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Repetitions in online doctor–patient communication: Frequency, functions, and reasons

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ABSTRACT

Objectives: To attain insights into language repetition during online doctor–patient communication (DPC), understand why doctors and patients use repetition, and improve the current deficiencies in online medical platforms.
Methods: The study performed a content analysis of 72 sets of textual doctor–patient conversations on the Chinese online medical consultation platform *Chunyu Doctor*.
Results: Repetitions occurred 1412 times in the 72 sets of online DPC. Patient self-repetitions were the most prevalent (30.7 %), while patient repetitions of doctors were the least common (17.1 %). Doctors used repetitions for explanations and affirmations. Patients used repetition for emphasis, verification, and turn-taking. The repetition frequencies of doctors and patients were primarily influenced by personal factors. However, doctor-dimension factors exerted a greater impact on the frequency of patient repetitions.
Conclusions: The reasons for repetitions in online DPC differ from those offline. Online DPC increases patient initiative and reduces doctor authority. Nevertheless, it could be affected by gender stereotypes generated during offline consultations. Doctors still dominated the conversations but attended sufficiently to the patient discourse. Online DPC is gradually attempting to fulfill the expectations of a new patient-centered healthcare pattern.
Practical implications: The findings yield suggestions for healthcare providers and the designers of online healthcare platforms.

1. Introduction

The demand for high-quality medical resources in China has long exceeded their supply [1], largely because of the prevailing imperfect system of hierarchical diagnosis and treatment [2]. Chinese citizens can directly access all levels of healthcare facilities [3]. Unlike western nations, their choices are not subject to suggested diagnosis-seeking plans and restrictions [4,5]. Therefore, level-A tertiary hospitals[2] account for 7.6 % of all hospitals in mainland China but encompass 47 % of the national aggregate of patient visits [6]. Fortunately, the trend of online medical consultations (OMC) is growing rapidly because of developments in Internet technology and now constitutes a significant complementary approach to offline healthcare services [7]. China's 2020 White Paper on the Internet Medical Consultation Industry reported that the demand-side market for Chinese OMC rose ten times the supply-side market to 283.96 billion yuan in 2019 [8], demonstrating the strong momentum toward the progression of the Chinese OMC market.

Online doctor–patient communication (DPC) denotes doctor–patient interactions conducted online via an electronic format through texts, pictures, and videos exchanged on OMC platforms [9]. This study attends to text-based communication, the most common form of online DPC in China [10]. Online DPC ameliorates the convenience and efficiency of medical treatment considerably through connectivity [11–13],

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[2] Hospitals in China are classified into three tiers: primary, secondary, and tertiary. These rankings are further subdivided into levels A, B, and C based on a hospital's services, size, quality, facilities, medical technology, and other factors. Level-A tertiary hospitals represent the most advanced hospitals in China.

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asynchronism [14], and visual anonymity [15–17]. However, it also introduces obvious interaction barriers such as speech incoherence, comprehension deviation [18], inaccurate diagnostic clues, and the inability of either party to ensure timely responses [19].

A speaker's strategies and intentions can be analyzed using numerous clues and cues evident from the person's language behaviors. The communication barriers can then be apprehended [20]. Studies of online DPC have found that doctors use high-performance language strategies such as appropriate question-answer correspondence, the tendering of individualized information for patients, and the apt extension of speech act ranges to increase patient satisfaction [21]. Doctors also employ empathetic expressions to develop a patient-centered communication style: endorsing viewpoints, articulating favorable judgments, and offering unconditional support and encouragement [22].

