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Prostate cancer screening beyond opportunistic testing: A Delphi consensus and evidence integration

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Purpose: Prostate cancer has become the most common male malignancy in Korea, yet prostate-specific antigen (PSA)–based screening remains excluded from the national cancer screening program and is performed predominantly on an opportunistic basis. Long-term randomized evidence comparing organized PSA-based screening with opportunistic testing is complex and variably interpreted. This study aimed to assess expert consensus on whether an organized early-detection framework offers advantages over the current opportunistic model in Korea.

Materials and Methods: A structured, three-round Delphi study was conducted among 15 Korean urologists with expertise in prostate cancer management and PSA-based early detection. Statements were informed by international guidelines, long-term randomized trial evidence, and Korean epidemiologic data, covering conceptual justification and screening parameters. Consensus was predefined using Likert-scale agreement/disagreement thresholds and a within-group agreement index (r_{wg} ≥0.80).

Results: All panelists completed all three rounds. Consensus was achieved that PSA-based early detection provides a net population-level benefit; that organized, invitation-based screening is preferable to opportunistic testing; and that active surveillance should be the default for low-risk disease. Initiation at age 55 reached stable consensus, whereas discontinuation at age 80 reached consensus only in the final round, indicating an upper bound within an individualized 75- to 80-year stopping range. No fixed screening interval achieved sustained agreement, supporting risk-adapted approaches.

Conclusions: This Delphi study supports the feasibility of an organized, risk-adapted PSA-based early detection framework in Korea. Subsequent multidisciplinary input from preventive medicine, primary care, health economics, and patient perspectives is

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required before policy implementation.

Keywords: Delphi technique; Health policy; Mass screening; Prostate cancer; Prostate-specific antigen

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INTRODUCTION

Prostate-specific antigen (PSA)–based prostate cancer screening has been shown to reduce disease-specific mortality in large-scale randomized trials, including the European Randomized Study of Screening for Prostate Cancer (ERSPC) and the Göteborg randomized population-based trial, most convincingly when implemented as organized, invitation-based programs with structured diagnostic pathways [1,2]. However, randomized evidence also demonstrates that opportunistic PSA testing—driven by individual initiative without standardized follow-up—achieves substantially inferior outcomes. In the Göteborg trial, the control arm was exposed to high levels of opportunistic testing, with cumulative PSA testing rates reaching 56% among men aged 55–69 years by 2007 [3]. Despite this contamination, organized biennial screening demonstrated significantly greater mortality reduction and more favorable overdiagnosis profiles [3]. At 22 years of follow-up, organized screening delayed the time to reach a 1% cumulative prostate cancer mortality threshold by approximately 2.8 years compared with opportunistic testing alone [2]. The Swedish national Organised Prostate Cancer Testing (OPT) program has concluded that unstructured opportunistic testing increases healthcare costs, promotes differential overtreatment, and fails to equitably reduce population-level mortality [4].

The contemporary evidence base also includes the US-based Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer Screening Trial, which reported no mortality benefit of annual PSA screening versus usual care after extended follow-up [5]. Subsequent analyses, however, have shown that an estimated 86% of control-arm participants underwent some PSA testing during the trial and that approximately half had undergone PSA testing within the preceding 3 years before enrollment [5]. Accordingly, the trial comparison more closely approximates organized versus opportunistic screening than screening versus no screening. Under this reframing, the null mortality result can be interpreted as concordant with, rather than contradictory to, the benefit observed in the ERSPC and Göteborg trials. It also directly informs the conceptual motivation of the present study: in settings where unstructured PSA testing is already occurring at scale, the relevant comparison is not screening versus no screening but organized versus opportunistic screening.

Korea faces a distinctive epidemiologic context. Prostate cancer ranked 9th among male malignancies in 1999 but rose to the most common male cancer in the 2023 national registry [6], while contemporary Korean real-world data show a persistently high-risk–dominant disease profile at diagnosis [7]. Despite this rapid transition, PSA testing is excluded from the national cancer screening program, no designated insurance reimbursement code exists for PSA screening, and no standardized shared decision-making (SDM) guidelines have been established. Public awareness is correspondingly low: only 9.7% of Korean men recognized PSA as a screening tool [8], and the population-level testing rate reached only 10.2% among men aged 50 years and older by 2016 [9]. An independent national registry analysis covering 1999–2020 confirmed that prostate cancer exhibited one of the steepest sustained incidence increases among all urological cancers in Korea (average annual percent change 6.72%) [10]. With further population aging, this trajectory may continue in the absence of systematic early detection. As the population ages and awareness gradually increases, opportunistic PSA testing is expected to expand in an unstructured manner, potentially replicating the socioeconomic disparities and overtreatment documented in European settings [3,11].

