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Awareness of and attitudes toward translational medicine among health personnel in hospitals in Shanghai, China

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Abstract

Objective: The study aim was to evaluate the knowledge and attitudes of hospital health personnel toward translational medicine.

Methods: We conducted a cross-sectional survey from July 2013 to September 2013 with a representative sample of 1690 health personnel from 13 large comprehensive or specialized hospitals in Shanghai, China.

Results: The results showed that awareness of and attitudes toward translational medicine significantly differed by gender, age, highest level of education, profession, and professional rank. Health personnel showed a highly positive attitude toward translational medicine; however, their knowledge of translational medicine was low.

Conclusion: Effective measures are needed to improve health personnel's awareness of and attitudes toward translational medicine.

Keywords

Translational medicine, translational research, health personnel, awareness, knowledge, China, survey

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Introduction

In recent years, translational medicine has developed rapidly worldwide.[1] The term 'translational medicine', often used interchangeably with the term 'translational

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research', was introduced by the director of the National Institutes of Health (NIH) in the 2003 NIH Roadmap.[2] Translational medicine is a type of medical research that proposes a two-way interaction between laboratory and clinical research; it aims to translate basic scientific research discoveries into clinical applications and health policies that can improve public health.[3,4] Different phases of translational research, separated by 'translational blocks', have been identified. For example, the 2T road map includes two translational steps (T1 and T2) and evolves into a 4T road map, which includes four translational steps (T1, T2, T3, and T4).[5] Sung et al. posited a two-phase translational process in 2003,[6] which was expanded into three phases by Westfall[7] and Dougherty.[8] However, some researchers have suggested that a four-phase translational continuum is needed to ultimately improve public health.[9,10] A current widely accepted model divides the translational paradigm into four stages, designated as T1, T2, T3, and T4.[11] The T1 stage is characterised by translation of knowledge to humans. In this stage, basic knowledge is translated to theoretical knowledge that can be applied to human medicine; this stage links basic science with potential clinical applications[12] and often involves phase 1 clinical trials.[13] The T2 stage is characterised by translation to patients, and translates theoretical knowledge to efficacy knowledge. In T2, the efficacy of new treatments and interventions is tested.[14] The T3 stage comprises translation to practice; in this phase, new recommendations are translated into guidelines to treat complex patients routinely seen in practice.[11] The T4 stage comprises translation to communities or population health. In this stage, factors affecting the health of the population are analysed; the aim is to develop comprehensive methods of improving population health.[13]

The NIH has created centres of translational research in its institutes and launched the Clinical and Translational Science Award (CTSA) program in 2006; by 2016, 64 CTSA-funded academic centres had been established.[15] Many other countries have also set up translational medicine institutions and established translational research as a main focus. Many translational medicine research centres have been set up in China,[16] where translational research has made tremendous progress and is obtaining peer recognition worldwide.[17] Seven Sino-American Symposia on Clinical and Translational Medicine (SAS-CTM) were held in China from 2010 to 2016. The SAS-CTM promote Sino-US bilateral communication and cooperation to realize the common goal of 'improving disease diagnosis and treatment of patients'. Chinese physicians and scientists are increasingly aware that translational medicine can provide a bridge between basic science, clinical practice, and health policy.[18]

Although translational medicine will optimize patient care and ultimately benefit society by transforming fundamental experimental discoveries into clinical applications and health policy, there are still numerous obstacles hindering the development of translational medicine, including insufficient funds, shortage of physician-scientists, and lack of data sharing and translation.[16,19] The process of translational research is often long, complex, and costly and is characterised by uncertain outcomes; researchers in this area thus experience substantial professional risk.[20] Moreover, the findings of translational medicine are often overlooked. Many studies still focus on animal models rather than follow the translational medicine process, which begins at the bedside, proceeds to the animal or cellular model, and finally ends with clinical trials and clinical applications.[21] For this reason, it is very important that scientists in the initial stage of their career

understand translational medicine so that they can become involved in translational research.[22]