Repetition is a pervasive component of language [23,24]. An important linguistic strategy, repetition can structure meaning and enhance mutual understanding [25,26]. Repetition has also been observed to denote a common language behavior during medical consultations [27–30]. First, studies have operationalized repetition through frequency, such as recording the frequency of language repetition in doctor–patient dialogs from the dimensions of subjects, forms, semantics, and pragmatic functions [27], indicating the frequent occurrence of repetition in offline consultations. Then, some researchers have focused on the functions of repetition offline. They have revealed emphasizing information, guiding, and explaining as the principal functions of doctor-initiated repetition during consultations and that patient repetitions occur to solicit feedback, express doubt, ease nervousness, participate in decision-making [29], and confirm information to reduce uncertainty [31]. In addition, repetition research on offline medical consultations has comprehensively investigated the reasons for language repetition [27–30]. Studies from non-medical fields have also found repetition influenced by age [32,33] and gender [34]. However, as far as we know, the extant literature has focused only on offline medical consultations rather than OMC or other online environments. It remains unknown whether the characteristics of online DPC alter or endow the functions of repetition and what factors related to doctors and patients influence repetition. Therefore, we further aim to understand the factors concerning doctors and patients that can affect the frequency of repetition. The present study used content analysis to decipher the language strategies employed by doctors and patients to construct and develop their dialogic discourses. This can help us understand why physicians and patients utilize repetition, identify potential difficulties in online DPC, overcome communication barriers, and address present limitations in online medical platforms.

Specifically, we proposed the following research questions:

RQ1. How often do doctors and patients use repetition during online DPC?

RQ2. What functions does repetition accomplish for doctors and patients during online DPC? How does the utility of repetition differ for online and offline medical consultations?

RQ3. What factors influence repetition frequency during online DPC?

2. Method

Content analysis was conducted to evaluate repetition during online DPC. Content analysis is widely used in a naturalistic paradigm to derive meaning from textual data and elaborate on incomplete present theories [35].

2.1. Research subject and sampling

The current best-known OMC platforms in China include *Chunyu Doctor*, *Haodf.com*, and *Dingxiang Doctor*. However, *Dingxiang Doctor* limits dialogs to only three turns and forms a simple closed-loop of questions and answers. *Haodf.com* is more focused on doctor evaluations and enables patients to communicate with their preferred doctors via web-based telephony. Thus, it offers scant asynchronous textual data. Conversely, *Chunyu Doctor* includes more detailed and comprehensive responses and allows patients to ask unlimited questions within 48 h of their visit. Additionally, registered users can access their consultation records for free. We selected the *Chunyu Doctor* website after comparing the communication styles of varied OMC platforms in China. *Chunyu Doctor* enjoys a good reputation and allows comparatively more turns in doctor–patient conversations. The webpages of its 17 departments display lists of doctors from various hospitals across the nation, primarily from level-A tertiary hospitals, and encompass information such as the doctor's job title, institution, specialization, number of patients served, and patient feedback. The "Questions" section enables users to view doctor–patient conversations in totality.

The website lists numerous doctors but does not disclose the total number of doctors available in every department. Therefore, our sampling frame constituted the first 100 doctors of every department who used text responses rather than voice recordings. We generated random numbers to select five doctors from each department. However, the plastic surgery department only listed 39 doctors, so we selected two doctors from this field. We then extracted 20 sets of diagnostic conversations from each selected doctor according to their time sequence.

2.2. Data collection and cleaning

The doctor–patient conversation records analyzed in the study were compiled from anonymized consultations that reflected doctor–patient engagement and were publicly available to all users of the *Chunyu Doctor* website. The consultation histories were open to all registered users; however, information regarding patient identity was fully protected, and only details such as gender and age were provided. Octopus, a Chinese web crawler tool, was used in February 2022 to obtain text containing doctor–patient dialogs from the *Chunyu Doctor* website. We obtained 1440 sets of dialog from 72 doctors after eliminating duplicate values. Samples with short conversations or unsuitable topics were eliminated in accordance with our research needs. Stratified sampling was then performed and one conversation was randomly selected from each doctor. Finally, 72 sets of online doctor–patient consultation records comprising approximately 99,000 words were included for