In this context, we conducted a structured Delphi study to develop expert consensus on a Korean model of organized PSA-based early detection. Drawing on long-term ERSPC evidence [1] and contemporary diagnostic and treatment advances [12-16], this study addresses eligibility age, screening interval, stopping criteria, and active surveillance (AS) strategy, tailored to the Korean epidemiologic context characterized by late-stage diagnosis and high-risk disease predominance in elderly men [7].

MATERIALS AND METHODS

1. Study design and ethics

This study was approved by the Institutional Review Board of the Ewha Womans University Mokdong Hospital

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(approval number: EUMC IRB 2025-09-029-002). We conducted a structured, three-round Delphi study involving Korean urologists with expertise in prostate cancer screening and management. The Delphi method was used to systematically synthesize expert judgment and quantitatively assess consensus in areas where randomized trial evidence is incomplete and policy decisions require adaptation to national epidemiologic characteristics. This study was designed to inform the development of an organized PSA-based screening framework in the Korean healthcare context; while the underlying principles may be transferable, specific parameters should be interpreted within local epidemiologic and health-system settings.

2. Panel composition and recruitment

Fifteen board-certified urologists with expertise in prostate cancer diagnosis, treatment, and early detection strategies were invited to participate in this Delphi study, reflecting its focus on the clinical implementation of PSA-based early detection. All panelists were actively involved in clinical practice in Korea and had direct experience with PSA-based screening and prostate cancer management. The panel included representatives from tertiary referral centers and academic institutions, capturing perspectives across diverse clinical settings. No patient representatives or non-urologic specialists were included, as the primary objective was to assess the feasibility and clinical coherence of PSA-based early detection strategies from a urologic practice perspective. We acknowledge at the outset that a urologist-only panel is likely to exhibit a systematic directional orientation toward endorsing early detection, and we interpret the absolute magnitude of consensus on conceptually framed statements (Q1–Q2) accordingly in the Discussion section.

3. Steering committee and questionnaire development

A steering committee developed the Delphi questionnaire. Draft statements were informed by international prostate cancer screening guidelines, long-term evidence from randomized and observational studies of PSA-based screening—including extended follow-up data from the ERSPC—and contemporary Korean epidemiologic and health services evidence. The present analysis focused on two domains: (1) conceptual and ethical foundations, and (2) screening parameters, including starting age, screening interval, and stopping age. Each statement was rated on a 9-point Likert scale (1–3=disagreement; 4–6=uncertainty; 7–9=agreement), and free-text fields were provided to allow panelists to suggest refinements or identify missing elements.

4. Consensus definitions

Consensus definitions followed established Delphi methodology. Consensus ("Yes") was defined by the simultaneous fulfillment of the following criteria: (1) ≥70% of ratings in the 7–9 range; (2) <15% of ratings in the 1–3 range; and (3) a within-group agreement index (r_{wg}) ≥0.80. "No consensus" was assigned when either <70% of ratings fell in the 7–9 range or r_{wg} was <0.80, indicating insufficient convergence. These criteria were applied uniformly across all rounds, with final consensus status determined based on Round 3 ratings. Because r_{wg} reflects agreement on the rating given and is indifferent to the direction of that rating, a high r_{wg} accompanied by a low mean indicates consistent rejection of the item rather than endorsement. Accordingly, the "Yes" classification was reserved for items that concurrently meet the rating-distribution criteria in the agreement direction (≥70% in 7–9 and <15% in 1–3) together with r_{wg} ≥0.80. Items exhibiting high r_{wg} but a low mean were interpreted as consensus rejection rather than endorsement and annotated accordingly in the relevant tables. In reporting the temporal robustness of consensus findings, we distinguished between stable and late-emerging consensus. Stable consensus was defined as a final consensus item that showed sustained agreement-direction support across all three rounds and met the full consensus criteria from Round 2 onward. Late-emerging consensus was defined as an item that met the full consensus criteria only in Round 3. Although late-emerging consensus was pre-specified as valid consensus, it was interpreted with greater caution.

5. Delphi procedure

The Delphi process was conducted across three structured rounds and administered using an email-based system managed by an independent data coordinator (statistical specialist). All responses were anonymized to minimize conformity pressure and preserve independent judgment. Across all rounds, all statements were re-rated regardless of prior agreement levels, allowing assessment of stability, convergence, and changes in within-group agreement.

