

# Intertemporal Decision-Making Ability in Patients with Chronic Diseases: A Concept Analysis

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**Purpose:** Intertemporal decision-making ability influences adherence to health behavior and clinical outcomes in patients with chronic diseases. However, its concept remains insufficiently defined. This study aimed to identify the key attributes, antecedents, consequences, and empirical referents of intertemporal decision-making ability in patients with chronic diseases.

**Methods:** The Walker and Avant's concept analysis method was used. A systematic search for studies on intertemporal decision-making ability in patients with chronic diseases was conducted across the following databases: PubMed, Web of Science, CINAHL, Embase, PsycINFO, and the China National Knowledge Infrastructure (CNKI). The search covered literature from the beginning until January 2026.

**Results:** A total of 35 articles were included. Four defining attributes of intertemporal decision-making ability in patients with chronic diseases were identified: impulse control, emotional self-regulation, future health valuation, and future-oriented thinking and planning. Antecedents included economic factors, knowledge level, perceived health competence, disease status, emotional status, personality traits, and time perspective, while its consequences encompassed improved psychological status, adherence, and clinical outcomes.

**Conclusion:** Intertemporal decision-making ability in patients with chronic diseases is a multidimensional psychological construct. A thorough examination of this concept can facilitate the development of appropriate assessment instruments and stratified interventions. In clinical practice, healthcare providers can deliver individualized interventions based on patients' specific deficient attributes, using strategies such as immediate rewards, environmental restructuring, health education, and episodic future thinking training to enhance intertemporal decision-making ability, thereby improving adherence to health behaviors and optimizing clinical outcomes.

**Keywords:** intertemporal decision-making, chronic disease, health behavior, concept analysis

## Introduction

Chronic diseases are a major global public health challenge and a leading cause of disability and mortality. Cancer, diabetes, chronic respiratory diseases, and cardiovascular diseases account for 74% of all deaths globally.<sup>1</sup> These diseases are typically chronic and difficult to cure completely. Improvements in recovery and quality of life depend on patients' long-term health behaviors. Such behaviors include regular medication adherence, a balanced diet, moderate physical activity, and consistent self-monitoring.<sup>2</sup> However, data from the World Health Organization indicate that only 50% of patients with chronic diseases can adhere to recommended treatments and lifestyle modifications over the long term.<sup>3</sup>

The patient's relationship with temporality may represent an overlooked factor contributing to non-adherence.<sup>4</sup> Hypothesizing that the rewards of non-adherence are immediate and tangible, whereas those of adherence are abstract and distant, it is expected that most patients are predisposed to non-adherence.<sup>4</sup> The benefits of health behavior adherence depend on long-term persistence, which is contrary to inherent human temporal preferences.<sup>2</sup> During decision-making, individuals prefer to engage in unhealthy behaviors that yield immediate gratification, rather than opting for health choices that generate relatively greater benefits at a later time point. This behaviour constitutes intertemporal decision-making.<sup>2</sup>



Emerging evidence suggests that intertemporal decision-making plays a critical role in behavioral maintenance and modification, and serves as a useful predictor of adherence to health behavior and clinical outcomes among patients with chronic diseases.<sup>5,6</sup> Therefore, enhancing intertemporal decision-making ability is regarded as a promising intervention target for promoting health behaviors among patients with chronic diseases.<sup>7,8</sup> The most widely used intervention is episodic future thinking skill training via digital technology. This approach enables individuals to create vivid, meaningful future scenarios using episodic memory. As a result, individuals place greater value on future rewards and show reduced temporal discounting in health-related decision-making.<sup>9</sup> Several behavioral economics strategies, such as framing effects<sup>10</sup> and commitment devices,<sup>11</sup> have also shown potential to improve intertemporal decision-making ability.

Intertemporal decision-making has long been a concern across psychology, behavioral economics, and neurocognition. From a neurocognitive perspective, intertemporal decision-making ability is not innate but rather develops continuously with brain development.<sup>12,13</sup> The three brain network model proposed by Peters and Büchel,<sup>14</sup> namely, the cognitive control network, the reward valuation network, and the prospection network, are considered the foundation for measuring intertemporal decision-making ability,<sup>15</sup> and interindividual differences exist in these three neural mechanisms.<sup>16</sup> Although this model has identified brain networks associated with intertemporal decision-making ability, these findings have not yet been translated into operational indicators that can be used for clinical assessment or intervention. The discounted utility model<sup>17</sup> and the hyperbolic discounting model,<sup>18</sup> both originating from behavioral economics, operationalize intertemporal decision-making ability as a parameter, the discount rate “*k*”, which is determined by discounted subjective value, undiscounted future value, and delay time. The primary measurement paradigm involves choices between a smaller, immediate monetary reward and a larger, delayed reward. This approach is considered a valid measure of intertemporal decision-making ability.<sup>12</sup> However, discounting rates may vary depending on the measurement technique employed,<sup>19</sup> and this parameter overlooks an in-depth understanding of the psychological constructs that underlie intertemporal decision-making processes. In addition, in current practice, intertemporal decision-making ability is often conflated with self-regulation ability. Several individual traits reflecting a tendency to prioritize immediate over long-term outcomes have been proposed, including conscientiousness, self-control, the ability to delay gratification, and impulsivity. It is often assumed that self-regulation ability is central to future-oriented choice.<sup>20</sup> However, intertemporal decision-making and self-regulation are distinct processes; specifically, low self-regulation is not a prerequisite for decisions that devalue potential future outcomes.<sup>20</sup>