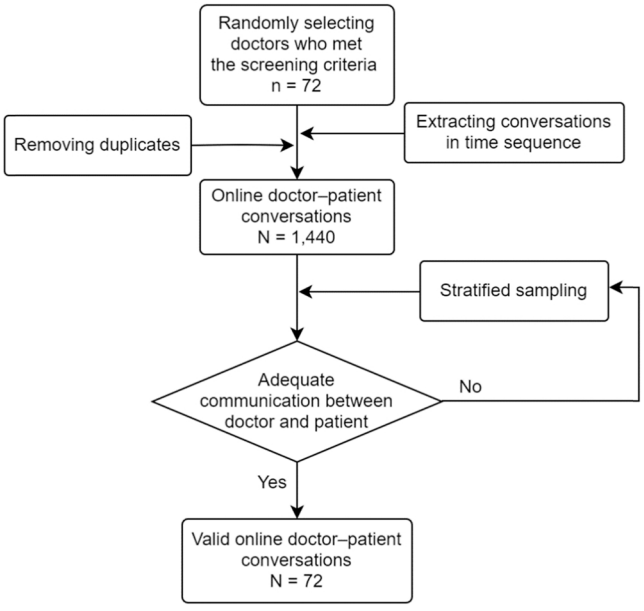

Fig. 1. The sampling process.

content analysis. Fig. 1 displays the sampling process.

2.3. Data coding

Data coding was accomplished in two rounds. First, we used each dialog as a unit of analysis to observe the effects of doctor- and patient-dimension factors on repetition frequency. Second, we utilized repetition as the unit of analysis to observe the structure, subject, and function of every repetition.

The doctor-dimension factors determined through the first round of coding included department, gender, job title, hospital level, years of practice, and the number of patients served. The patient-dimension factors encompassed gender, age, and identity (i.e., whether the patient consultation concerned a personal health condition or was conducted on behalf of another person). We recorded the number of repetitions in each dialog.

The second round of coding focused primarily on the subjects and functions of repetitions. We adapted the coding criteria posited by Xiao for repetition subject [36]: patient self-repetition (PRP), doctor self-repetition (DRD), patient repetition of doctor (PRD), and doctor repetition of patient (DRP). We referenced multiple coding criteria for repetition functions given the limited studies on repetition in medical consultations and the varying coding systems employed by different studies, [23,26,37]. We combined the existing stipulations and codes based on the preliminary observation of the corpus to create criteria that best suited our data. Finally, we divided repetition functions into nine categories: pure reply, affirmation, emphasis, explanation, supplementation, skepticism, verification, turn-taking, and comforting. Table 1 presents the coding criteria for the repetition characteristics with examples. We also coded the forms and semantics of repetition in accordance with Xiao [36]. We categorized the forms of repetition into reiterations of words, phrases, or sentences. Repetition semantics were grouped as complete or partial semantic repetitions.

The data coding was executed by two trained coders, who completely understood the sampled conversations during the pre-coding process. They were able to agree to the classifications assigned to repetitions. Both coders used the DiVoMiner website (an online coding website)[3] to independently code 100 repetitions from out-of-sample dialogs to test their internal reliability. In instances of unclear content, the coders arrived at a consensus after discussion and achieved a suitable internal reliability standard (Holsti's composite reliability coefficient = 0.86). Both coders demonstrated their comprehensive apprehension of the criteria designated for each category. Subsequently, each coded 36 sets of conversations in the sample.

2.4. Statistical methods

The IBM SPSS Statistics 26 software was used for statistical analyses. Descriptive statistics were used to answer RQ1 (the repetition frequency of doctors and patients). A chi-square test was performed to answer RQ2 (the relationships between repetition subjects and functions). Linear regression was conducted to answer RQ3 (the factors influencing repetition frequency).

2.5. Ethical considerations

This study used data available for public reference from *Chunyu Doctor*,[4] and patients were already anonymized by the website. We excluded all published identifiers (nicknames) from the results to further protect user privacy.

Table 1
Coding criteria for repetition subjects and functions.