In Round 1, panelists rated all statements and provided qualitative comments. Statements considered ambiguous were reworded for clarity without altering their conceptual intent, consistent with established Delphi methodology. In Round 2, controlled feedback was provided, including the panel-wide mean score from Round 1 and each panelist's own prior rating. Panelists then re-rated all statements. The same controlled-feedback procedure was applied between Rounds 2 and 3; no external literature or steering-committee interpretation was added between these rounds. Additional-

Table 1. Conceptual and ethical statements (Q1–Q4)

Question	Round 1 Mean / consensus / r_{wg}	Round 2 Mean / consensus / r_{wg}	Round 3 Mean / consensus / r_{wg}
Q1. PSA-based early detection of prostate cancer provides a net population-level benefit.	8.07 / Yes / 0.82[a]	8.20 / Yes / 0.91[a]	8.33 / Yes / 0.94[a]
Q2. Organized PSA screening better aligns with goals of mortality reduction, harm minimization, and equity than opportunistic testing.	8.27 / Yes / 0.88[a]	8.33 / Yes / 0.92[a]	8.40 / Yes / 0.94[a]
Q3. Organized PSA screening can reduce regional and socioeconomic disparities in diagnosis and treatment.	8.20 / Yes / 0.78	8.40 / Yes / 0.90[a]	8.47 / Yes / 0.92[a]
Q4. Adopting active surveillance as the default for low-risk prostate cancer reduces overtreatment within an organized screening program.	7.73 / Yes / 0.78	7.80 / Yes / 0.87[a]	7.87 / Yes / 0.87[a]

PSA, prostate-specific antigen; r_{wg}, within-group agreement index.
[a]:r_{wg} >0.80.

Table 2. Starting age for PSA screening (Q5)

Question	Age (y)	Round 3 Mean / consensus / r_{wg}
Q5. What is the most appropriate starting age (general-risk population) for organized PSA screening?	45	2.80 / No[a] / 0.82[b]
	50	6.20 / No / 0.59
	55	8.33 / Yes / 0.94[b]
	60	6.87 / No / 0.81[b]

PSA, prostate-specific antigen; r_{wg}, within-group agreement index.
[a]:r_{wg} quantifies within-group agreement and is indifferent to the direction of ratings. Thus, a high r_{wg} paired with a low mean, as observed for the 45-year starting-age option, indicates consistent rejection rather than endorsement. Consensus ("Yes") was assigned only when the agreement-direction rating criteria (≥70% in 7–9 and <15% in 1–3) were satisfied together with r_{wg} ≥0.80.
[b]:r_{wg} >0.80.

ly, aggregated anonymized free-text comments submitted by panelists were returned to the group as part of the Round 3 feedback package. This allowed panelists to consider their own qualitative reasoning during re-rating, particularly for items for which consensus had not emerged. Round 3 served as the final confirmation phase, during which statements were rated again to assess stability and finalize consensus. Statements meeting predefined thresholds in Round 3 were classified as consensus items. Items failing to reach consensus after the final Delphi round were retained for analysis and interpretation.

RESULTS

1. Overall response and agreement

All fifteen panelists completed all three rounds of the Delphi process, yielding a 100% response rate. Overall agreement tended to improve across rounds, as reflected by increasing r_{wg} values for many items from Round 1 to Round 3, while several items remained below predefined consensus thresholds in the final round. Final mean scores, consensus status, and agreement indices for both consensus and non-consensus items are summarized in Tables 1-4, with corresponding trends and Round 3 rating distributions shown in Figs. 1-4.

Consensus stability across rounds varied by item. The four conceptual and ethical statements (Q1–Q4) and the starting age of 55 years (Q5) showed sustained agreement-direction support across all three rounds and met the full consensus criteria from Round 2 onward (stable consensus). In contrast, the stopping age of 80 years (Q7) met the full consensus criteria only in Round 3 (late-emerging consensus). The Q7 finding should be interpreted with greater caution, particularly in light of the response-option constraint detailed in the Q7 subsection below.

2. Conceptual and ethical foundations (Q1–Q4)

All four statements addressing the conceptual and ethical foundations of organized PSA-based screening achieved consensus across all three rounds (Table 1). Progressive convergence in ratings was observed, with sustained high mean scores and generally increasing r_{wg} values across rounds

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Table 3. Screening interval (Q6)

Question	Interval (y)	Round 3 Mean / consensus / r_{wg}
Q6. What is the most appropriate interval between PSA screening rounds in an organized program?	1	3.40 / No / 0.40
	2	5.00 / No / 0.42
	4	6.40 / No / 0.10
	5	7.00 / No / 0.29

PSA, prostate-specific antigen; r_{wg}, within-group agreement index.

