Analyzing Prostate Cancer Patient Association Utilization of the Metaverse during the 2023 Blue Ribbon Campaign: Cross-Sectional Survey Study

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Submitted to: Journal of Medical Internet Research
on: June 07, 2024

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Jung Ki Jo[1*] PhD, MD; Yeeun Kim[2*]; Yun-Sok Ha[3] MD, PhD; Kwang Taek Kim[4]; Sangjun Yoo[5] MD, PhD; Woo Suk Choi[6] MD, PhD; Jihye Yang[7]; Jaeeun Shin[7]; Sun Il Kim[8] MD, PhD; Jeong Hyun Kim[9] PhD, MD

[1]Department of Medical and Digital Engineering Hanyang University Seoul KR
[2]Department of Urology School of Medicine, Kyungpook National University Daegu KR
[3]Department of Urology Gachon University Gil Medical Center Incheon KR
[4]Department of Urology Seoul Metropolitan Government - Seoul National University Boramae Medical Center Seoul KR
[5]Department of Urology Konkuk University Medical Center Konkuk University School of Medicine Seoul KR
[6]Enzaim Health Seoul KR
[7]Department of Urology Ajou University School of Medicine Suwon KR
[8]Department of Urology Kangwon National University School of Medicine Chuncheon KR
[*]these authors contributed equally

Corresponding Author:
Jeong Hyun Kim PhD, MD
Department of Urology
Kangwon National University School of Medicine
Kangwon National University School of Medicine Bldg
Chuncheon
KR

Abstract

Background: It is important to explain early diagnosis and treatment plans to patients due to the different stages that diagnosis is made at and corresponding stage-specific treatment options, as well as the varying prognoses depending on the choices made. While various studies have implemented Metaverse interventions across diverse clinical settings for medical education, there is a lack of publications addressing the implementation and validation of patient education using this technology. This study explored the potential of the metaverse as an educational and informational tool for prostate cancer.

Objective: This study aimed to measure and analyze participants' satisfaction and perceptions of the Prostate Cancer Metaverse Patient Association.

Methods: The study was conducted via questionnaire administered from September 15 to October 20, 2023, during the blue ribbon campaign organized by the Korean Urological Foundation and the Korean Society of Urological Oncology. The questionnaire was designed to assess the effectiveness of utilizing the metaverse to increase awareness of prostate cancer. A total of 119 participants completed the survey within the metaverse space, and their satisfaction and changes in awareness were analyzed.

Results: Mean educational satisfaction score was 4.17 (±0.65), mean psychological satisfaction score was 4.06 (±0.70), mean overall satisfaction score was 4.12 (±0.72), and mean awareness score was 4.09 (±0.72) out of a possible five points. Statistical analysis revealed significant differences in psychological (4.0 [3.50-4.63] vs 4.50 [4.0-4.56]) and overall aspects (4.0 [3.67-4.83] vs 4.33 [4.0-4.67]) between general population individuals versus patients and caregivers (4.0 [3.33-4.33] vs 4.67[4.0-4.67]).

Conclusions: Many people appear willing to participate in the metaverse based patient association. These results suggest that using Metaverse for healthcare education and information delivery is a valid way to improve healthcare quality and increase patient engagement. This is an important contribution to the advancement of metaverse technology, expanding its potential applications in healthcare.

(JMIR Preprints 07/06/2024:63030)
DOI: https://doi.org/10.2196/preprints.63030

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J.K. Jo
Department of Urology, College of Medicine, Hanyang University, Seoul 04763, Korea
Y. Kim
Department of Medical and Digital Engineering, Hanyang University, Seoul 04763, Korea
Y. Ha
Department of Urology, School of Medicine, Kyungpook National University, Daegu 41944, Korea
K.T. Kim
Department of Urology, Gachon University Gil Medical Center, Incheon 21565, Korea
S. Yoo
Department of Urology, Seoul Metropolitan Government - Seoul National University Boramae Medical Center, Seoul 07061, Korea
W.S. Choi
Department of Urology, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul 05030, Korea
J. Yang
Enzaim Health, Seoul 03043, Korea
J. Shin
Enzaim Health, Seoul 03043, Korea
S.I. Kim
Department of Urology, Ajou University School of Medicine, Suwon 16499, Korea
E-mail: sikimuro@ajou.ac.kr
J.H. Kim
Department of Urology, Kangwon National University School of Medicine, Chuncheon 24341, Korea
E-mail: urodr348@kangwon.ac.kr
(†These authors contributed equally, *These authors contributed equally)

Abstract

Background

It is important to explain early diagnosis and treatment plans to patients due to the different stages that diagnosis is made at and corresponding stage-specific treatment options, as well as the varying prognoses depending on the choices made. While various studies have implemented Metaverse interventions across diverse clinical settings for medical education, there is a lack of publications addressing the implementation and validation of patient education using this technology. This study explored the potential of the metaverse as an educational and informational tool for prostate cancer.