Translational medicine provides information needed to draw key conclusions abut disease from clinical trials; therefore, health professionals with translational medical knowledge are more likely to derive hypotheses from clinical practice or to apply new findings about diseases in clinical studies.[23] It is therefore necessary to evaluate knowledge and attitudes regarding translational medicine and translational medicine centres among health personnel to identify areas that require improvement. Therefore, we conducted a comprehensive survey of health personnel to examine awareness of translational medicine and identify critical knowledge gaps in domains relevant to translational research and translational medicine centres. We also assessed attitudes of health personnel toward the development of translational medicine and translational medicine centres. In this study, health personnel comprised administrators, physicians, and nurses working in hospitals. We hoped that a deeper understanding of the obstacles that hinder translational research would provide insight into the issues that face health personnel in translational medicine.

Materials and methods

Study design

A cross-sectional survey was conducted from July 2013 to September 2013 in Shanghai, China. Stratified sampling was used to select a representative sample of health personnel. A total of 13 comprehensive or specialized hospitals in Shanghai were stratified by geographic distribution. In each selected hospital, 30 administrators and 100 physicians and nurses were selected using random sampling. A total of 1690 participants were sampled.

A structured questionnaire was administered by trained health service administration professionals. The questionnaire consisted of close-ended questions to assess participants' sociodemographic characteristics and to evaluate their awareness and attitudes regarding translational medicine (Appendix).

Statistical analysis

EpiData 3.1 software (EpiData Association, Odense, Denmark) was used for data collection, and statistical analyses were performed using SAS 8.2 (SAS Institute Inc., Cary, NC, USA) and PASW Statistics for Windows, Version 18.0 (SPSS Inc., Chicago, IL, USA). Enumeration data were summarized in tables. Differences in proportions between groups were assessed using the chi-square test. Multinomial logistic regression analysis was used to test the relationship between participants' attitude toward translational medicine and translational medicine centres and variables selected via chi-square. The level of statistical significance was set at 0.05.

The questionnaire was validated using Cronbach's alpha, content validity assessment and the Kaiser–Meyer–Olkin (KMO) test. Cronbach's alpha was used to estimate the internal consistency reliability of the questionnaire; values of 0.70 indicated acceptable internal consistency.[24] Content validity is the extent to which the questionnaire measures the content or subject area it is intended to evaluate[25] and is often established using expert reviews;[26] thus, we invited five experts to perform a content validity assessment. Construct validity was assessed using the KMO test in SPSS with the varimax rotation method; KMO values of 0.7 or higher indicated good questionnaire validity.[27]

The study was performed in accordance with the Declaration of Helsinki of the World Medical Association and ethical

approval was obtained from the Second Military Medical University ethics committee (approval reference number 2013LL058). The aims and objectives of the study were explained to all participants. Participants were also informed that participation was voluntary and confidentiality would be maintained. Written informed consent was obtained from all participants before the survey was conducted. All experimental protocols were approved by the ethics committee.

Results

Reliability and validity of the questionnaire

Satisfactory reliability and validity were confirmed by a Cronbach's alpha coefficient of 0.749, KMO coefficient of 0.734 and $P<0.001$ for Bartlett's test of sphericity. Five experts confirmed the content validity of the questionnaire.

Demographic characteristics of participants

The study population comprised 1690 health personnel, of which 1527 returned the questionnaire and 1504 returned completed questionnaires. All demographic characteristics are reported in Table 1. Most participants were female (67.75%), aged between 20 and 29 years (40.43%), had a Bachelor's degree (36.9%), and were junior professionals (56.45%). The proportions of participants working as administrators, physicians, and nurses were 26.86%, 28.39%, and 44.75%, respectively.