Table 4. Age to stop screening (Q7)

Question	Age (y)	Round 3 Mean / consensus / r_{wg}
Q7. What is the most appropriate age to discontinue organized PSA screening?	69	2.33 / No / 0.73
	70	3.13 / No / 0.53
	75	6.60 / No / 0.53
	80[a]	6.87 / Yes / 0.81[b]

PSA, prostate-specific antigen; r_{wg}, within-group agreement index.
[a]:The Round 3 consensus on age 80 was late-emerging, as it first satisfied the full consensus criteria in Round 3.
[b]:r_{wg} >0.80.

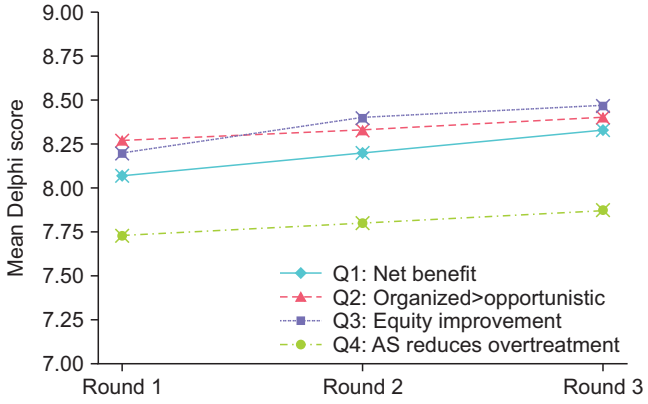


Fig. 1. Mean scores across rounds for conceptual and ethical statements (Q1–Q4). Lines represent the mean rating for each statement in Rounds 1–3, using distinct marker shapes and line styles for clarity. All four items demonstrated sustained agreement-direction support and progressive convergence across rounds, indicating stable consensus on the conceptual and ethical foundations of an organized PSA-based early-detection framework. PSA, prostate-specific antigen; AS, active surveillance.

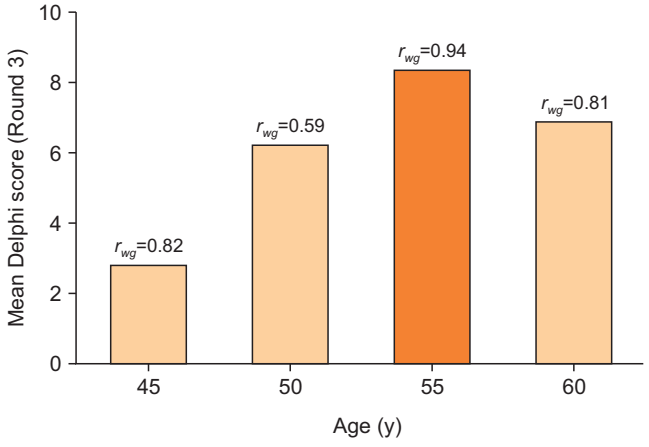


Fig. 2. Round 3 ratings for candidate starting ages of organized PSA-based screening (Q5). Bars show mean Round 3 scores for candidate starting ages (45, 50, 55, and 60 years). The darker orange bar indicates options meeting the predefined agreement-direction consensus criteria (≥70% of ratings in 7–9, <15% in 1–3, and r_{wg} ≥0.80). Age 55 demonstrated the highest level of support, was the only option to reach consensus, and was classified as a stable consensus item across rounds. In contrast, the high r_{wg} observed for age 45 reflected consistent rejection rather than endorsement. PSA, prostate-specific antigen; r_{wg}, within-group agreement index.

(Fig. 1).

The statement that PSA-based early detection provides a net population-level benefit demonstrated consistently high agreement (Round 3 mean 8.33; r_{wg}=0.94). Consensus was also observed for the superiority of organized screening over opportunistic testing in achieving mortality reduction, harm mitigation, and equity (Round 3 mean 8.40; r_{wg}=0.94), and for its potential to reduce regional and socioeconomic disparities (Round 3 mean 8.47; r_{wg}=0.92). Adoption of AS as the default management strategy for low-risk disease within an organized program also achieved consensus (Round 3 mean 7.87; r_{wg}=0.87).

3. Starting age for screening (Q5)

Among candidate starting ages (45, 50, 55, and 60 years), age 55 was the only option to achieve sustained consensus across all rounds (Table 2), constituting a stable consensus