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Results

Mean educational satisfaction score was 4.17 (±0.65), mean psychological satisfaction score was 4.06 (±0.70), mean overall satisfaction score was 4.12 (±0.72), and mean awareness score was 4.09 (±0.72) out of a possible five points. Statistical analysis revealed significant differences in psychological (4.0 [3.50-4.63] vs 4.50 [4.0-4.56]) and overall aspects (4.0 [3.67-4.83] vs 4.33 [4.0-4.67]) between general population individuals versus patients and caregivers (4.0 [3.33-4.33] vs 4.67[4.0-4.67]).

Conclusions

Many people appear willing to participate in the metaverse based patient association. These results suggest that using Metaverse for healthcare education and information delivery is a valid way to improve healthcare quality and increase patient engagement. This is an important contribution to the advancement of metaverse technology, expanding its potential applications in healthcare.

Keywords

virtual reality; urology; prostatic neoplasms; self-help groups; patient satisfaction; surveys and questionnaires; digital health

Introduction

Prostate cancer is the second most common cancer among men globally and the most common urologic malignancy in developed countries. In 2020, there were an estimated 1,414,000 diagnosed cases and 375,304 deaths related to prostate cancer. [1] It is important to note that prostate cancer can progress without symptoms, leading to missed treatment opportunities. [2] It is characterized by a wide spectrum of diagnosis stages and treatments, ranging from low-risk stages with no treatment and active surveillance to high-risk stages treated by prostatectomy and various treatment modalities such as radiation, hormone therapy, and chemotherapy. Early diagnosis and explanation of the treatment plan appropriate to the patient's stage is critical, as treatment options and prognoses vary depending on stage. [3, 4]

To reduce morbidity and mortality associated with prostate cancer, it is important to accurately communicate knowledge and encourage early screening. In addition, patient awareness and active participation in the treatment process affect treatment outcomes and costs, so research on interventions to increase patient engagement is important. [5, 6] Misconceptions need to be corrected and reliable information needs to be communicated, and several studies have highlighted the importance of research to generate resources for the development and implementation of relevant educational programs. [7, 8]

To increase the effectiveness of prostate cancer education, patient association meetings were held in a metaverse space rather than in a traditional setting. While there is no single definition of the metaverse, it is generally considered to be a superset of virtual reality and augmented reality, and refers to a three-dimensional virtual space that integrates physical and digital realities, where people can be represented virtually in a digital environment. [9] Gartner named the metaverse as one of its top 10 strategic technologies in 2019 and again in 2023, with a focus on accelerating strategies to capitalize on emerging virtual markets. [10] In 2022, Gartner also predicted that by 2026, 25% of people worldwide will spend at least one hour a day in the metaverse. [11] Use of the metaverse overcomes physical and time constraints and improves accessibility for both patients and healthcare providers, and once deployed, is repeatable. Additionally, there is no risk of spreading infectious diseases in virtual environments, ensuring safety in recent pandemic situations such as COVID-19. [12, 13] A few previous studies have discussed the potential of metaverses [13-15] or focused on healthcare providers. [16-18] Among the studies that included the term 'metaverse' in searches of PubMed, Google Scholar, and Web of Science, no studies on patient associations hosting and training were found, making it difficult to understand the potential effectiveness of metaverse-based cognitive improvement. In addition, relatively few studies have investigated educational uses of the metaverse. [19]

The aim of this study was to measure participant satisfaction with and awareness of the metaverse as part of a global prostate cancer awareness blue ribbon campaign. We hypothesized that satisfaction and awareness scores would vary by age, gender, relevance to patients, and geographic region.

Methods

Study design

This national cross-sectional survey study aimed to evaluate participants' satisfaction and awareness of the 'Prostate Cancer Disease Awareness Metaverse Event'. A questionnaire was used to assess satisfaction with participation in the metaverse, and data were collected from September 15, 2023 to October 20, 2023 during the blue ribbon campaign hosted Foundation for Korean Urological Association and The Korean Urological Oncology Society. The study aimed to collect information on users' experiences and awareness of their metaverse experience without imposing any restrictions on research participation. The manuscript adheres to STROBE guidelines and all procedures were approved by the Institutional Review Board of Hanyang University Hospital (IRB File No. 2024-01-029).

Participants

Between September 15, 2023 and October 20, 2023, 119 participants were recruited to participate in the 2023 Prostate Cancer Facts Metaverse Event and responded to an online survey. Participants included men and women, diagnosed or not, prostate cancer patients, caregivers, and general population individuals without any direct association to the disease or caregiving roles. No exclusion criteria were applied. Informed consent was obtained from all participants after explaining the purpose of the study before they participated in the survey.