Attitudes toward translational medicine and influencing factors

Table 2 shows health personnel's attitudes toward translational medicine. Participants showed a highly positive attitude toward translational medicine, with most (85.9%) participants agreeing that it is necessary to develop translational medicine; the rate of agreement for physicians (74.9%) was lower than for administrators (90.3%) and nurses (90.2%). Participants who knew a lot about translational medicine were more likely to have a positive attitude (87.5%) than participants who knew nothing about translational medicine (36.4%). There were significant differences in attitude toward translational medicine for gender ($P=0.001$), age ($P<0.001$), highest level of education ($P<0.001$), profession ($P<0.001$), professional rank ($P<0.001$), awareness of translational medicine ($P<0.001$), whether participants' institutions were capable of developing translational medicine ($P<0.001$), and whether participants' institutions had already set up a translational medicine centre ($P<0.001$).

Table 1. Demographic sample characteristics.

Variables	N (%)
Gender	
Male	485 (32.25)
Female	1019 (67.75)
Age (years)	
20–29	608 (40.43)
30–39	584 (38.83)
40–49	255 (16.95)
50–59	57 (3.79)
Education level	
Some college	45 (2.99)
Associate's degree	485 (32.25)
Bachelor's degree	555 (36.9)
Master's degree	286 (19.02)
Doctoral degree	116 (7.71)
Post-doctoral	17 (1.13)
Profession	
Administrator	404 (26.86)
Physician	427 (28.39)
Nurse	673 (44.75)
Professional rank	
Junior	849 (56.45)
Intermediate	464 (30.85)
Vice senior	154 (10.24)
Senior	37 (2.46)

Table 2. Attitudes toward translational medicine.

Variables	N (%)	Necessary to develop translational medicine		Chi-square	P value
		Agreement N (%)	Disagreement N (%)		
Total		1292 (85.9)	212 (14.1)		
Gender				11.764	0.001
Male	485 (32.2)	395 (81.4)	90 (18.6)		
Female	1019 (67.8)	897 (88.0)	122 (12.0)		
Age (years)				24.964	<0.001
20–29	608 (40.4)	548 (90.1)	60 (9.9)		
30–39	584 (38.8)	499 (85.4)	85 (14.6)		
40–49	255 (17.0)	197 (77.3)	58 (22.7)		
50–59	57 (3.8)	48 (84.2)	9 (15.8)		
Education level				51.665	<0.001
Some college	485 (32.3)	439 (90.5)	46 (9.5)		
Associate's degree	555 (36.9)	431 (77.7)	124 (22.3)		
Bachelor's degree	286 (19.0)	256 (89.5)	30 (10.5)		
Master's degree	116 (7.7)	110 (94.8)	6 (5.2)		
Doctoral degree	17 (1.1)	16 (94.1)	1 (5.9)		
Post-doctoral	45 (3.0)	40 (88.9)	5 (11.1)		
Profession				59.188	<0.001
Administrator	404 (26.9)	365 (90.3)	39 (9.7)		
Physician	427 (28.4)	320 (74.9)	107 (25.1)		
Nurse	673 (44.7)	607 (90.2)	66 (9.8)		
Professional rank				24.512	<0.001
Junior	849 (56.4)	756 (89.0)	93 (11.0)		
Intermediate	464 (30.9)	383 (82.5)	81 (17.5)		
Vice senior	154 (10.2)	118 (76.6)	36 (23.4)		
Senior	37 (2.5)	35 (94.6)	2 (5.4)		
Knowledge of translational medicine				138.473	<0.001
Know nothing	228 (15.2)	83 (36.4)	145 (63.6)		
Know a little	546 (36.3)	459 (84.1)	87 (15.9)		
Know average amount	519 (34.5)	490 (94.4)	29 (5.6)		
Know quite a lot	179 (11.9)	170 (95.0)	9 (5.0)		
Know a lot	32 (2.1)	28 (87.5)	4 (12.5)		
Whether participants' institutions are capable of developing translational medicine				184.93	<0.001
Yes	942 (62.6)	898 (95.3)	44 (4.7)		
No	562 (37.4)	394 (70.1)	168 (29.9)		
Attitude toward the number of translational medicine centres in a country				4.339	0.114
The more the better	141 (9.4)	129 (91.5)	12 (8.5)		
Dozens	822 (54.6)	705 (85.8)	117 (14.2)		
A few national centres	541 (36.0)	458 (84.7)	83 (15.3)		
Whether participants' institutions have already set up a translational medicine centre				16.323	<0.001
Yes	711 (47.3)	638 (89.7)	73 (10.3)		
No	793 (52.7)	654 (82.5)	139 (17.5)		