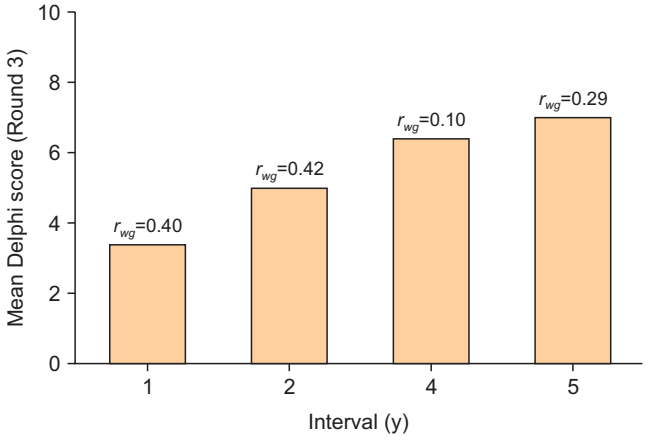


Fig. 3. Round 3 ratings for candidate screening intervals (Q6). Bars represent mean Round 3 ratings for four interval options (1, 2, 4, and 5 years). None of the intervals met the predefined consensus criteria. Although the 5-year interval received the highest mean rating, dispersion remained wide, reflecting panelists' shift away from a single fixed interval toward a risk-adapted framework with shorter intervals for men at higher baseline risk and longer intervals for men with low baseline PSA and no additional risk factors. PSA, prostate-specific antigen; r_{wg}, within-group agreement index.

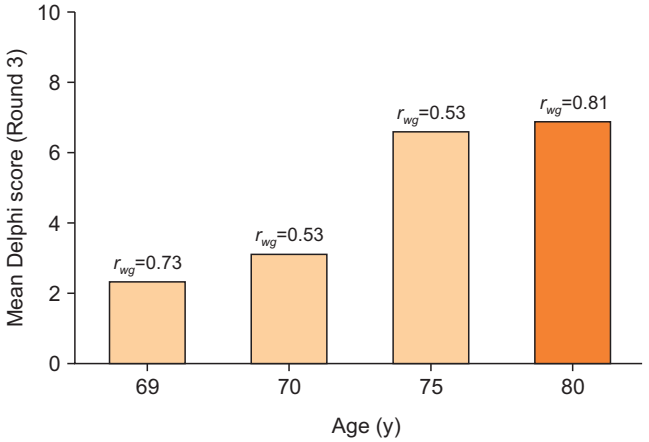


Fig. 4. Round 3 ratings for candidate stopping ages for organized PSA-based screening (Q7). Bars show mean Round 3 scores for candidate stopping ages (69, 70, 75, and 80 years). The darker orange bar indicates options meeting the predefined consensus criteria. Age 80 was the only option to meet the predefined consensus criteria in Round 3; however, this late-emerging consensus should be interpreted as the upper bound of an individualized 75- to 80-year stopping range rather than as a single preferred chronological age. PSA, prostate-specific antigen; r_{wg}, within-group agreement index.

under the criteria defined above. As shown in Fig. 2, age 55 demonstrated both the highest mean rating (8.33) and the highest within-group agreement (r_{wg}=0.94).

Age 50 received moderate support (Round 3 mean 6.20) but did not meet predefined consensus thresholds. Starting at age 45 attracted consistent rejection (Round 3 mean 2.80; r_{wg}=0.82): the high agreement index paired with a low mean indicates that panelists consistently agreed that this option was inappropriate, rather than agreeing that it was appropriate. Although age 60 showed higher ratings in earlier rounds, it did not meet final consensus criteria.

4. Screening interval (Q6)

Four candidate screening intervals (1-, 2-, 4-, and 5-year) were assessed, but no interval achieved final consensus in Round 3, reflecting persistent heterogeneity in expert ratings (Table 3). Round 3 ratings demonstrated that no interval met the predefined consensus criteria (Fig. 3).

Although the 2-year interval achieved consensus in Round 2 (mean 7.20; r_{wg}=0.82), both the mean rating and within-group agreement declined in Round 3 (mean 5.00; r_{wg}=0.42), resulting in failure to meet the final consensus criteria. The 5-year interval showed the highest mean score in Round 3 (mean 7.00), but dispersion remained wide and within-group agreement was low (r_{wg}=0.29). The Round 2-to-Round 3 shift reflected re-framing of the item rather than reversal of a prior consensus. Aggregated anonymized free-text commentary returned to the panel between rounds converged on the view that a single fixed interval was inappropriate; panelists reasoned that intervals should instead be risk-adapted—for example, an initial annual check to establish PSA trajectory, a 2-year interval for men at higher baseline risk, and extension to 5 years or to a 10-year lifetime-transition check for men with low baseline PSA and no risk factors. Round 3 ratings therefore dispersed toward the two ends of a risk-adapted spectrum, yielding a distribution in which no single fixed interval could satisfy the predefined consensus criteria. Because no external literature or steering-committee interpretation was introduced between Rounds 2 and 3, this shift most likely reflects panelists' reassessment in response to aggregated peer comments rather than external steering.