Given the above background, the concept of intertemporal decision-making ability remains ambiguous, and the underlying psychological constructs have not been systematically analyzed. This may lead to one-size-fits-all interventions in clinical practice, which are largely confined to health education and the delivery of preventive information, without offering personalized interventions tailored to patient subgroups to address deficits in decision-making ability itself. Therefore, there is a need for a systematic concept analysis of intertemporal decision-making ability in patients with chronic diseases, to clarify its attributes, antecedents, consequences, and empirical indicators, thereby providing a basis for subsequent tool development and personalized interventions.

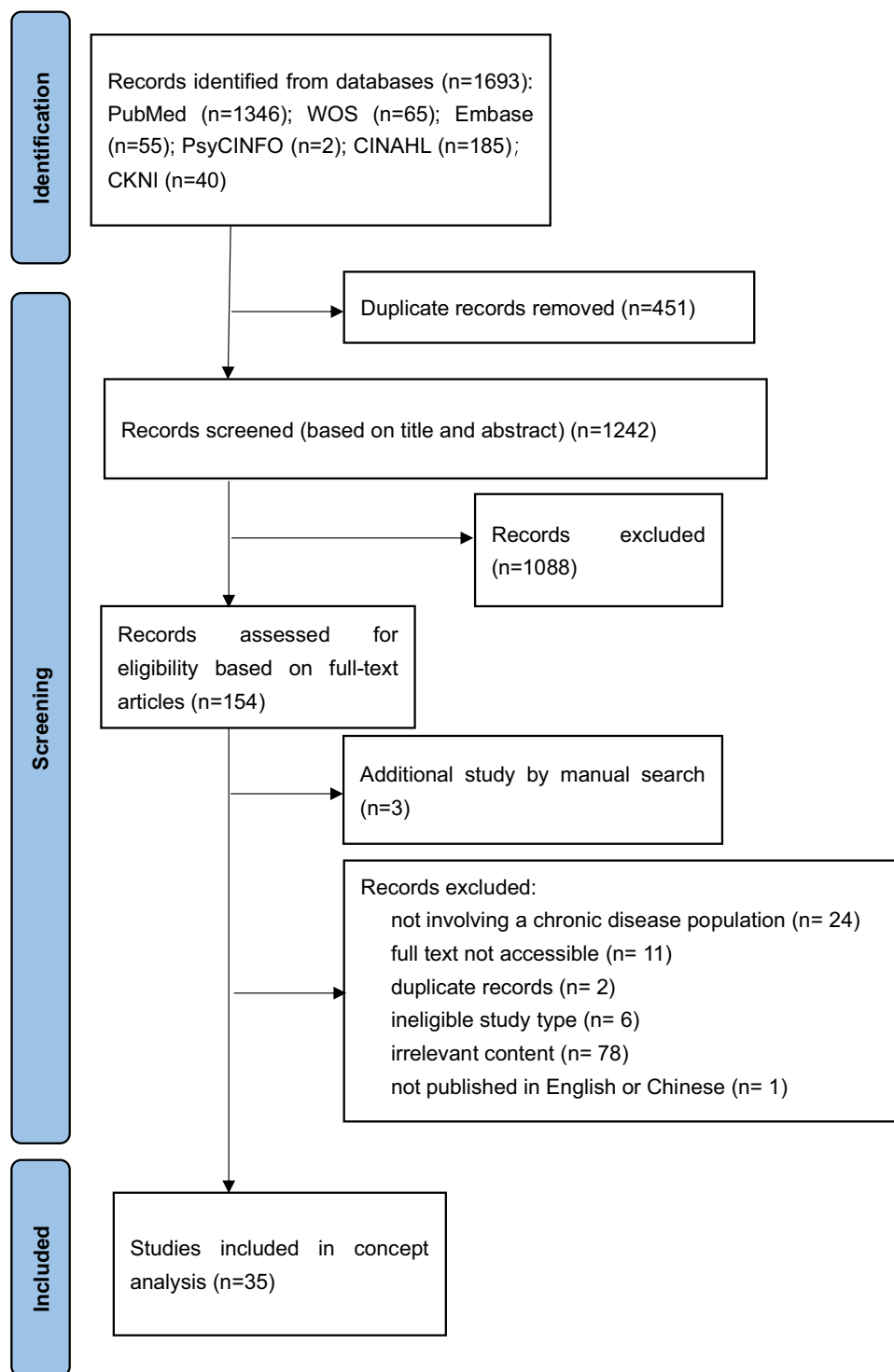
## Method

### Data Source

A literature search was conducted using the PubMed, Web of Science, CINAHL, Embase, PsycINFO, and CNKI databases, covering the period from their inception to January 1, 2026. The keywords used were “chronic disease,” “intertemporal decision-making ability,” and “delay discounting.” Search terms were used individually and in combination. The search strategy is detailed in [Supplementary File 1](#).

Zotero software was used to manage the retrieved literature and remove duplicate records. The initial search yielded 1639 articles, and 451 duplicate records were removed. After screening the titles and abstracts of the remaining articles, 1088 articles were excluded. The full texts of 154 articles were assessed, and an additional 3 articles were identified through manual searching. The inclusion criteria were as follows: (1) qualitative, quantitative, and mixed-methods studies published in peer-reviewed journals; (2) studies that included adult patients with chronic diseases, regardless of the type of chronic disease; and (3) studies with content focused on identifying elements of intertemporal decision-

making ability. Articles not published in English or Chinese, as well as those focusing solely on neurobiological mechanisms, were excluded. (The rationale for this exclusion is that findings at the neurobiological level and concepts at the psychological level reside at different levels of analysis; directly incorporating them could blur conceptual boundaries and increase clinical operational complexity). After full-text assessment, 122 articles were excluded. Ultimately, 35 publications were included in this study (see [Figure 1](#)). The review process was conducted in accordance with the PRISMA 2020 checklist.<sup>21</sup>