Logistic regression analysis of attitudes toward translational medicine (Table 3) indicated that nurses were more likely to have a positive attitude toward the development of translational medicine than physicians ($P<0.001$). Compared with participants who had no knowledge about translational medicine, participants who had little, average, or substantial knowledge of translational medicine were more likely to support the development of translational medicine ($P<0.001$). Participants whose institutions were capable of developing translational medicine were less likely to support the development of translational medicine ($P<0.001$). Those who belonged to institutions with a translational medicine centre were more willing to support the development of translational medicine ($P=0.023$).

Attitudes toward translational medicine centres and influencing factors

As indicated in Table 4, there were significant differences in the attitude toward

Table 3. Logistic regression analysis of attitudes toward translational medicine and influencing factors.

Parameter	Estimate	OR	95% CI	*P* value
Gender (ref: Female)				
Male	0.000	1.000	0.651–1.537	1.000
Age (ref: 50–59 years)				
20–29	−0.382	0.682	0.231–2.013	0.489
30–39	−0.619	0.539	0.195–1.486	0.232
40–49	−0.715	0.489	0.186–1.285	0.147
Education level (ref: Post-doctoral)				
Some college	−0.141	0.869	0.291–2.595	0.801
Associate's degree	−0.598	0.55	0.182–1.662	0.289
Bachelor's degree	0.086	1.09	0.322–3.693	0.889
Master's degree	0.717	2.049	0.479–8.76	0.333
Doctoral degree	0.759	2.136	0.181–25.172	0.546
Profession (ref: Nurse)				
Administrator	−0.284	0.753	0.419–1.352	0.342
Physician	−1.334	0.263	0.148–0.469	<0.001
Professional rank (ref: Senior)				
Junior	−0.627	0.534	0.097–2.944	0.472
Intermediate	−0.83	0.436	0.085–2.247	0.321
Vice senior	−1.27	0.281	0.054–1.447	0.129
Knowledge of translational medicine (ref: Know nothing)				
Know a little	1.137	3.116	2.056–4.722	<0.001
Know average amount	2.081	8.01	4.703–13.644	<0.001
Know quite a lot	2.009	7.454	3.265–17.015	<0.001
Know a lot	0.96	2.612	0.768–8.886	0.124
Whether participants' institutions are capable of developing translational medicine (ref: No)				
Yes	−1.663	0.19	0.127–0.284	<0.001
Whether participants' institutions have already set up a translational medicine centre (ref: No)				
Yes	0.457	1.579	1.064–2.343	0.023

OR: odds ratio; CI: confidence interval.

Table 4. Attitudes toward translational medicine centres.

	Necessary to set up translational medicine centre			
	Necessary N (%)	Not necessary N (%)	Chi-square	*P* value
All	1160 (77.1)	344 (22.9)		
Gender			9.181	0.002
Male	351 (72.4)	134 (27.6)		
Female	809 (79.4)	210 (20.6)		
Age (years)			29.201	<0.001
20–29	496 (81.6)	112 (18.4)		
30–39	458 (78.4)	126 (21.6)		
40–49	168 (65.9)	87 (34.1)		
50–59	38 (66.7)	19 (33.3)		
Education level			21.599	0.001
Some college	394 (81.2)	91 (18.8)		
Associate's degree	395 (71.2)	160 (28.8)		
Bachelor's degree	233 (81.5)	53 (18.5)		
Master's degree	94 (81.0)	22 (19.0)		
Doctoral degree	13 (76.5)	4 (23.5)		
Post-doctoral	31 (68.9)	14 (31.1)		
Profession			20.628	<0.001
Administrator	323 (80.0)	81 (20.0)		
Physician	296 (69.3)	131 (30.7)		
Nurse	541 (80.4)	132 (19.6)		
Professional rank			20.836	<0.001
Junior	688 (81.0)	161 (19.0)		
Intermediate	342 (73.7)	122 (26.3)		
Vice senior	102 (66.2)	52 (33.8)		
Senior	28 (75.7)	9 (24.3)		
Attitude toward the number of translational medicine centres in a country			16.485	<0.001
The more the better	128 (90.8)	13 (9.2)		
Dozens	624 (75.9)	198 (24.1)		
A few national centres	408 (75.4)	133 (24.6)		
Whether participants' institutions have already set up a translational medicine centre			43.479	<0.001
Yes	602 (84.7)	109 (15.3)		
No	558 (70.4)	235 (29.6)		
Should a translational medicine centre be a research institution or a coordinating office?			7.838	0.005
Research institution	592 (80.2)	146 (19.8)		
Coordinating office	568 (74.2)	198 (25.8)		
'Cooperation and management' or 'facilities and equipment': which one is more important?			0.002	0.962
Facilities and equipment	386 (77.2)	114 (22.8)		
Cooperation and management	774 (77.1)	230 (22.9)		