5. Age to stop screening (Q7)

Among the candidate stopping ages (69, 70, 75, and 80 years), age 80 achieved consensus in Round 3 (mean 6.87; r_{wg}=0.81) (Table 4). However, no stopping age demonstrated sustained consensus across all three rounds, and this late-emerging consensus should be interpreted with the caveats detailed below.

The four candidate ages (69, 70, 75, and 80 years) were selected a priori for comparability with international guideline thresholds and commonly used Korean administrative age strata. They did not, however, include the age range corresponding to a 10-year life expectancy threshold in contemporary Korean men (approximately 77–78 years, derived

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from the 2024 national life table). Panelists were therefore constrained to choose between 75 and 80 years for the upper bound, and qualitative commentary indicated that several endorsed 75 years as the operational baseline with individualized extension to 80 years for men in good health. The Round 3 consensus on age 80 should accordingly be interpreted as an upper bound beyond which screening is not supported, rather than as the preferred operational termination age for most men. The finding is therefore best reported as an individualized stopping range of 75–80 years, guided by life expectancy.

DISCUSSION

This Delphi study established expert consensus on the foundational principles and operational parameters for organized PSA-based prostate cancer early detection in Korea. The panel reached stable consensus across all three rounds that PSA-based early detection provides a net population-level benefit (Q1), that organized screening is preferable to opportunistic testing (Q2–Q3), that AS should serve as the default for low-risk disease (Q4), and that screening should begin at age 55 (Q5). Discontinuation at age 80 (Q7) reached consensus only in the final round and is reported as the upper bound of an individualized 75- to 80-year stopping range. No consensus was achieved for a fixed screening interval (Q6), indicating that this parameter requires adaptive, risk-stratified implementation.

With respect to the net population-level benefit of screening (Q1), the panel reached consensus in favor of PSA-based early detection (Round 3 mean 8.33). Free-text commentary emphasized that this benefit is contingent on risk-adapted implementation, including protocolized AS for low-risk disease and avoidance of indiscriminate biopsy triggered by PSA alone. This reasoning is consistent with the trajectory of randomized evidence: ERSPC demonstrated that the absolute risk reduction improved from 0.16% at 16 years to 0.22% at 23 years, with efficiency metrics improving correspondingly (number needed to invite [NNI], 628 to 456; number needed to diagnose [NND], 18 to 12) [1]. A comprehensive systematic review similarly supports the conclusion that PSA-based screening reduces prostate cancer-specific mortality, while effects on all-cause mortality are attenuated by competing risks [17]. Population-level analyses further suggest that observed mortality declines in the PSA era track with screening utilization rather than treatment advances alone [18]. However, randomized trials also demonstrated substantial overdiagnosis when screening relied on PSA level alone, underscoring the importance of risk-stratified implementation to optimize net benefit [19]. The PLCO trial is often invoked as evidence against PSA screening, yet extended 15-year follow-up and contamination analyses indicate that the comparator arm was heavily exposed to opportunistic PSA testing, with an estimated 86% of control-arm men tested during the trial [5]. Thus, PLCO more closely approximates a comparison of organized versus opportunistic screening than screening versus no screening. Under this reframing, the null mortality result can be interpreted as concordant with, rather than contradictory to, the benefits observed in ERSPC and Göteborg. It also supports the panel's consensus on Q2: organized screening is preferable to the opportunistic model in settings where unstructured testing is already occurring. In the Korean context, where PSA testing is largely driven by non-systematic factors such as bundled health check-ups [20] and approximately half of newly diagnosed patients present with high-risk disease [7], the potential for structured screening to translate the mortality benefit demonstrated in organized trials is directly relevant but remains unrealized.

On the superiority of organized over opportunistic screening (Q2) and its potential to reduce disparities (Q3), the panel reached stable consensus (Round 3 means 8.40 and 8.47, respectively). Panelists reasoned in free-text commentary that opportunistic testing is structurally unequal in Korea because it is accessed primarily through private health check-ups, and that formal invitation with standardized information is an important precondition for meaningful shared decision-making. This reasoning aligns closely with the randomized and observational evidence. In the Göteborg trial, organized biennial screening demonstrated a 29% mortality reduction at 22 years (41% after adjustment for attendance), with an NNI of 217 and an NND of 9 [2]—substantially more favorable than the outcomes observed in the control arm, which was substantially exposed to opportunistic PSA testing [3]. Men diagnosed through organized screening were younger, had lower PSA levels at diagnosis, and were less likely to present with high-risk or advanced disease, whereas tumors detected through opportunistic testing more frequently exhibited adverse features consistent with delayed diagnosis [2,3]. The Göteborg data further suggest that contamination from opportunistic testing in control arms attenuated the true effect of organized screening, implying that the observed benefit is a conservative estimate [1,2].