**Figure 1** Literature search flowchart.

To ensure the traceability of the analysis, we established a systematic extraction procedure. Braun and Clarke's thematic analysis method<sup>22</sup> was used. First, LXR and LYM independently read the full texts of the included literature and extracted descriptive statements, definitions, operationalization methods, influencing factors, and outcomes related to intertemporal decision-making ability. Second, the two researchers coded meaningful statements related to intertemporal decision-making ability, such as "simulating meaningful future events," "considering the distant future," and "avoiding impulsive choices." Next, the initial codes were grouped into candidate themes based on their similarities, such as grouping the codes "simulating meaningful future events" and "considering the distant future" into the theme "future-oriented thinking". At this stage, the two researchers met after every 10 analyzed articles to discuss differences in themes. Any disagreements were resolved through discussion with the corresponding author, ZC. During the third meeting, the entire research team participated in discussions to refine the candidate themes into final defining attributes. For the antecedents and consequences, a similar inductive process was applied, supported by at least two independent studies. A summary of the final included literature is provided in [Supplementary File 2](#).

The Walker and Avant's concept analysis method provides a structured and systematic approach to clarifying and defining intertemporal decision-making ability in patients with chronic diseases.<sup>23</sup> The method comprises eight steps:<sup>23</sup> (1) selecting a concept; (2) determining the aims of the analysis; (3) identifying all uses of the concept; (4) defining its key attributes; (5) constructing a model case; (6) presenting borderline and contrary cases; (7) identifying antecedents and consequences; and (8) defining empirical referents.

## Results

The "Results" section will cover steps two through eight, as the first step has already been introduced in the preceding text, and "intertemporal decision-making ability" is the selected concept.

### Determining the Aims of the Analysis

The aim of the analysis was to identify the key attributes, antecedents, consequences, and empirical referents of intertemporal decision-making ability in patients with chronic diseases, thereby providing a basis for the development of assessment instruments and the design of interventions.