(continued)

Table 4. Continued

	Necessary to set up translational medicine centre			
	Necessary N (%)	Not necessary N (%)	Chi-square	*P* value
Should translational groups be fixed or open?			3.507	0.061
Fixed	393 (80.0)	98 (20.0)		
Open	767 (75.7)	246 (24.3)		
What is the role of the community in translational medicine?			70.856	<0.001
Volunteers	296 (72.7)	111 (27.3)		
Subjects	188 (77.4)	55 (22.6)		
Volunteers and subjects	635 (83.1)	129 (16.9)		
No role	41 (45.6)	49 (54.4)		
Is a resource coordinator necessary for a translational medicine centre?			117.044	<0.001
Yes	968 (83.5)	191 (16.5)		
No	192 (55.7)	153 (44.3)		
Should core resources be shared?			131.222	<0.001
Yes	1016 (83.1)	207 (16.9)		
No	144 (51.2)	137 (48.8)		
What is the difference between translational medicine and traditional medicine research			0.208	0.648
Research starting point	640 (77.6)	185 (22.4)		
Research object	520 (76.6)	159 (23.4)		
What is the object of translational research?			0.701	0.704
Animal	301 (75.6)	97 (24.4)		
Cell	236 (77.9)	67 (22.1)		
Human	623 (77.6)	180 (22.4)		
Awareness of the most important assessment stage			27.281	<0.001
Admittance assessment	659 (78.2)	184 (21.8)		
Process assessment	339 (82.3)	73 (17.7)		
Outcome assessment	162 (65.1)	87 (34.9)		
Should researchers bear the treatment costs of participants?			44.186	<0.001
Yes, all costs	437 (73.9)	154 (26.1)		
Yes, partial costs	614 (83.4)	122 (16.6)		
No	109 (61.6)	68 (38.4)		

translational medicine centres in relation to gender ($P = 0.002$), age ($P < 0.001$), highest level of education ($P = 0.001$), profession ($P < 0.001$), professional rank ($P < 0.001$), attitude toward the number of translational medicine centres in a country ($P < 0.001$), whether participants' institutions already had a translational medicine centre ($P < 0.001$), attitude toward whether a translational medicine centre should be a research institution or a coordinating office ($P = 0.005$), awareness of the role of the community in translational medicine ($P < 0.001$), attitude toward resource coordinators ($P < 0.001$), and attitude toward whether core resources should be shared ($P < 0.001$). The proportion of participants who regarded it as necessary to set up translational medicine centres was 77.1%.

A logistic regression analysis was conducted based on the chi-square test results (Table 5). The results showed that

Table 5. Logistic regression analysis of attitudes toward translational medicine centres and influencing factors.