From an equity perspective, opportunistic PSA testing consistently shows socioeconomic gradients in participation internationally [11,21] and within Korea [20]. Population-based data from Sweden demonstrate that, prior to orga-

nized invitation, opportunistic PSA testing was less common among men with lower income and those living alone; following implementation of organized testing, overall participation increased substantially, although socioeconomic differences persisted [11]. Analogous Korean National Cancer Screening Survey data from colorectal cancer screening further provide evidence that organized programs can substantially attenuate socioeconomic inequalities in uptake compared with opportunistic models [22]. These observations are particularly relevant given that PSA testing in Korea currently lacks a dedicated organized screening pathway and is primarily accessed through privately arranged routes, which may structurally disadvantage lower-income populations. Organized screening, by providing systematic invitation and standardized information materials, may serve not only as a more equitable detection strategy but also as a practical precondition for meaningful SDM—ensuring that all eligible men are at least exposed to balanced information about PSA testing, irrespective of socioeconomic status [8,9,23,24]. Safeguards against overdiagnosis and overtreatment—including structured diagnostic pathways and protocolized AS—can be embedded within the organized program design itself, thereby preserving SDM principles while addressing the fundamental access deficit in Korea.

The consensus that AS should serve as the default for low-risk prostate cancer addresses the principal downstream harm of screening—unnecessary definitive treatment. Panelists reasoned in free-text commentary that implementing AS as the default strategy would require a standardized, protocolized AS pathway; in the absence of such a pathway, clinician-level variability and patient anxiety were considered likely to erode adherence. US national registry data show that AS utilization increased from 26.5% in 2014 to 59.6% in 2021, though meaningful practice-level variation persists [25]. Long-term PRIAS data (8,910 men; Grade Group 1) demonstrated 15-year cumulative incidences of only 2.7% for metastasis and 0.23% for disease-specific mortality, supporting the oncologic safety of deferred treatment [26]. Although Korean data remain less extensive than Western registry data, they have recently begun to define the AS-eligible denominator. In a nationwide study of 27,075 biopsy-confirmed cases across 51 general hospitals spanning all 17 administrative regions, approximately 24.3% of newly diagnosed Korean men were AS-eligible under an expanded definition that included favorable intermediate-risk disease [27]. AS eligibility declined from 27.6% in 2010 to 22.0% in 2020, and differed markedly by residential setting (urban 26.4% versus rural 20.5%) and by administrative region [27]. These findings indicate that the AS-eligible pool in Korea remains constrained by the high-risk-predominant risk distribution at diagnosis. The population-level impact of Q4 therefore depends on simultaneously (1) expanding the AS-eligible denominator through organized early detection and (2) addressing regional disparities in AS access and protocolized delivery. AS also remains vulnerable to practice- and clinician-level variability and patient decision-making barriers [25,28-30], reinforcing the panel's position that embedding AS as the protocolized default within an organized framework is essential to ensuring a favorable population-level benefit–harm balance [25].

For the starting age, the panel's consensus on 55 years aligns with ERSPC evidence demonstrating that mortality benefit was most clearly realized among men screened between 55 and 69 years [1], and with the Göteborg trial showing that younger entry age was associated with greater long-term benefit, whereas entry after 60 years yielded diminishing returns [2]. In the Korean epidemiologic context, where national data show that prostate cancer case burden begins to rise substantially from the 55- to 69-year age group [9], and where high-risk disease accounts for approximately half of newly diagnosed cases [7], this threshold balances the opportunity for timely detection against the risk of overdiagnosis associated with earlier initiation. No consensus in support of starting at 45, 50, or 60 years was achieved.

The panel's preference for age 55 over age 50 warrants more explicit explanation, given that the Korean epidemiologic pattern of late-stage and high-risk disease in elderly men might, at face value, support an earlier initiation. Three considerations drawn from the panelists' free-text commentary underpin this judgment. First, panelists considered the incidence of clinically significant prostate cancer below age 50 in Korean men to be low, making screening in the 45- to 49-year window more likely to detect indolent disease and increase the relative risk of overdiagnosis. Second, panelists reasoned that the accumulated high-risk disease observed in older Korean men at diagnosis reflects the absence of systematic early detection across the lifetime rather than a biology unique to men in their late 40s; many such cancers would likely become detectable within a program beginning at age 55. Third, in the absence of Korean randomized or prospective screening data specific to the 45–54-year window, the panel chose to align with the age range in which randomized mortality benefit has been directly demonstrated (ERSPC, 55–69 years). Age 50 should therefore be viewed as a defensible alternative that was not preferred for these specific reasons, rather than as a self-evidently inferior option. Whether initiation at age 50 is appropriate for specific higher-risk subgroups (family history, germline mutations)

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is a related but distinct question that this Delphi instrument did not formally address.