Procedures

The metaverse platform was developed with Caitory (https://www.caitory.com) for easy website and mobile access. Participants engaged with the event through online articles, communities related to prostate cancer, and YouTube. Within the metaverse environment, communication between clinicians and participants was facilitated via an on-screen chat interface. Healthcare lecture on prostate cancer, a question board, live Q&A, and a room for participating in satisfaction surveys were established within the metaverse space. An overview of prostate cancer, along with diagnosis, treatment, and postoperative care, was offered as lecture topics for participants.The live Q&A session between clinicians and participants was recorded and made available for replay on YouTube. **(Figure 1).**

Fig.1 Schematic overview of the Metaverse prostate cancer patient associations a Campaign Introduction Area: An entry space where users can learn about and interact with the campaign in a virtual reality setting. **b** Informational Sector: An area where users can educate themselves on various health topics and diagnostic methods. **c** Live Q&A Session: A space for real-time interaction where experts respond to health-related queries, allowing users to engage in conversations and pose questions instantly. **d** Segment of an Educational Session: A virtual classroom setting where live lectures on health education are conducted, offering users the chance to listen to experts in real time and communicate directly in a virtual setting

Online Survey

Distribution and collection of the questionnaire for this study were managed by Enzaim Health (www.enzaim.co.kr), a healthcare marketing communications company. The questionnaire design utilized the Delphi method to structure the questions through iterative feedback from a group of

urologists. Finally, the questionnaire was reviewed and iteratively improved by members of the Korean Urological Oncology Society. The questionnaire consisted of 20 mandatory questions, with participants answering between 18 and 22 questions depending on their gender, patient status, and experience with the metaverse. Some participants omitted answers that were not applicable. The questionnaire was divided into four parts: general information (eight questions), experience using the metaverse (two questions), satisfaction with the Prostate Cancer Information Metaverse event (seven questions), and awareness of using the metaverse in disease awareness programs (six questions). Four of the questions in the survey utilized a five-point Likert scale (from 1=Strongly disagree to 5=Strongly agree). A higher score on the scale indicates a more positive response. The remaining questions were presented as multiple-choice items. Information about consent was included on the last page of the questionnaire. Written consent was obtained from all participants prior to completing the questionnaire. All content was processed to ensure that specific individuals could not be identified, in accordance with the Personal Information Protection Act. An incentive was provided by awarding gift certificates to 33 individuals through a random draw.

The four items of the questionnaire used in this study were structured on a five-point Likert scale and rated using Cronbach's alpha coefficient. Each scale demonstrated high internal consistency, with a minimum alpha value of 0.820, indicating reliable constructs. On average, educational satisfaction scored 4.17 (±0.65), psychological satisfaction 4.06 (±0.70), overall satisfaction 4.12 (±0.72), and awareness 4.09 (±0.72), reflecting the positively of the respondents' experiences **(Table 1).**

Table 1. Description of the Questionnaire

	Scale	Number of items	Mean ± SD	Chronbach's alpha
Satisfaction				
	Educational	4	4.17±0.65	0.881
	Psychological	4	4.06±0.70	0.842
	Overall	3	4.12±0.72	0.903
Awareness		3	4.09±0.72	0.820

Data shown are number of scales and mean(SD). SD: Standard Deviation

Statistical analysis

Statistical analysis was conducted using R version 4.3.2. [20] There were no missing data. Basic descriptive statistics were used to summarize each dataset. Cross-tests were analyzed using the Chi-square test, while differences between groups were analyzed using the Kruskal-Wallis test and Mann Whitney U test as non-parametric tests. Significance was interpreted by reference to Bonferroni-corrected p-values. The cut-off for the p-value was 0.05 The reliability of the questionnaire was calculated using Cronbach's alpha coefficient. [21] To examine the relationship between the four scales measuring satisfaction with metaverse events, Spearman's correlation coefficient was employed.

Results

Participant's characteristics

The age composition of participants in the study was notably skewed towards younger adults, with individuals in their 20s accounting for 44 participants (37.0%) and those in their 30s accounting for 49 participants (41.2%). There were 14 participants (11.8%) in their 40s, four (3.4%) in their 50s, and eight (6.7%) aged 60 and above, illustrating that the majority of participants, approximately 80%, were between 20-30 years old. This age distribution mirrors the pronounced involvement of the

younger demographic in the metaverse. Gender representation was nearly balanced, with 61 males (51.3%) and 58 females (48.7%). In terms of geographical distribution, 51 (42.9%) participants were from Seoul, the campaign's host city, and 68 (57.1%) were from other regions. Regarding disease status, 79 (66.4%) were general population individuals without any direct association to the disease or caregiving roles, 33 (27.7%) were family members and caregivers of patients with prostate cancer, and seven (5.9%) were prostate cancer patients. With respect to prostate cancer stage, three patients (42.8%) had stage 2 disease, while two patients each (28.6%) had stage 3 or 4 disease. Regarding the metaverse experience, 64(53.8%) participants had prior experience with the metaverse, while 55(46.2%) had not engaged with such virtual environments before **(Table 2).**

Table 2. Participant Demographics and Characteristics (N=119).