Parameter	Estimate	OR	95% CI	*P* value
Gender (ref: Female)				
Male	0.043	1.044	0.734–1.485	0.809
Age (ref: 50–59 years)				
20–29	0.27	1.31	0.583–2.943	0.514
30–39	0.264	1.302	0.605–2.803	0.5
40–49	0.127	1.136	0.546–2.359	0.733
Education level (ref: Post-doctoral)				
Some college	0.53	1.699	0.785–3.681	0.179
Associate's degree	0.346	1.414	0.635–3.145	0.396
Bachelor's degree	0.499	1.647	0.67–4.046	0.277
Master's degree	0.658	1.931	0.714–5.22	0.195
Doctoral degree	0.509	1.664	0.353–7.85	0.52
Profession (ref: Nurse)				
Administrator	0.645	1.906	1.17–3.105	0.01
Physician	−0.337	0.714	0.442–1.154	0.169
Professional rank (ref: Senior)				
Junior	−0.361	0.697	0.247–1.967	0.496
Intermediate	−0.478	0.62	0.235–1.634	0.334
Vice senior	−0.534	0.586	0.225–1.528	0.274
The number of translational medicine centres in a country (ref: A few national centres)				
The more the better	1.17	3.221	1.655–6.267	0.001
Dozens	0.195	1.216	0.911–1.622	0.184
Whether participants' institutions have already set up a translational medicine centre (ref: No)				
Yes	−0.423	0.655	0.484–0.887	0.006
Should a translational medicine centre be a research institution or a coordinating office? (ref: Coordinating office)				
Research institution	0.301	1.352	1.023–1.787	0.034
The role of the community in translational medicine (ref: No role)				
Volunteers	0.801	2.229	1.282–3.875	0.005
Subjects	1.107	3.027	1.636–5.598	<0.001
Volunteers & subjects	1.082	2.95	1.715–5.075	<0.001
Is a resource coordinator necessary for a translational medicine centre? (ref: Not necessary)				
Necessary	−0.952	0.386	0.251–0.592	<0.001
Should core resources be shared? (ref: No)				
Yes	−0.924	0.397	0.255–0.618	<0.001
Awareness of the most important assessment stage (ref: Outcome assessment)				
Admittance assessment	0.366	1.442	0.999–2.082	0.05
Process assessment	0.742	2.101	1.358–3.25	0.001
Should researchers bear the treatment costs of participants? (ref: No)				
Yes, all costs	0.373	1.452	0.955–2.207	0.081
Yes, partial costs	0.835	2.305	1.513–3.51	<0.001

OR: odds ratio; CI: confidence interval.

administrators were more likely to support the establishment of translational medicine centres ($P = 0.01$). Participants with the attitude 'the more translational medicine centres the better' were more inclined to agree with the idea of setting up a translational medicine centre than were those who thought 'a few national centres are enough' ($P = 0.001$). Participants whose institutions had not set up a translational medicine centre were more likely to agree with the establishment of translational medicine centres ($P = 0.006$). Participants who regarded translational medicine centres as research institutions were more likely to support them ($P = 0.034$). Compared with participants who thought that the community had no role in translational medicine, those who were aware that community members act as volunteers ($P = 0.005$, participants ($P<0.001$), and both volunteers and participants ($P<0.001$) were more willing to support translational medicine centres. Participants who thought that resource coordinators were unnecessary in translational medicine centres were more likely to support such centres ($P<0.001$). Those who considered it unnecessary to share core resources were more likely to support the establishment of translational medicine centres ($P<0.001$). There are three types of assessment in translational medicine: admittance assessment, which evaluates the research proposal and analyses the feasibility of the research through peer review; process assessment, which implements quality assurance systems with control procedures to assess threats and progress toward research goals, targets, and relevant metrics of success; and outcome assessments, which evaluate the results of medical procedures, medical interventions, new drugs, medical instruments, patents, and papers. The results showed that participants who thought that process assessment was the most important assessment stage were 2.101 times more likely to support translational medicine centres than were those who regarded outcome assessment as the most important assessment stage. Participants who thought that translational researchers should bear a part of the patient's treatment costs were 2.305 times more likely to support translational medicine centres than were those who considered that researchers did not need to bear any patient treatment costs.