Categories	Criteria	Examples
Repetition Subjects		
Patient self-repetition	A patient repeats himself or herself.	P: The baby has vomited milk a little these two days. P: *Should I let a doctor listen to his lungs?* D: The milk vomiting is a little indigestion after the illness. It doesn't matter. P: *Should I let a doctor listen to his lungs?*
Doctor self-repetition	A doctor repeats himself or herself.	D: *The stool was not shaped*, and this medicine may aggravate the condition that *your stool is not shaped*, you need to use some other medicine.
Patient repetition of doctor	A patient repeats what the doctor said.	D: The staple food is about *100 g*. P: *100 g* for each meal?
Doctor repetition of patient	A doctor repeats what the patient said.	P: There are *no side effects*? D: Yes, *no side effects*.
Repetition Functions		
Pure reply	To reply to a question without further explanation.	D: Do you prefer cold water or *warm water*? P: *Warm water*.
Affirmation	To confirm what the other asked or said.	P: There are *no side effects*? D: Yes, *no side effects*.
Emphasis	To highlight key points or draw the other's attention.	P: The spot couldn't be covered by *the diaper*, it's not where *the diaper* was.
Explanation	To explain something unclear or obscure.	*D: The stool was not shaped, and this medicine may aggravate the condition that your stool is not shaped, you need to use some other medicine.*
Supplementation	To add to (or correct) what one or the other just said.	P: He didn't *scratch* often, just occasionally. He might *scratch* a little when I changed his diaper.
Skepticism	To disagree with or doubt what the other said, using statements or rhetorical questions.	D: You can apply *calamine lotion*. P: But I don't think *calamine lotion* works well.
Verification	To get a more accurate response after failing to understand what the other said.	D: The staple food is about *100 g*. P: *100 g* for each meal?
Turn-taking	To repeat what one said after being interrupted or ignored.	P: The kid has several *small lumps* on his thigh. (After multiple turns…) P: Doctor, what about *the small lumps*?
Comforting	To soothe the other.	D: *Don't worry, don't worry*.

Note: D = doctor; P = patient.

3. Results

3.1. Information on doctors and patients

The sample of doctors comprised 49 males (68.1 %) and 23 females (31.9 %) who had practiced on average for 16.9 years (SD = 8.62) and served an average of 21,714 online patients (multiple consultations with the same person over time for different ailments were recorded as multiple patients). Most doctors held the title of attending physician or

[3] https://www.divominer.cn/
[4] https://www.chunyuyisheng.com/

associate chief physician and worked in level-A tertiary hospitals. The corresponding patients were 36 males (50 %) and 36 females (50 %) aged 29 years on average (SD = 14.7). Most patients consulted for themselves (77.8 %) rather than others.

3.2. Descriptive statistics regarding types of repetition during online DPC

Repetition occurred 1412 times in the 72 analyzed sets of online doctor–patient conversations, averaging 19.6 times per set. Each conversation included 11.3 doctor repetitions (SD = 4.2) and 10.8 patient repetitions (SD = 5.6) on average. Table 2 exhibits the overall distribution. PRP occurred most often (30.7 %) and PRD was least noted (17.1 %). Supplementation (22.2 %), pure reply (15.7 %), emphasis (15.2 %), verification (14.7 %), and explanation (13.1 %) denoted the most frequent functions of repetition. Word repetition (53 %) was the most common form, and partial semantic repetition was more frequent (88.5 %).

3.3. Relationships between the subjects and functions of repetition

A chi-square test was conducted to observe the associations between the subjects and the functions of repetition. The results are shown in Table 3.

We found significant differences in the subjective distribution of repetition functions. Affirmation appeared frequently in other-repetition and occurred more often in DRP (22.0 %) than in PRD (12.8 %). Emphasis and supplementation accounted for a large proportion of self-repetition, and no obvious difference was determined between patients (28.8 %/35.0 %) and doctors (35.0 %/37.4 %). Doctor repetition almost always entailed the function of explanation: in tendering explanations, 28.2% of doctors reiterated patient questions (DRP) while 19.8 % restated themselves (DRD). Almost all repetition aimed at verification, skepticism, and turn-taking occurred only during patient turns. Repetition for comforting was used only by doctors and accounted for only 1.8 % of all repetitions, mostly DRD.