Characteristic		Frequency (%)
Age		
	≤19	N/A
	20-29	44 (37.0)
	30-39	49 (41.2)
	40-49	14 (11.8)
	50-59	4 (3.4)
	≥60	8 (6.7)
Gender		
	Male	61 (51.3)
	Female	58 (48.7)
Patient status		
	General population	79 (66.4)
	Caregivers	33 (27.7)
	Patient	7 (5.9)
	Grade 1	N/A
	Grade 2	3 (42.8)
	Grade 3	2 (28.6)
	Grade 4	2 (28.6)
Region		
	Seoul	51 (42.9)
	Other cities	68 (57.1)
The metaverse experiences		
	YES	64 (53.8)
	NO	55 (46.2)

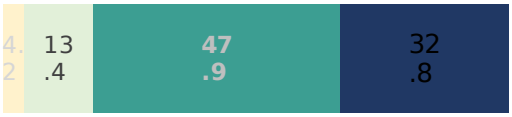
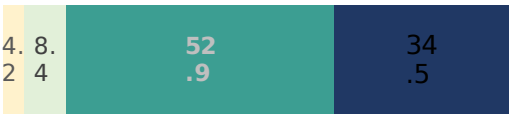
Data are numbers of participants. N/A: not applicable.

Questionnaire Outcomes

The results of our survey with 119 participants reveal that were overall satisfied with a 5-point Likert scale. Among the four categories, educational satisfaction was rated highest on average (M=4.17, SD=0.65), followed by overall satisfaction (M=4.12, SD=0.72), awareness (M=4.09, SD=0.72) and psychological satisfaction (M=4.06, SD=0.70). Analysis of scores above 4 points(=agree) in each sub-category revealed that the item regarding the benefit of gaining information about prostate cancer was most agreed upon within the educational aspect (n=103, 86.6%), whereas the item concerning the smooth progression of the event received relatively lower agreement (n=90, 75.6%). In terms of psychological aspects, the item stating that participating in the event was interesting and enjoyable received the most agreement (n=95, 79.8%), while the item about free communication with other participants and lecturers was the least agreed upon (n=87, 73.1%). Overall, the item expressing willingness to participate in the metaverse event again received the most agreement (n=98, 82.3%), and the item about actively recommending it to others received the least agreement (n=95, 79.8%). In the cognitive aspect, the item expressing a desire to participate in other disease awareness events using the metaverse platform received the most agreement (n=104, 87.4%), while the item about enhancing understanding of the metaverse world elicited the lowest agreement (n=85, 70.6%). **(Figure 2).**

Figure 2. Analyse the mean, standard deviation, and frequency distribution of Likert 5-point scale assessment items(N=119).

Scale	Item	Mean ± SD	Frequency(%)
Educational Satisfaction	I believe the event in the metaverse was conducted smoothly.	4.01±0.818	4.2 / 20.2 / 46.2 / 29.4
	The event was useful for acquiring information about prostate cancer.	4.24±0.701	0.8 / 12.6 / 47.9 / 38.7
	The metaverse-based event was well-organized, facilitating an easy understanding of prostate cancer information.	4.18±0.770	3.4 / 11.8 / 47.9 / 37
	The metaverse-based event was helpful in learning about information related to prostate cancer that I was curious about.	4.25±0.716	16 / 42.9 / 41.2
Psychological Satisfaction	Participating in the event was engaging and enjoyable.	4.13±0.791	2.5 / 17.6 / 43.7 / 36.1
	The metaverse-based event was more convenient than participating in offline face-to-face events or Zoom video lectures.	4.01±0.859	5.9 / 18.5 / 44.5 / 31.1
	Participating in the event through an avatar in the metaverse felt more comfortable than attending in-person or via video.	4.13±0.879	0.8 / 3.4 / 17.6 / 38.7 / 39.5
	I believe that the metaverse-based event allowed for free communication with other participants and lecturers.	3.97±0.863	5.9 / 21 / 43.7 / 29.4
Overall Satisfaction	I am generally satisfied with the metaverse-based event.	4.10±0.807	4.2 / 15.1 / 47.1 / 33.6
	I am willing to participate in a metaverse-based event again.	4.18±0.759	1.7 / 16 / 44.5 / 37.8
	I would actively recommend a metaverse-based event to others.	4.08±0.787	3.4 / 16.8 / 47.9 / 31.9
Awareness	I believe that my experience participating in the ‘Understanding Prostate Cancer via Metaverse’ has increased my understanding of the metaverse world.	3.96±0.942	0.8 / 6.7 / 21 / 38.7 / 31.9

	I think that there should be more events like the 'Understanding Prostate Cancer via Metaverse' that utilize metaverse platforms for disease awareness.	4.13±0.798	
	I would like to participate in other disease awareness events using metaverse platforms besides the ‘Understanding Prostate Cancer via Metaverse’.	4.18±0.755	

The figure shows the mean, standard deviation, and frequency distribution for a five-point likert scale. A bar graph shows the frequency distribution.