Discussion

To our knowledge, this is the first study to assess knowledge of and attitudes toward translational medicine and translational medicine centres among hospital personnel in China. The number of health personnel participating in the study was representative in terms of effective response rate and geographical distribution.

Regarding the attitudes toward translational medicine, it is noteworthy that more than five-sixths of the participants regarded the development of translational medicine as necessary. The main influencing factors for attitudes toward translational medicine were participants' profession, knowledge of translational medicine, and whether their institutions were capable of developing translational medicine and had already set up a translational medicine centre.

Regarding profession, it was interesting that the rate of approval of translational medicine among physicians (74.9%) was lower than among administrators (90.3%) and nurses (90.2%). This may reflect the debate among physicians about translational medicine. Some physicians think highly of translational medicine and use it in practice, and many prominent Chinese scientists have made exceptional progress in clinical and translational research. Professor Liu Shih-Hao, the founder of endocrinology in China, applied translational medicine to research, teaching, and clinical work in the 20th century.[28,29] Experienced Chinese

translational physicians and scientists have conducted research on the role of topical recombinant bovine basic fibroblast growth factor in burns,[30] T cells in skin inflammation,[31] Wnt/beta-catenin signalling in diseases[32,33], and the mechanism of infections.[34,35] However, many physicians overlook translational medicine and focus on routine clinical practice, because it may be professionally risky to research a new area in which human studies are time-consuming and expensive.[21] In addition, the average rate of successful translation from animal models to clinical cancer trials is low.[36] Many surgeons do not have the time or incentives to conduct research, a situation that is detrimental to translational medicine and may result in an increasing need for surgeon-scientists.[37] Given the importance of translational medicine, specific policies and funding incentives should be adopted. Funded career development training and education programs should be provided to develop clinical and translational researchers, and grants in translational medicine should be available to prepare health personnel to conduct translational research.[38]

Favourable attitudes toward translational medicine are more likely to develop among individuals with some knowledge of translational medicine. Our results suggest that individuals who knew a little, a moderate amount, or a lot about translational medicine were more willing to support translational medicine than those who knew nothing about translational medicine. Although the approval rate in participants who knew a lot about translational medicine (87.5%) was much higher than in participants who knew nothing about translational medicine (36.4%), the logistic regression analysis indicated that substantial knowledge of translational medicine was not associated with approval of translational medicine. This may be owing to the small number of participants with substantial knowledge of translational medicine (32, 2.1%). Participants whose institutions were capable of developing translational medicine were less likely to support the development of translational medicine, perhaps because of the high workload in their institutions and the uncertainty of translational research. Participants whose institutions had already set up a translational medicine centre had more opportunities to acquire translational medicine knowledge and were thus more willing to support the development of translational medicine.

Those who were aware that community members act as volunteers and/or participants in translational research were more willing to support translational medicine centres than were those who thought that community members had no role in translational medicine. Community-engaged research can build trust between researchers and communities, increase the relevance of research results[39] and benefit public health through the rapid application of basic research findings; thus, community engagement is very important.[40,41] To promote community engagement, programs that enable the translation of research into evidence-based practice are needed.[42]

It should be noted that participants who thought that resource coordinators or shared core resources were unnecessary in translational medicine centres were more likely to support translational medicine centres. This may reflect the lack of knowledge of translational medicine in China.

Participants who thought that process assessment was the most important assessment stage were more likely to support translational medicine centres. Translational medicine not only includes all the traditional research stages (e.g., basic, clinical, applied), but also involves a two-way process from basic research to clinical research;[43] therefore, the assessment stage in translational medicine should

involve process assessment. Individuals who regarded process assessment as the most important assessment stage tended to have greater knowledge of translational medicine and translational medicine centres. To promote translational medicine, more training and education about translation medicine is needed.[44,45]

Positive reactions to translational medicine practice are more likely in individuals who have some knowledge of translational medicine and are aware of its significance, and are less likely in individuals with unfavourable attitudes toward translational medicine. To increase awareness of translational medicine in China, effective measures are needed. Other studies have confirmed the important role of clinician-scientists in translational research and have identified barriers to career entry and progress.[46] Considering these issues, education and training on translational medicine and efforts to increase awareness should target all health personnel, from top scientists to community physicians. There is also a need for multilevel programs (including degree and certificate programs) and courses to enable health personnel to acquire the competencies necessary to conduct clinical and translational research.