3.4. Factors influencing repetition frequency

Linear regression was conducted to examine the factors influencing repetition frequency in an entire conversation. To highlight the differences between doctors and patients, we separately observed the doctor and patient repetition frequencies in **models 3** and **4** (see Table 4). Zhou (2018) pointed out that three regression models could be constructed to compare the influence of two sets of independent variables on dependent variables. The first group of independent variables was included in the first model, and the second group was incorporated in the second model. Finally, the third model encompassed both groups of independent variables. The effects of the different groups of independent variables on the dependent variables can be observed through differences in the R^2 values [38]. Therefore, we established three regression models in each set of regressions to examine the effects of the doctor- and patient-dimension factors on repetition frequency. Specifically, **models 3–1** and **4–1** only included doctor-dimension factors: gender, job title, hospital level, years of practice, and the number of patients served. The job titles were physician, attending physician, associate chief physician, and chief physician. These designations constituted a hierarchical relationship; hence, we excluded cases that displayed nutritionist as a doctor's job title. **Models 3–2** and **4–2** only included patient-dimension factors: gender, age, and identity. **Models 3–3** and **4–3** incorporated both doctor- and patient-dimension factors. Finally, the influence of different dimensions on repetition frequency was measured by comparing the R^2 values. Moreover, dialog length was included as a covariable in each regression model because it could also affect the repetition frequency. The multicollinearity between the variables is indicated by the VIF value.

The results revealed that all six versions of **models 3** and **4** were significant. The VIF values did not demonstrate multicollinearity between variables in the regression models. In **M3–1**, doctor repetition frequency was not predicted by the doctor's gender and the number of patients served. A more senior job title predicted lower doctor repetition frequency, while increased years of practice predicted higher doctor repetition frequency. Doctors attached to level-A tertiary hospitals also demonstrated higher repetition frequencies than doctors from non-level-A tertiary hospitals. Patient age did not affect doctor repetition frequency in **M3–2**, but patient gender did predict doctor repetition frequency. Doctors tended to repeat themselves less often when patients consulted for others rather than themselves. Explanatory power was computed at 34.1 % for M3–1 % and 31.6 % and 35.3 % for M3–2 and M3–3, respectively. Aggregating doctor-dimension factors increased the explanatory power (3.7 % vs. 1.2 %), evidencing that doctor-iterated repetitions emanated primarily from the doctors themselves.

Table 2
Descriptive statistics of repetition types during online doctor–patient communication.

Variable	Categories	Frequency
Repetition Subject	Patient self-repetition (PRP)	434 (30.7 %)
	Doctor repetition of patient (DRP)	418 (29.6 %)
	Doctor self-repetition (DRD)	318 (22.5 %)
	Patient repetition of doctor (PRD)	242 (17.1 %)
	Total	1412 (100.0 %)
Repetition Function	Supplementation	313 (22.2 %)
	Pure reply	222 (15.7 %)
	Emphasis	215 (15.2 %)
	Verification	207 (14.7 %)
	Explanation	185 (13.1 %)
	Affirmation	128 (9.1 %)
	Turn-taking	79 (5.6 %)
	Skepticism	38 (2.7 %)
	Comforting	25 (1.8 %)
	Total	1412 (100.0 %)
Repetition Forms	Word repetition	749 (53.0 %)
	Phrase repetition	478 (33.9 %)
	Sentence repetition	185 (13.1 %)
	Total	1412 (100.0 %)
Repetition Semantics	Partial semantic repetition	1250 (88.5 %)
	Complete semantic repetition	162 (11.5 %)
	Total	1412 (100.0 %)

Table 3
Chi-square test of functions and subjects.

	Self-repetition		Other-repetition		Total
	PRP	DRD	PRD	DRP	
Pure reply	1 (0.2 %)	8 (2.5 %)	**80 (33.1 %)**	**133 (31.8 %)**	222 (15.7 %)
Affirmation	1 (0.2 %)	4 (1.3 %)	**31 (12.8 %)**	**92 (22.0 %)**	128 (9.1 %)
Emphasis	**125 (28.8 %)**	**76 (23.9 %)**	4 (1.7 %)	10 (2.4 %)	215 (15.2 %)
Explanation	1 (0.2 %)	**63 (19.8 %)**	3 (1.2 %)	**118 (28.2 %)**	185 (13.1 %)
Supplementation	**152 (35.0 %)**	**119 (37.4 %)**	19 (7.9 %)	23 (5.5 %)	313 (22.2 %)
Skepticism	11 (2.5 %)	–	**21 (8.7 %)**	6 (1.4 %)	38 (2.7 %)
Verification	**78 (18.0 %)**	17 (5.3 %)	**80 (33.1 %)**	32 (7.7 %)	207 (14.7 %)
Turn-taking	**65 (15.0 %)**	10 (3.1 %)	4 (1.7 %)	–	79 (5.6 %)
Comforting	–	**21 (6.6 %)**	–	4 (1.0 %)	25 (1.8 %)
Total	434 (100.0 %)	318 (100.0 %)	242 (100.0 %)	418 (100.0 %)	1412 (100.0 %)

Note: $\chi^2 = 1096.93$ ($p < 0.001$). The main functions of the different subjects are highlighted in bold.