Correlation analysis was conducted to investigate the relationship between the three Likert items measuring satisfaction and recognition of metaverse events. Educational satisfaction showed a moderate positive correlation with psychological satisfaction (rs=0.674, p<0.001) and overall satisfaction (rs=0.657, p<0.001). Moreover, a high positive correlation was observed between psychological satisfaction and overall satisfaction (rs=0.766, p<0.001). Additionally, awareness demonstrated high positive correlations with educational satisfaction (rs=0.708, p<0.001), psychological satisfaction (rs=0.786, p<0.001), and overall satisfaction (rs=0.786, p<0.001) **(Table 3).**

Table 3. Spearman's correlations between scales(n=119).

		Educational	Psychological	General	Awareness
Educational	Rho				
	Sig.(2-tailed)				
	N				
Psychological	Rho	0.674**			
	Sig.(2-tailed)	<.001			
	N	119			
General	Rho	0.657**	0.766***		
	Sig.(2-tailed)	<.001	<.001		
	N	119	119		
Awareness	Rho	0.708***	0.786***	0.786***	
	Sig.(2-tailed)	<.001	<.001	<.001	
	N	119	119	119	

Rho=Spearman's correlation coefficient values. Sig.(2-tailed)=Significance(2-tailed)

Subgroup analysis

Satisfaction and awareness regarding the Understanding Prostate Cancer Metaverse Event were assessed across groups differentiated by age, gender, patient status, geographical location and metaverse experiences using the Kruskal-Wallis rank sum test and the Mann-Whitney U test. Age groups were the 20s, 30s, and ≥40. Psychological aspect satisfaction score (4.0 [3.50-4.63] vs 4.50 [4.0-4.56]; p<0.009) and overall aspect satisfaction score (4.0 [3.67-4.83] vs 4.33 [4.0-4.67]; p<0.025) showed significant differences between general population individuals and patients or caregivers, with patients or caregivers reporting higher scores. Significant differences in responses were also noted in the awareness items (4.0 [3.33-4.33] vs 4.67 [4.0-4.67]; p<0.005). Furthermore, the Kruskal-Wallis test revealed significant differences in psychological satisfaction among the age groups, and subsequent post-hoc tests with Bonferroni correction identified significant differences in response distributions between individuals in their 30s and those over 40 (4.25 [3.67-5.0] vs 3.75 [3.50-4.25]; p<0.041) **(Table 4).**

Table 4. Compare group significance for scores by Age, Gender, Patient Status, Region and the metaverse experience

		Age			p value†	Gender		p value‡	Patient Status		p value‡	Region	
		<30	30-39[a]	≥40[b]		Male	Female		Irrelevance	Relevance		Seoul	Other citie
Satisfaction													
	Educational	4.13(3.75-4.50)	4.25(4.0-5.0)	4.0(3.75-4.50)	0.142	4.25(4.0-4.50)	4.0(3.75-4.94)	0.753	4.0(3.75-4.75)	4.25(4.0-4.75)	0.072	4.25(3.75-4.88)	4.25(3.94-4.
	Psychological	4.13(3.75-4.50)	4.25(4.0-4.75)	3.75(3.50-4.25)	0.041* (a vs b)	4.25(3.75-4.50)	4.0(3.56-4.75)	0.589	4.0(3.50-4.63)	4.50(4.0-4.56)	0.009*	4.0(3.50-4.75)	4.25(3.75-4.
	General	4.33(3.67-4.67)	4.0(4.0-5.0)	4.0(3.67-4.33)	0.388	4.0(3.67-4.67)	4.0(3.67-5.0)	0.946	4.0(3.67-4.83)	4.33(4.0-4.67)	0.025*	4.0(3.50-4.83)	4.17(4.0-4.6
Awareness		4.0(3.67-4.67)	4.33(3.67-5.0)	4.0(3.33-4.33)	0.265	4.0(4.0-4.67)	4.0(3.42-4.67)	0.510	4.0(3.33-4.33)	4.67(4.0-4.67)	0.005*	4.0(3.33-4.67)	4.0(4.0-4.6

Data are median(IQR). †: Kruskal-wallis rank sum test. ‡: Mann Whitney U test

To compare the general characteristics of patient-related groups and the general population group, a chi-square test was performed, and significant distribution variations by age (p=0.001), gender (p=0.001), residential area (p=0.044) and the metaverse experiences (p=0.172) were found. **(Table 5)**

Table 5. General Characteristics of Patient-Related Groups and the General Population Group.

	Variables	Frequency(%)		χ^2 test	P-value
		General Population	Patients and Caregivers		
Age				13.815	0.001
	<30	27(34.18)	17(42.5)		
	30-39	41(51.90)	8(20.0)		
	≥40	11(13.92)	15(37.5)		
Gender				10.879	0.001
	Male	32(40.51)	29(72.5)		
	Female	47(59.49)	11(27.5)		
Region				4.067	0.044
	Seoul	39(49.37)	12(30.0)		
	Other cities	40(50.63)	28(70.0)		
The metaverse experiences					
	YES	46(58.23)	18(45.0)	1.8693	0.172
	NO	33(41.77)	22(55.0)		

Data are n(%).