This study had some limitations. First, participants' self-reported attitudes and awareness regarding translational medicine and translational medicine centres may be overestimations or underestimations of their actual attitudes and awareness. Second, we investigated awareness and attitudes, rather than actual practice. Future studies need to consider the practice of translational medicine and health personnel's engagement in other aspects of translational medicine. Third, the questionnaire did not measure participants' attitudes to education, training, and funding regarding translational medicine; these aspects should be explored in future research. Fourth, although participants were given a definition of translational medicine before they started the survey, the concept can mean different things to different individuals. Participants may not have fully understood the concept of the translational research paradigm prior to their input. In future studies, participants should be given an information leaflet containing more detailed explanations and examples of translational medicine. Fifth, the closed-ended questions on the questionnaire may have produced biased responses (e.g., the Pygmalion effect). To examine attitudes in more depth, we plan to conduct future research using semi-structured interviews and qualitative analysis.

Conclusion

Health personnel in Shanghai, China, showed highly positive attitudes toward translational medicine. Our results show that the willingness of health personnel to support translational medicine is influenced by their profession, knowledge of translational medicine, and whether their institutions are capable of developing translational medicine and have already set up translational medicine centres. Participants' attitudes toward translational medicine centres were associated with their profession, awareness of the number of translational medicine centres needed, whether their institution had set up a translational medicine centre, their awareness of translational medicine centres (research institution or coordinating office), attitudes toward the role of the community and sharing of core resources and patient costs, and assessment of translational medicine. However, most health personnel knew little or nothing about translational medicine. Effective measures are needed to improve awareness and attitudes among health personnel and encourage their practice of translational research. More training and education opportunities in

translational medicine may help to improve the research environment and reduce the professional risk of engaging with translational medicine.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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Appendix

Questionnaire assessing awareness of and attitudes toward translational medicine

1. What is your gender? (Male; Female)
2. What is your current age? (20–29; 30–39; 40–49; 50–59)
3. What is the highest level of education you have completed? (Some college; Associate's degree; Bachelor's degree; Master's degree; Doctoral degree; Post-doctoral)
4. Your profession is: (Administrator; Physician; Nurse)
5. Your professional rank is: (Junior; Intermediate; Vice senior; Senior)
6. Do you think it is necessary to develop translational medicine? (Yes; No)
7. How much knowledge of translational medicine do you have? (Know nothing; Know a little; Know average amount; Know quite a lot; Know a lot)
8. Is the institution to which you belong capable of developing translational medicine? (Yes; No)
9. What is your attitude toward the number of translational medicine centres in a country? (The more the better; Dozens are necessary; A few national centres are sufficient)
10. Is the institution to which you belong already set up as a translational medicine centre? (Yes; No)
11. Is it necessary to set up a translational medicine centre? (Necessary; Not necessary)
12. Should a translational medicine centre be a research institution or a coordinating office? (Research institution; Coordinating office)
13. 'Cooperation and management' or 'facilities and equipment': which one is more important in a translational medicine centre? (Cooperation and management; Facilities and equipment)
14. Should translational groups be fixed or open? (Fixed; Open)
15. What is the role of the community in translational medicine? (Volunteers; Subjects; Volunteers and subjects; No role)
16. Is a resource coordinator necessary for a translational medicine centre? (Yes; No)
17. Should core resources be shared? (Yes; No)
18. What is the difference between translational medicine and traditional medicine research? (Research starting point; Research object)
19. What is the object of translational research? (Animal; Cell; Human)
20. What is the most important assessment stage in translational medicine? (Admittance assessment; Process assessment; Outcome assessment)
21. Should researchers bear the treatment costs of participants? (Yes, all costs; Yes, partial costs; No)