Table 4
Linear regression of repetition frequency.

	Model 3 Doctor repetition frequency			Model 4 Patient repetition frequency		
	M3-1	M3-2	M3-3	M4-1	M4-2	M4-3
Doctor-dimension factors						
Gender	.022		.038	−.032		−.070*
(Male = 0)	(VIF = 1.13)		(VIF = 1.27)	(VIF = 1.12)		(VIF = 1.27)
Job title	−.262***		−.242***	.169***		.188***
	(VIF = 1.93)		(VIF = 2.13)	(VIF = 2.16)		(VIF = 2.20)
Hospital level	.156***		.151***	.023		−.001
(non-Tertiary A = 0)	(VIF = 1.18)		(VIF = 1.22)	(VIF = 1.25)		(VIF = 1.29)
Years of practice	.112**		.112**	.024		−.003
	(VIF = 1.72)		(VIF = 1.82)	(VIF = 1.89)		(VIF = 1.90)
Number of patients	−.007		.004	−.017		.040
	(VIF = 1.06)		(VIF = 1.09)	(VIF = 1.06)		(VIF = 1.10)
Patient-dimension factors						
Gender		.069*	.022		.213***	.247***
(Male = 0)		(VIF = 1.13)	(VIF = 1.28)		(VIF = 1.11)	(VIF = 1.19)
Age		.050	.041		.216***	.192***
		(VIF = 1.05)	(VIF = 1.12)		(VIF = 1.02)	(VIF = 1.11)
Identity		−.089**	−.093**		.052	.049
(Self = 0)		(VIF = 1.12)	(VIF = 1.26)		(VIF = 1.09)	(VIF = 1.26)
Covariable						
Dialog length	.542***	.568***	.556***	.557***	.656***	.636***
	(VIF = 1.19)	(VIF = 1.03)	(VIF = 1.25)	(VIF = 1.20)	(VIF = 1.03)	(VIF = 1.28)
Model results						
F	60.274	80.997	42.186	72.402	137.401	70.047
Sig.	***	***	***	***	***	***
R^2	.341	.316	.353	.400	.457	.493
N	707	707	707	659	659	659

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Patient repetition frequency was not predicted by a doctor's gender, years of practice, the number of patients served, or hospital level in **M4–1**, but a doctor's job title was positively related to patient repetition frequency. Specifically, a more senior job designation was associated with increased patient repetition. In **M4–2**, female patients evinced higher repetition frequencies than male patients. Patient age was also positively related to patient repetition. Differences in patient identity did not predict the patient repetition frequency. Noteworthily, **M4–3** demonstrated increased patient repetition with male doctors. The explanatory power was calculated at 40.0 % for M4–1 % and 45.7 % and 49.3 % for M4–2 and M4–3, respectively. Aggregating patient-dimension factors increased the explanatory power (9.3 % vs. 3.6 %), evidencing that patient repetition frequencies stemmed predominantly from the patients themselves. Combining both sets of regressions allowed the speculation that repetition frequencies were primarily influenced by self-related factors. However, doctor-dimension elements exerted a greater impact on patients.

4. Discussion and conclusions

4.1. Discussion

Repetition is widespread during online DPC displayed on the *Chunyu Doctor* website. We believe that the online environment of OMC platforms influences repetition strategies adopted by doctors and patients and consequently shapes a new doctor–patient power relationship. We offer some remarkable findings that can supplement the reports of previous studies on language repetition or online DPC.

First, we found differing reasons for repetition during online textual communication and offline medical consultations. The existing research on offline consultations shows that repetition may partly be attributed to inadequate time available for language preparation [27,36]. Conversely, online DPC gives both doctors and patients adequate time to organize language and eliminates the tensions of offline medical encounters. Both doctors and patients are more relaxed and can converse casually, a mode that is prone to repetition [14]. Further, the errors and omissions of casual expression are recorded verbatim during online DPC. The efficacy of supplementary content and corrections is reduced, resulting in unclear information and causing repeated questioning and confirmations.