### Use of the Concept

#### Dictionary Definitions

A specific definition for "intertemporal decision-making ability" was not found in dictionaries. Loewenstein et al<sup>24</sup> defined intertemporal decision-making as the judgments and choices individuals make when weighing the costs and benefits that occur at different points in time. Merriam-Webster Dictionary defines "decision" as the act or process of deciding something.<sup>25</sup> In the Chinese dictionary, "decision-making" refers to the process by which individuals formulate ideas and make determinations regarding various matters.<sup>26</sup> It is a complex cognitive process involving information gathering, processing, and ultimately forming judgments and reaching conclusions.<sup>26</sup> In a healthcare context, decision-making is "the cognitive process of making a choice",<sup>27</sup> often involving a consideration of available treatments, benefits, and risks, uncertainties, and associated burdens.<sup>28,29</sup>

Cambridge Dictionary defines "ability" as the physical or mental power or skill needed to do something.<sup>30</sup> Generally, ability can be examined through a multidimensional analysis from psychological, philosophical, and vocational competence development perspectives. From a psychological perspective, ability refers to the individual psychological characteristics required for completing certain activities.<sup>31</sup>

#### Use of the Concept in the Literature

In 1834, Rae, a Scottish economist, first introduced the concept of intertemporal decision-making.<sup>32</sup> From an evolutionary perspective, intertemporal decision-making is a critical decision-making ability that emerged as human society transitioned from a hunter-gatherer to an agricultural civilization.<sup>33</sup> Wang et al<sup>15</sup> noted that decision-making between available outcomes occurring at different time points often requires suppressing impulsive decisions to maximize long-term rewards, and that the degree of future orientation demonstrated during this process may reflect the strength of an

individual's intertemporal decision-making ability. Intertemporal decision-making originated from the fields of behavioral economics and psychology. With the prevalence of chronic diseases, including various types such as cancer, diabetes, and hypertension, increasing attention has been paid to intertemporal decision-making ability in the context of chronic illness.<sup>2,34,35</sup> Xie<sup>36</sup> pointed out that patients with Parkinson's disease exhibit impaired intertemporal decision-making ability, characterized by an inability to rationally weigh the value of delayed rewards, with a tendency to prefer immediate rewards and more impulsive decision-making. Deng et al<sup>37</sup> indicated that enhancing the intertemporal decision-making ability of patients with type 2 diabetes is necessary to improve their self-management behaviors. Jin et al<sup>2</sup> suggested that improving intertemporal decision-making ability represents a promising intervention for promoting healthy behaviors among patients with chronic diseases.

## Defining Attributes

The defining attributes of intertemporal decision-making ability in patients with chronic diseases can be distinguished by several key elements, including impulse control, emotional self-regulation, future health valuation, and future-oriented thinking and planning. The literature that identifies these defining attributes of intertemporal decision-making ability is presented in Table 1.

### Impulse Control

This means that when faced with tempting but unhealthy options that offer immediate gratification, such as high-sugar foods or skipping exercise, chronic disease patients can consciously control automatic impulsive responses and mobilize cognitive resources, such as attention and working memory, to prioritize long-term goals.<sup>43,48</sup>

### Emotion Self-Regulation

This means that when experiencing negative emotions (such as anxiety, depression, or fear) and treatment uncertainty, chronic disease patients can recognize and regulate the interference of these emotions in decision-making,<sup>48</sup> thereby prioritizing long-term health goals rather than making detrimental choices to alleviate immediate emotional distress.<sup>39,47</sup>

### Future Health Valuation

This means that chronic disease patients can assign a sufficiently high subjective value to future health outcomes, such as avoiding complications and improving quality of life.

### Future-Oriented Thinking and Planning

This means that chronic disease patients possess the ability to orient their thinking towards the future, including the capacity to vividly imagine (or simulate) their future self-states, foresee the long-term consequences of their current behaviors, and, based on these insights, set goals and formulate specific action plans.<sup>8,60,61</sup>

## Identify a Model Case

The model case exemplifies all the defining attributes of the concept.<sup>23</sup> This case is presented for illustrative purposes only.

Mr. Wang, a 55-year-old patient with type 2 diabetes, was about to abandon his exercise routine on a cold winter evening. Through self-persuasion, he successfully resisted the urge to give up and decided to continue running (impulse