When participants were asked about their subjective satisfaction with the event, the most common comments included "uniqueness of the metaverse platform," "accessibility and convenience," "variety of prostate cancer-related content," and "real-time face-to-face interactions to answer questions." Disappointments included "complexity of the metaverse platform," and "incomplete implementation of the metaverse."

The content that was most appreciated ('best content') included real-time Q&A sessions about prostate cancer by 27 participants (22.7%), followed by the introduction of the blue ribbon campaign by 26 participants (21.9%), videos on prostate cancer treatment by 22 participants (18.5%), videos on prostate cancer diagnosis by 19 participants (16%), videos on post-operative care for prostate cancer by 14 participants (11.8%), and overview videos on prostate cancer by 11 participants (9.2%).

In terms of preferred formats for events and lectures, the metaverse was favored by 48 participants (40.3%), followed by online video conferences by 40 participants (33.6%), and offline face-to-face meetings by 31 participants (26.1%), with no significant difference in response rates. Offline face-to-face communication was considered the most effective by 55 participants (46.2%); however, for 'material sharing,' 62 participants (52.1%) found the use of the metaverse to be the most effective, and for 'information dissemination,' this method was preferred by 51 participants (42.9%).

Regarding topics of interest for future prostate cancer-related events and lectures, respondents

emphasized the need for information on prostate cancer, prostate cancer surgery and management, cases of prostate cancer patients, and issues relevant to the families and caregivers of prostate cancer patients. Especially for patients and their families, practical information that can be applied to daily life is of great interest. This includes topics such as the daily routines of cancer patients and precautions for caregivers.

Discussion

This is the study to investigate whether incorporating the metaverse platform into a prostate cancer campaign is effective in raising awareness among participants and whether metaverse events are more satisfying to participants than face-to-face methods. The study focused on prostate cancer because prostate cancer requires different therapeutic approaches, including active surveillance, surgery, and radiation therapy, depending on the location and severity of the disease, and the choice of treatment is based on a combination of the patient's age, underlying medical conditions, life expectancy, general health, preferences, and side-effects of treatment methods. [3, 22] Therefore, it is crucial to offer patients objective and comprehensible information and education regarding the diagnosis and treatment process. Educational counseling can assist patients in comprehending their condition and taking an active role in treatment decisions. Healthcare professionals have a significant responsibility to clarify the diverse treatment choices that are available and support patients with the challenges they encounter in prostate cancer treatment. [23, 24] Additionally, as prostate cancer has a hereditary component, [25] we utilized the metaverse to provide valuable information for caregivers, making it accessible to anyone interested in prostate cancer, not just patients and their caregivers. Participants reported high satisfaction with educational, and psychological aspects of the event, indicating positive reactions to the novelty, accessibility, and convenience of the metaverse platform. There was a difference in satisfaction between general population individuals versus patients and caregivers, likely due to the event's content being more directly relevant to prostate cancer patients and their families than general population individuals. Given the broad age of onset of the disease, respondents may perceive the same platform differently based on their characteristics. Previous studies have suggested that participants became interested in computers and the internet, which they had not used before, due to their experience with websites. [26] This highlights the importance of exposing people to simple interfaces initially to spark their interest and facilitate adaptation. Additionally, other studies have emphasized the need for education and understanding of the concept of the metaverse itself. [27] Future endeavors should prioritize simplifying the interface rather than implementing multiple functional elements of the metaverse. Developing a metaverse platform that includes information and content related to prostate cancer will be valuable to prostate cancer patients and their caregivers.

A strength of our study is the high internet usage rate in Korea, with 93.0% of the total population using the internet. Additionally, 94.0% of people in their 60s and 54.7% of people in their 70s or older use the internet. Furthermore, the penetration rate of mobile devices has reached 92.0%. Although still in the early stages of introduction, the usage rates of artificial intelligence services and the metaverse were reported to be 42.4% and 11.0%, respectively. [28] This high level of digital awareness, based on the penetration rate and digital literacy, means that conditions for metaverse campaigns in Korea are favorable. Furthermore, side-effects of prostate cancer such as urinary incontinence, which can occur after prostate cancer surgery, can lead to the use of diapers or cause difficulties in social participation. [29] Measuring sensitive issues like erectile dysfunction accurately is challenging, and discussing them can be uncomfortable. [30] A previous study reported that men who had limited access

to medical services and were experiencing social isolation were at a higher risk for both prostate cancer development and death due to prostate cancer. [31] This suggests that the metaverse can play an important role in providing access to needed information, increasing awareness, and improving management without physical limitations.
However, it is important to note the limitations of this study. No study population criteria were used, and participants were primarily healthy individuals and active metaverse users in their 30s. Considering these points, future research should aim to include a broader and more diverse range of patients across different ages and backgrounds. Another important point to consider is that the questionnaire assessed satisfaction, which can be difficult to interpret without introducing bias. Previous studies have also highlighted the limitation of not clearly defining 'satisfaction'. [32] Additionally, the survey may not have comprehensively covered a broad range of aspects. Future studies should use more detailed and multidimensional questionnaires to identify specific factors beyond satisfaction before and after participation. This could help increase the depth and accuracy of the research, leading to generalizable results and expanding the reliability and applicability of the study. [33, 34]

Conclusions

This study is the first to explore the potential of using the metaverse in prostate cancer campaigns. We found that education and information provision through the metaverse had a positive impact on patients, caregivers, and healthy individuals. This finding suggests that use of the metaverse could have a significant impact on awareness and participation in prostate cancer treatment and could potentially lead to advancements in other important areas of medical education and information provision.