Second, the proportion of DRP was much higher than that of PRD. This result was diametrically opposed to the findings reported by offline outpatient repetition studies [27], indicating that the discourse power of patients improved significantly during online DPC. The doctor repetition result implies that medical practitioners maintained their authority in online DPC in congruence with traditional medical consultations to a certain extent. However, their power position in online DPC diminished vis-à-vis the offline consultation environment. DRP was used in online DPC primarily to explain and affirm and this finding aligned with the results of an offline outpatient repetition investigation [29]. The repeated affirmations, instructions, and explanations by doctors during online DPC could signify that patients constantly question their doctors and are eager to learn further about the safety of surgeries or the side effects of drugs. For example, patients could express a lack of faith in treatment regimens differing from other opinions obtained on the Internet [39], and online doctors can then restore patient confidence merely through repetition. DRD was also usually accompanied by complete semantic repetitions, revealing that doctors took a more passive position during online communications with their patients.

Third, patient repetition reflected the improvement of patient initiatives in OMC. Of the four previously mentioned repetition subjects, PRP occurred most frequently during online DPC and was used predominantly for emphasis, supplementation, verification, and turn-taking. This finding indicated that online patients desired the right to speak and to completely articulate their views and attitudes toward their

ailments. This outcome accords with previous findings that online patients are more autonomous and active [40] and harbor a dynamic need for health information [41]. Patients initiated turn-taking repetitions mainly because of neglect by doctors. Unlike offline patients who must seize speech opportunities because of interruptions by their doctors [42], online DPC does not impose time constraints and allows patients to record their entire medical history in long paragraphs, producing information overload for doctors [19]. Neglected patients can reorient the conversation through self-repetition. PRD often accompanied verification and skepticism stemming from the self-belief of patients, who were unclear or confused about the answers offered by the doctors or doubted their diagnoses and suggestions. Research shows that shared doctor–patient decision-making can effectively improve patient compliance with treatment [43]. Patients may consider their doctor unprofessional and untrustworthy if the doctor's judgment is inconsistent with their self-diagnosis [44]. The anonymity of online communication emboldens patients to challenge the authority of doctors. This result is congruent with the findings of a previous study reporting that OMC has changed the traditional hierarchical powerful-powerless relationship between doctors and patients [45].

Fourth, the frequencies of doctor and patient repetition were principally affected by gender and doctor designations. Patients repeated more when conversing with male doctors, and doctors repeated more with female patients. We believe that patients sustain an inherent impression of the gender of the doctor even though online doctors of different gender exhibit similar expertize. Offline medical consultation experiences could have impressed patients with the stereotype that male healthcare workers tend to view doctor–patient communications as overbearing and inhibited [46], whereas female doctors are more empathetic and patient-centered during consultations [47,48]. Patients could still retain the belief that they must constantly emphasize their points to attract a male doctor's attention in the online environment. It is also simultaneously possible that doctors have also transported their stereotypes about women to online DPC, assuming that female patients require increased repetition to feel valued and satisfied. Female speech patterns are often considered gentle, trivial, detailed, tentative, and repetitive [49,50]. Female patients are loquacious and register longer offline consultation times than male patients [51]. Doctor–patient interaction styles have been proven gender-dependent and influenced by stereotypes [46]. Future studies could find it worthy to investigate how stereotypes generated in the offline environment interact with online DPC. Also, doctors with higher professional titles used less repetition but elicited more repetition from patients. Highly qualified doctors focus on communication brevity, which can create a meaning gap between doctors and patients and can inculcate uncertainty in patients about the diagnosis. This discovery aligns with a previous finding that more-experienced doctors used less restatement than less-experienced practitioners and were more likely to talk concurrently and interrupt patients [52].