**Table 1** Literature Identifying the Defining Attributes

| Defining Attributes                   | Studies (First Author)  |
|---------------------------------------|---|
| Impulse control                       | Reach, <sup>38</sup> Ding, <sup>39</sup> Hu, <sup>40</sup> Shain, <sup>41</sup> Madsen, <sup>42</sup> Facque, <sup>43</sup> Boonmanun <sup>44</sup>   |
| Emotional self-regulation             | Vaughn, <sup>8</sup> An YD, <sup>45</sup> Ding, <sup>39</sup> Campbell, <sup>46</sup> Campbell, <sup>47</sup> Gerhart, <sup>48</sup> Sukumar, <sup>49</sup> Qu, <sup>50</sup> Zhang <sup>51</sup>   |
| Future health valuation               | Lebeau, <sup>6</sup> Deng, <sup>37</sup> Krousel-Wood, <sup>52</sup> Karl, <sup>53</sup> Sheffer, <sup>7</sup> Stoianova, <sup>54</sup> An YD, <sup>45</sup> Jin, <sup>2</sup> Le Clainche, <sup>55</sup> Ding, <sup>39</sup> Hu, <sup>40</sup> |
| Future-oriented thinking and planning | Campbell, <sup>46</sup> Campbell, <sup>47</sup> Shain, <sup>41</sup> Gurmankin, <sup>56</sup> Satoh, <sup>57</sup> Facque, <sup>43</sup> Jarmolowicz, <sup>58</sup> Wu, <sup>59</sup> Xie <sup>36</sup>   |
|                                       | Lebeau, <sup>6</sup> Karl, <sup>53</sup> Vaughn, <sup>8</sup> Epstein, <sup>60</sup> Ei Haj, <sup>61</sup> Sukumar, <sup>49</sup> Brown, <sup>62</sup> Boonmanun <sup>44</sup>  |

control). One month later, Mr. Wang returned to the hospital for a follow-up blood glucose test. The persistently high level left him to feeling disappointed and anxious. He relieved his stress by breathing in the park's fresh air (emotion self-regulation). Mr. Wang said, "The long-term commitment is exhausting, I'm willing to endure this hardship compared to the prospect of daily insulin injections in the future (future health valuation)". He has also linked his commitment to exercise with the imagery of "traveling with his wife ten years from now," and has decided to track and monitor his daily exercise habits using a health app (future-oriented thinking and planning).

## Identify Borderline, Related, and Contrary Cases

### Borderline Case

The borderline case contains most of the defining attributes.<sup>23</sup> This case is presented for illustrative purposes only.

Ms. Yang, a 63-year-old with an 8-year history of hypertension, understands the importance of a low-salt diet for lowering blood pressure and preventing stroke (future health valuation). When dining alone, she can resist the temptation of strongly flavored foods (impulse control). She expressed that if she does not experience a stroke in the coming years, she will be able to continue square dancing with her close friends (future-oriented thinking and planning). However, when feeling emotionally low, she seeks comfort by consuming strongly flavored foods (a failure of emotional self-regulation).

### Related Case

A related case is similar to the concept under study in some respects, but it is not the concept itself. This case is presented for illustrative purposes only.

Xiao Li, a 32-year-old patient with type 1 diabetes, can engage in a 30-minute daily brisk walk under parental supervision. When he feels emotionally low due to poor blood glucose control, his parents actively comfort him. However, his motivation for completing his daily exercise goals stems from a fear of criticism from his family rather than a commitment to a healthy future. Xiao Li's behavior exemplifies a passive choice in health behavior rather than autonomy in intertemporal decision-making ability.

### Contrary Case

The contrary case is a clear example that does not follow the concept at all.<sup>23</sup> This case is presented for illustrative purposes only.

Mr. Ji, a 61-year-old patient with COPD and a 40-year smoking history, has been repeatedly advised by his physician that quitting smoking could slow the decline in lung function. Nevertheless, he still smokes more than a pack a day. He explicitly stated, "The future is too far off; I just want to enjoy each day as it comes," refusing to consider the long-term progression of his disease (lack of future-oriented thinking and planning) and viewing the future health benefits of quitting smoking as "not worth considering" (lack of future health valuation). When attempting to quit smoking, he finds the withdrawal symptoms nearly intolerable and immediately relapses (a failure in impulse control). Moreover, when feeling irritable, he often surrenders his efforts under the excuse that "only smoking can calm me down" (a lack of emotional self-regulation).

## Identifying Antecedents and Consequences

Antecedents are events that must exist before the concept.<sup>23</sup> Consequences are events that occur as a result of the concept.<sup>23</sup> Table 2 presents the literature on identifying the antecedents and consequences of intertemporal decision-making ability in patients with chronic diseases.

### Antecedents

The antecedents of intertemporal decision-making ability in patients with chronic diseases include economic factors, level of knowledge, disease status, perceived health competence, personality traits, emotional status, and time perspective.