Acknowledgements

The authors would like to thank all the participants who took part in the '2023 Blue Ribbon Campaign'. We acknowledge Caitory's contribution to creating the metaverse platform. This work was supported by Foundation for Korean Urological Association and The Korean Urological Oncology Society.

Competing interests

The authors declare that they have no conflicting interests, except for the following relevant financial interests: Sun Il Kim serves as a board member of The Korean Urological Oncology Society, the sponsor of this study.

Author contributions

J.K.Jo, S.I.Kim, and J.H.Kim designed the study. Y.Kim, and J.K.Jo performed the statistical analysis, wrote the draft and were major contributors to the writing of the manuscript. Y.Ha, K.T.Kim, S.Yoo, and W.S.Choi provided a literature review and critical review. J.Yang and J.Shin acquired data from an online survey. All authors read and approved the final manuscript.

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA: A Cancer Journal for Clinicians. 2021;71(3):209-49. doi: https://doi.org/10.3322/caac.21660.
2. Jahn JL, Giovannucci EL, Stampfer MJ. The high prevalence of undiagnosed prostate cancer at autopsy: implications for epidemiology and treatment of prostate cancer in the Prostate-specific Antigen-era. International Journal of Cancer. 2015;137(12):2795-802. doi: https://doi.org/10.1002/ijc.29408.
3. Mohler JL, Antonarakis ES, Armstrong AJ, D'Amico AV, Davis BJ, Dorff T, et al. Prostate Cancer, Version 2.2019, NCCN Clinical Practice Guidelines in Oncology. Journal of the National Comprehensive Cancer Network J Natl Compr Canc Netw. 2019 01 May. 2019;17(5):479-505. doi: 10.6004/jnccn.2019.0023.
4. Pinsky PF, Parnes H. Screening for Prostate Cancer. New England Journal of Medicine. 2023;388(15):1405-14. PMID: 37043655. doi: 10.1056/NEJMcp2209151.
5. Jessica Greene JHH, Rebecca Sacks, Valerie Overton, and Carmen D. Parrotta. When Patient Activation Levels Change, Health Outcomes And Costs Change, Too. Health Affairs. 2015;34(3):431-7. PMID: 25732493. doi: 10.1377/hlthaff.2014.0452.
6. Ryhänen AM, Siekkinen M, Rankinen S, Korvenranta H, Leino-Kilpi H. The effects of Internet or interactive computer-based patient education in the field of breast cancer: A systematic literature review. Patient Education and Counseling. 2010 2010/04/01/;79(1):5-13. doi: https://doi.org/10.1016/j.pec.2009.08.005.
7. Winterich JA, Grzywacz JG, Quandt SA, Clark PE, Miller DP, Acuña J, et al. Men's knowledge and beliefs about prostate cancer: education, race, and screening status. Ethn Dis. 2009 Spring;19(2):199-203. PMID: 19537233.
8. Forrester-Anderson IT. Prostate cancer screening perceptions, knowledge and behaviors among African American men: focus group findings. J Health Care Poor Underserved. 2005 2005/11//;16(4 Suppl A):22-30. PMID: 16327094. doi: 10.1353/hpu.2005.0122.
9. Mystakidis S. Metaverse. Encyclopedia. 2022;2(1):486-97. PMID: doi:10.3390/encyclopedia2010031.
10. Gartner. Gartner Top 10 Strategic Technology Trends for 2023. Gartner; 2023 [cited 2022 October 17]; Available from: https://www.gartner.com/en/articles/gartner-top-10-strategic-technology-trends-for-2023.
11. Gartner. Gartner Predicts 25% of People Will Spend At Least One Hour Per Day in the Metaverse by 2026. 2022 [updated February 7, 2022]; Available from: https://www.gartner.com/en/newsroom/press-releases/2022-02-07-gartner-predicts-25-percent-of-people-will-spend-at-least-one-hour-per-day-in-the-metaverse-by-2026.
12. Dwivedi YK, Hughes L, Baabdullah AM, Ribeiro-Navarrete S, Giannakis M, Al-Debei MM, et al. Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International Journal of Information Management. 2022 2022/10/01/;66:102542. doi: https://doi.org/10.1016/j.ijinfomgt.2022.102542.
13. Kye B, Han N, Kim E, Park Y, Jo S, Huh S. Educational applications of metaverse: possibilities and limitations. jeehp. 2021 12;18(0):32-0. doi: 10.3352/jeehp.2021.18.32.
14. Randazzo G, Reitano G, Carletti F, Iafrate M, Betto G, Novara G, et al. Urology: a trip into metaverse. World J Urol. 2023 Oct;41(10):2647-57. PMID: 37552265. doi: 10.1007/s00345-023-04560-3.
15. Román-Belmonte JM, Rodríguez-Merchán EC, De la Corte-Rodríguez H. Metaverse