In general, the repetition strategies adopted by both doctors and patients were primarily influenced by self-factors, in agreement with the conclusions drawn by the Communication Theory of Identity (CTI). CTI claims that identities prescribe modes of appropriate and effective communication and that individuals can construct and strengthen their identities through communication [53,54]. The online doctor–patient interaction mode interacts with the identity cognition of doctors and patients. Doctors perceive themselves as authority figures and as experts who answer questions. Patients sense that the online environment enhances their voice and enables them to create a new self-motivated identity. Therefore, the repetition strategies of both doctors and patients display strong subjectivity. Nevertheless, doctors dominated the conversations despite the improved subjectivity of online patients. Doctor-dimension factors influenced patient repetition frequency more significantly, suggesting that online DPC retains the doctor-oriented features of the traditional doctor–patient relationship. Conversely, offline doctors predominantly initiate command speech and function as questioners in traditional medical consultations, during which patients answer all of their doctors' questions and doctors only partly answer their patients' queries [55]. However, we found that online patients generally actively asked questions about their conditions rather than merely responding to the guidance of their doctors. Therefore, online DPC is gradually fulfilling the expectations of a new more patient-centered healthcare pattern.

4.2. Limitations

First, this study examined only one OMC platform; therefore, our research data was limited. The doctor–patient conversations on this platform could display commonalities but lack representativeness. Second, this study's corpus was obtained from publicly published online text consultation records. Future studies could entail more private online doctor–patient conversations for further analysis. Third, this study's analysis did not include key patient demographic characteristics such as occupation and education level because the platform does not collect this information. Thus, we could not consider the influence of socioeconomic factors on repetition in online DPC. Fourth, the entire coding was manually accomplished because of the complexity of recognizing repetition and analyzing its semantics. Machine learning methods could have helped us include a larger corpus; however, scholars have indicated that machine learning lacks sufficient maturity to achieve complex semantic recognition [56]. We expect that future studies would utilize more scientific methods to include larger samples. Finally, the extension and generalization of our conclusions to other regions remain unexplored because of the particularity of doctor–patient relationships in China. Additionally, qualitative interviews are required to further determine the validity of our conclusions.

4.3. Conclusions

This study adopted the *Chunyu Doctor* website as its research object and observed the communication patterns and power distributions of online DPC through the aspect of language repetition. First, repetition occurs in online DPC for reasons other than reiterations in offline consultations. The online environment is devoid of face-to-face conversations that include body language and paralanguage. In such instances, repetition represents a new language cue and serves as a bridge to communication and understanding. Second, online DPC occurs outside the hospital environment and without the image of the doctor's persona. Although it increases the discourse power of patients, it could also reduce the authority of doctors and lead patients to distrust the diagnoses of doctors. Third, we cannot ignore the influence of gender on online DPC. Gender stereotypes generated in offline consultations could affect online DPC. Finally, doctors still lead the conversations during online DPC, but ample attention is devoted to the discourse of patients. Currently, online DPC denotes a beneficial praxis for patient-centered medical care.

4.4. Practice implications

This study offers suggestions for healthcare providers and the designers of online healthcare platforms. Hospitals and OMC platforms should consider training doctors for online consultations, focusing on the similarities and differences between online and offline consultations. As professionally trained healthcare providers, doctors must set the tone of medical consultations by avoiding long speeches encompassing vague points and ensuring that their explanations are easily grasped by patients. Doctors should understand that patient repetition stems from inadequate comprehension and psychological tension, and should thus try to identify the anxiety and fear that patients tend to express through repetition. Patient expressions should be improved by reducing misleading information and useless repetition. Patients must also accept that online doctors may not be able to deliver answers with 100 %

certainty without physical examinations and should not deify or berate their doctors. Further, patients should understand that online doctors attend to both online and offline patients; inevitably, their responses may not always be timely. Platforms should better convey the sense of authority of hospitals and doctors to help reassure and convince patients. An increased set of emoticons and greetings should be available in the platform chat options to help compensate for the absence of body language clues and emotional communication in the online environment. In addition, OMC platforms could provide doctors and patients with key points or discourse supplements through algorithms to ensure smooth, high-quality, and efficient communication.

CRediT authorship contribution statement

Zhang Wen: Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Zhou Fangzhou:** Data curation, Investigation, Formal analysis, Writing – original draft. **Fei Yifeng:** Data curation, Investigation, Software.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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