Financially secure patients are more likely to prioritize health issues, which may not be the most pressing concern for those living in poverty.<sup>66</sup> Chronic disease patients with higher education levels are more adept at leveraging information

**Table 2** Studies on Identifying the Antecedents and Consequences

| Studies on Identifying the Antecedents (First Author)  | Studies on Identifying the Consequences (First Author)   |
|--|--|
| Axon, <sup>34</sup> Krousel-Wood, <sup>52</sup> Campbell, <sup>46</sup> Ei Haj, <sup>61</sup> Reach, <sup>38</sup> Deng, <sup>37</sup> Le Clainche, <sup>55</sup> Shain, <sup>41</sup> Qu, <sup>50</sup> Wu, <sup>59</sup> Borgmann, <sup>63</sup> Ding, <sup>39</sup> Sukumar, <sup>49</sup> Vaughn, <sup>8</sup> Gerhart <sup>48</sup> | Reach, <sup>38</sup> Lebeau, <sup>6</sup> Axon, <sup>34</sup> Deng, <sup>37</sup> Krousel-Wood, <sup>52</sup> Karl, <sup>53</sup> Sheffer, <sup>7</sup> Stoianova, <sup>54</sup> Vaughn, <sup>8</sup> An YD, <sup>45</sup> Jin, <sup>2</sup> Ding, <sup>39</sup> Hu, <sup>40</sup> Campbell, <sup>46</sup> Epstein, <sup>60</sup> Shain, <sup>41</sup> Loeb, <sup>64</sup> Madsen, <sup>42</sup> Sukumar, <sup>49</sup> Jarmolowicz, <sup>58</sup> Kairies-Schwarz, <sup>65</sup> Boonmanun, <sup>44</sup> Wu, <sup>59</sup> Qu, <sup>50</sup> Zhang <sup>51</sup> |

and knowledge to assess future benefits.<sup>63</sup> Additionally, a higher level of perceived health competence enhances patients' ability to envision a meaningful future and focus more on positive outcomes.<sup>39</sup>

Positive emotions enable patients to adopt a long-term perspective, whereas negative emotions, such as anxiety, depression, pessimism, fear, and stress, tend to make individuals focus more on immediate interests.<sup>39,48</sup> Patients experiencing worsening symptoms and physical and cognitive limitations often exhibit short-sightedness and consequently may experience more negative emotions when the benefits of healthy behaviors are delayed.<sup>55</sup>

Individuals with the personality trait of conscientiousness are more likely than those with other traits, such as neuroticism, to give up immediate gratification in pursuit of long-term health.<sup>37,55</sup>

Time perspective can influence patients' perception of behavioral benefits. It is the patient who places greater importance on the future than on the present who is likely to derive relatively greater benefits from health-related behaviors.<sup>56</sup> Better temporal continuity, that is, the patient's capacity for future thinking and sense of connection with their distant self, may lead them to avoid discounting future rewards.<sup>61</sup>

## Consequences

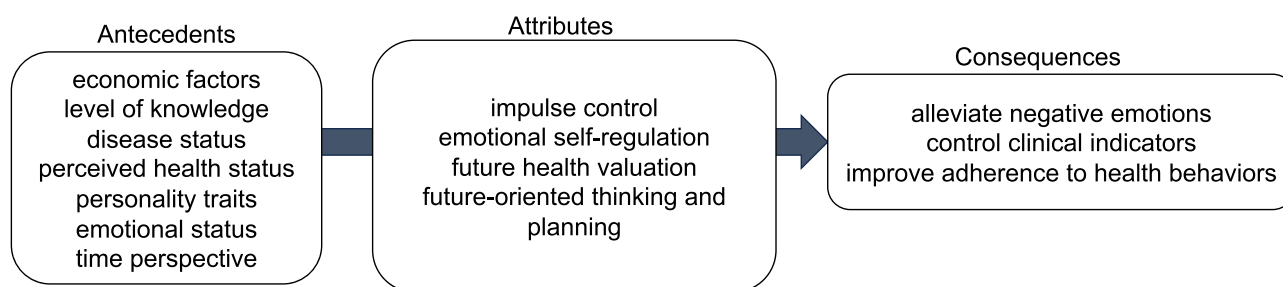
Enhancing intertemporal decision-making ability in patients with chronic diseases can alleviate negative emotions;<sup>47</sup> contributes to the control of physiological indicators such as blood pressure and blood glucose<sup>6,52</sup> and improves adherence to health behaviors, including accepting screening or treatment,<sup>54</sup> self-monitoring,<sup>53</sup> taking medication,<sup>52</sup> exercising regularly, and eating a balanced diet.<sup>34</sup>

Based on this conceptual analysis, the intertemporal decision-making ability of patients with chronic conditions can be defined as the comprehensive psychological ability to exercise impulse control, regulate emotions, value future health, and engage in future-oriented thinking and planning when confronted with health-related benefits and costs occurring at different time points. [Figure 2](#) presents the conceptual framework.