applied to musculoskeletal pathology: Orthoverse and Rehabverse. Postgraduate Medicine. 2023:1-9.
16. Moro C, Štromberga Z, Raikos A, Stirling A. The effectiveness of virtual and augmented reality in health sciences and medical anatomy. Anatomical Sciences Education. 2017;10(6):549-59. doi: https://doi.org/10.1002/ase.1696.
17. Chytas D, Salmas M, Demesticha T, Noussios G, Paraskevas G, Chrysanthou C, et al. A review of the use of virtual reality for teaching radiology in conjunction with anatomy. Cureus. 2021;13(12).
18. Yilmaz R, Winkler-Schwartz A, Mirchi N, Reich A, Christie S, Tran DH, et al. Continuous monitoring of surgical bimanual expertise using deep neural networks in virtual reality simulation. npj Digital Medicine. 2022 2022/04/26;5(1):54. doi: 10.1038/s41746-022-00596-8.
19. Tlili A, Huang R, Shehata B, Liu D, Zhao J, Metwally AHS, et al. Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis. Smart Learning Environments. 2022 2022/07/06;9(1):24. doi: 10.1186/s40561-022-00205-x.
20. Team RC. R: A language and environment for statistical computing. R Foundation for Statistical Computing. (No Title). 2013.
21. Tavakol M, Dennick R. Making sense of Cronbach's alpha. International journal of medical education. 2011;2:53.
22. Litwin MS, Tan H-J. The Diagnosis and Treatment of Prostate Cancer: A Review. JAMA. 2017;317(24):2532-42. doi: 10.1001/jama.2017.7248.
23. Menendez ME, van Hoorn BT, Mackert M, Donovan EE, Chen NC, Ring D. Patients With Limited Health Literacy Ask Fewer Questions During Office Visits With Hand Surgeons. Clinical Orthopaedics and Related Research®. 2017 2017/05/01;475(5):1291-7. doi: 10.1007/s11999-016-5140-5.
24. Kim J, So B, Heo Y, So H, Jo JK. Advances in Male Contraception: When Will the Novel Male Contraception be Available? World J Mens Health. 2024 0/;42.
25. Grönberg H. Prostate cancer epidemiology. The Lancet. 2003;361(9360):859-64. doi: 10.1016/S0140-6736(03)12713-4.
26. Rozmovits L, Ziebland S. What do patients with prostate or breast cancer want from an Internet site? A qualitative study of information needs. Patient Education and Counseling. 2004 2004/04/01/;53(1):57-64. doi: https://doi.org/10.1016/S0738-3991(03)00116-2.
27. Zallio M, Clarkson PJ. Designing the metaverse: A study on inclusion, diversity, equity, accessibility and safety for digital immersive environments. Telematics and Informatics. 2022 2022/12/01/;75:101909. doi: https://doi.org/10.1016/j.tele.2022.101909.
28. Agency MosaINIS. 2022 Survey on the Internet Usage. April 2023. Report No.: NIA VIII-RSE-C-22071.
29. Kopp RP, Marshall LM, Wang PY, Bauer DC, Barrett-Connor E, Parsons JK. The Burden of Urinary Incontinence and Urinary Bother Among Elderly Prostate Cancer Survivors. European Urology. 2013 2013/10/01/;64(4):672-9. doi: https://doi.org/10.1016/j.eururo.2013.03.041.
30. Kim J, So B, Heo Y, So H, Jo JK. Penile Erection Morphometry: The Need for a Novel Approach. World J Mens Health. 2024 0/;42.
31. Coughlin SS. A review of social determinants of prostate cancer risk, stage, and survival. Prostate International. 2020 2020/06/01/;8(2):49-54. doi: https://doi.org/10.1016/j.prnil.2019.08.001.
32. Mair F, Whitten P. Systematic review of studies of patient satisfaction with telemedicine. BMJ. 2000;320(7248):1517-20. doi: 10.1136/bmj.320.7248.1517.
33. Dean LT, Gehlert S, Neuhouser ML, Oh A, Zanetti K, Goodman M, et al. Social

factors matter in cancer risk and survivorship. Cancer Causes & Control. 2018 2018/07/01;29(7):611-8. doi: 10.1007/s10552-018-1043-y.
34. Cuevas AG, Trudel-Fitzgerald C, Cofie L, Zaitsu M, Allen J, Williams DR. Placing prostate cancer disparities within a psychosocial context: challenges and opportunities for future research. Cancer Causes & Control. 2019 2019/05/01;30(5):443-56. doi: 10.1007/s10552-019-01159-1.

Supplementary Files

Figures

Schematic overview of the Metaverse prostate cancer patient associations.