assessment skills’, ‘resource development skills’ and ‘creative networking skills.’ The scale has acceptable internal consistency and concurrent validity. The ICC-CMC has potential to advance both individual practices and team performance in interprofessional collaboration, in addition to improving satisfaction and outcomes for CMC and their families.

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