## Empirical Referents

Empirical referents are the means by which attributes or measurements are recognized, rather than the concept itself.<sup>23</sup>

Monetary choice tasks are typically administered via computer-based simulation,<sup>67</sup> or by completing the monetary choice questionnaire,<sup>41</sup> intertemporal decision-making questionnaire,<sup>68</sup> or by presenting questions<sup>53</sup> in which participants choose between a larger, delayed monetary reward and a smaller, immediate monetary reward. Based on participants' choices, the subjective value is determined, and the delay discounting rate is calculated by incorporating the subjective



**Figure 2** Conceptual framework of intertemporal decision-making ability in patients with chronic diseases.

value, delay duration, and delayed reward into the formula. The subjective valuation of rewards at different time points in a monetary choice task mirrors the attributes of “future health valuation.”

The quick delay discounting questionnaire comprises 10 self-report items that access both delay discounting and delay aversion.<sup>69</sup> The higher the delay discounting score, the lower the value assigned to future outcomes. A higher delay aversion score is consistent with heightened emotional distress in the presence of delays. This aligns with the attributes of “future health valuation” and “emotional self-regulation” identified in this study.

The consideration of future consequences scale consists of 14 items and measures the extent to which individuals consider the potential future outcomes of their current behavior.<sup>70</sup> Items such as “When I make a decision, I think about how it might affect me in the future” are similar to the attribute of “future-oriented thinking and planning” identified in this study.

The impulsive behavior scale includes five factors of impulsivity: negative urgency, lack of premeditation, lack of perseverance, sensation seeking, and positive urgency.<sup>71</sup> This is similar to the “impulse control” dimension within the defining attributes.

## Discussion

This study employed the Walker and Avant method to analyze the concept of intertemporal decision-making ability in patients with chronic diseases. The findings encompassed a multidimensional psychological construct that includes impulse control, emotional self-regulation, future health valuation, and future-oriented thinking and planning. This study helps to clarify the ambiguity of this term in the literature, facilitates the development of appropriate measurement tools, and informs the design of targeted interventions.

The four defining attributes proposed in this study need to be compared with existing theoretical models of intertemporal decision-making. First, although the delay discounting rate derived from temporal discounting models is often used to measure intertemporal decision-making ability,<sup>18</sup> this parameter fails to distinguish why patients discount future health benefits. Two patients with the same discount rate may differ in their performance across the four dimensions, thereby requiring different interventions. In other words, although the delay discounting rate provides a useful summary of intertemporal decision-making tendency, it does not describe the underlying psychological constructs that explain the ability. The present analysis complements the discounting rate by specifying the psychological components that constitute intertemporal decision-making ability.

In the field of neuroscience, the three brain network model proposed by Peters and Büchel,<sup>14</sup> which supports different neural systems underlying intertemporal decision-making, corresponds to the attributes identified in the present study. For example, the cognitive control network supports the attributes of impulse control and emotional self-regulation; the reward valuation network corresponds to future health valuation; and the prospection network corresponds to future-oriented thinking and planning. The analysis and comparison at both neural and psychological levels further enhance the validity of the multidimensional structure of intertemporal decision-making ability. More importantly, the conceptual framework of this study translates neural substrates into measurable psychological abilities, thereby establishing a bridge between neuroscience and clinical interventions.

The dual-process theory suggests that the decision-making is shaped by the interaction between two brain systems: the emotional system (associated with limbic and striatal regions) and the reflective system (associated with the prefrontal cortex).<sup>72,73</sup> In this study, the attributes of “impulse control” and “emotional self-regulation” reflect the regulatory role of System 2 over System 1. Based on the other two attributes identified in this study, namely “future health valuation” and “future-oriented thinking and planning”, individuals who assign high value to future health benefits may still fail to translate that valuation into action due to a lack of future thinking. However, dual-process theory treats System 2 as a relatively unitary control mechanism, which may not be able to finely distinguish between these two attributes.

This conceptual analysis defines the intertemporal decision-making ability of patients with chronic diseases as an operationalizable multidimensional psychological construct encompassing four core attributes. However, existing delay discounting tasks or related scales cannot fully capture all four attributes. Therefore, future research could develop a composite assessment tool by drawing on relevant components from existing instruments (for example, items related to

“future orientation” in the consideration of future consequences scale,<sup>70</sup> and items related to impulse control in the impulsive behavior scale<sup>71</sup>) or construct a new assessment tool based on the defined attributes, in order to identify the primary sources of non-adherent behavior in patients.

After the characteristics of patients with chronic diseases across different attributes of intertemporal ability are identified, personalized interventions can be developed. For example, patients with high impulsivity and those with low future value evaluation require different intervention strategies. For patients with predominant impulse control deficits, interventions may benefit from impulse control training (primarily involving self-monitoring and distraction management to train individuals not to respond to irrelevant environmental stimuli),<sup>74</sup> temptation bundling (pairing immediate rewards with healthy behaviors), and environmental restructuring (removing temptations from the environment).<sup>11</sup> For patients with deficits in emotional self-regulation, healthcare providers may offer mindfulness or emotion regulation skills training.<sup>75,76</sup> In severe cases, timely referral to the psychology department or psychiatry department for professional assessment and intervention is recommended. For patients with low valuation of future health benefits, healthcare providers may intervene using value clarification and the provision of short-term, tangible immediate rewards. For patients with weak future-oriented thinking, episodic future thinking training (vividly imagining positive future events related to health adherence) can enhance patients’ ability to think about the future and construct future pathways.<sup>9</sup> In addition, interventions should also take into account the antecedents, such as knowledge, economic status, and perceived health competence. In the future, it is advisable to integrate health education and economic incentives into interventions to enhance intertemporal decision-making ability.<sup>39</sup> If possible, screening for intertemporal decision-making ability could also be incorporated into initial nursing assessments in the future, with intervention strategies dynamically adjusted during follow-up based on the assessment results.

Notably, the studies included in this analysis cover diverse geographical and cultural contexts, including the United States, China, France, Germany, Thailand, Japan, and others. However, the study did not explicitly compare the impact of cross-cultural differences (individualism versus collectivism) or variations in healthcare system on each defining attribute of intertemporal decision-making ability. Future research should conduct cross-cultural analyses to examine whether the defining attributes vary by cultural background. Furthermore, disease characteristics may also influence intertemporal decision-making ability. For example, patients with progressive neurodegenerative diseases, like Parkinson’s disease, may exhibit greater impulse control deficits.<sup>77</sup> Patients with high treatment burdens may make different trade-offs between “extending life” and “reducing treatment”. Therefore, this conceptual analysis framework is intended as a general foundation, and future research should test its adaptability in specific disease populations.

## Limitation

This study has several limitations. Firstly, the literature search was limited to six databases in Chinese and English, potentially missing studies published in other languages or indexed in other databases. Furthermore, this conceptual analysis excluded studies that focused exclusively on neurobiological mechanisms. Although this was intended to ensure conceptual clarity at the psychological level, it may introduce a bias. Therefore, future research should further validate and enrich the findings through multidisciplinary approaches. Secondly, real-world intervention trials directly targeting intertemporal decision-making ability in patients with chronic diseases remain very limited. The included studies were predominantly cross-sectional, necessitating caution when making causal inferences. Future research should prioritize randomized controlled trials with long-term follow-up to assess changes in intertemporal decision-making ability and improvements in clinical outcomes. Furthermore, cultural and healthcare system factors were not adequately analyzed in the included studies, and these factors may influence patient value assessment and future thinking. Future research should explore these contextual differences and consider the cross-cultural adaptability of assessment tools and interventions. Thirdly, the included studies focused primarily on diabetes, cancer, and hypertension, with limited research on intertemporal decision-making abilities in other chronic diseases (such as chronic obstructive pulmonary disease, chronic kidney disease, and rheumatic immune diseases). Furthermore, patients with different disease characteristics and treatment burdens exhibit differences in intertemporal decision-making, which potentially limits the applicability of the conceptual framework. Finally, although this study critically compared the proposed defining attributes with models from behavioral economics and neurology, the conceptual framework itself has not yet been empirically tested. Future

research is needed to examine whether the four attributes exhibit discriminant validity and whether they predict health outcomes.

Nevertheless, this study has several strengths. To the best of our knowledge, this is the first conceptual analysis of intertemporal decision-making ability in the context of chronic disease. The study strictly adhered to Walker and Avant's concept analysis method, incorporated evidence from multiple disciplines, and provided model, borderline, related, and contrary cases, which help readers understand the connotation and extension of the concept. Furthermore, this study explicitly proposed four defining attributes and outlined their implications for the development of assessment tools and stratified interventions, which not only respond to the needs of clinical practice but also enhance the practical value of the research.

## Conclusion

This study systematically analyzed the concept of intertemporal decision-making ability in patients with chronic diseases and proposed defining attributes, including impulse control, emotional self-regulation, future health valuation, and future-oriented thinking and planning. In the future, researchers could develop assessment tools based on these defining attributes. Nurses and other clinical practitioners could use screening assessment tools to identify patients' primary attribute deficits and implement personalized interventions through strategies such as health education, immediate rewards, environmental restructuring, and episodic future thinking training, thereby enhancing patients' intertemporal decision-making abilities. Furthermore, screening for this decision-making ability could be incorporated into initial nursing assessment programs, enabling dynamic monitoring and adjustment of intervention strategies based on the results during follow-up periods.

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