No candidate screening interval (1-, 2-, 4-, or 5-year) achieved final consensus, reflecting inherent tension between detection sensitivity and overdiagnosis risk. As detailed in the Results section, Round 3 ratings showed persistent dispersion rather than convergence on a single fixed interval. Aggregated qualitative commentary suggested that this dispersion reflected a preference for risk-adapted intervals rather than a fixed-frequency approach. Long-term trial data demonstrate that efficiency metrics improve progressively with longer follow-up rather than being uniquely tied to a specific testing frequency [1]. Current guidelines similarly endorse risk-adapted ranges rather than fixed intervals, recommending longer intervals for men with very low PSA levels and shorter intervals as PSA increases [24,31,32]. The panel's non-consensus appropriately identifies screening interval as a domain requiring flexible, risk-stratified implementation. From a policy perspective, this finding supports adaptable frameworks in which intervals are guided by baseline PSA and individual risk profiles.

The panel's consensus on 80 years as the stopping age requires interpretation within the Korean demographic context and the structural constraint of four discrete response options (69, 70, 75, and 80 years), which did not include an option corresponding to the epidemiologically relevant range of approximately 77–78 years. According to the 2024 national life table, the period life expectancy for Korean men falls below 10 years at age 78 (9.8 years) and is approximately 10.5 years at age 77 [33]. Using the widely endorsed 10-year life expectancy threshold for screening benefit [1,24,31,32], the population-level upper boundary would correspond to approximately 77–78 years. Because this precise range was not included as a response option, panelists had to choose between 75 and 80 years. Free-text commentary indicated that several endorsed 75 years as the operational baseline, with individualized extension to 80 years for men in good health. This rationale is broadly consistent with the Swedish OPT program's target age range of 50–74 years [4] and with the principle that organized screening programs target asymptomatic, community-dwelling men whose health status may exceed population averages. The EAU (European Association of Urology), NCCN (National Comprehensive Cancer Network), and AUA (American Urological Association) guidelines similarly emphasize life expectancy, general health, and competing mortality when determining when PSA-based early detection should be discontinued [24,31,32]. The late-emerging Round 3 consensus on age 80 is therefore best interpreted as the upper bound of an individualized 75- to 80-year stopping range, rather than as the preferred operational termination age for most men. These findings suggest that the operational stopping criterion in a Korean program should incorporate life expectancy estimation rather than relying on chronological age alone.

This study has several limitations. First, the findings reflect structured expert judgment rather than empirical outcome data, and consensus may be influenced by panel composition and prevailing practice patterns. Second, the panel consisted exclusively of board-certified urologists. Urologists, by training and professional orientation, may hold systematically more favorable views toward prostate cancer early detection than preventive medicine specialists, family physicians, health economists, or patient representatives, who weigh population-level opportunity costs and harms differently. Consequently, the high absolute agreement observed for conceptually framed statements—particularly Q1 (net population-level benefit) and Q2 (superiority of organized over opportunistic testing)—should be interpreted as reflecting the consolidated view of the specialty most directly engaged in PSA-based diagnostic pathways, rather than as a balanced multi-stakeholder population-level judgment. The directional conclusion (favoring organized over opportunistic screening) is concordant with the randomized evidence synthesized above; however, the magnitude of endorsement may have been higher than what a multidisciplinary panel would have produced. Accordingly, we position the present consensus as a clinical-domain input into future policy processes rather than as a substitute for them. Subsequent national guideline development should incorporate preventive medicine, primary care, health economics, and patient perspectives before any implementation recommendation is finalized. Third, the 15-member panel, although exhibiting 100% retention, is small in absolute terms and is particularly susceptible to dispersion effects on non-consensus items. The very low r_{wg} values for screening interval (0.10–0.42 in Round 3) could in principle reflect either a small number of outliers or broader dispersion driven by an emerging risk-adapted re-framing. The qualitative data favor the interpretation that this dispersion reflected risk-adapted re-framing rather than random disagreement alone. A larger and multidisciplinary panel might have produced either sharper convergence on a single interval or a broader risk-stratified grid. The non-consensus on Q6 should accordingly be read as a policy-relevant signal that fixed-interval framings may not capture current expert thinking within this panel, rather than simply as a failure of convergence. Fourth, consensus stability varied by item: Q1–Q4 and Q5 (age 55) were stable consensus findings, whereas Q7 (age 80) represented late-emerging consensus.

The Q7 finding, together with the response-option constraint described above, should be interpreted as provisional and should motivate more granular age-limit work in future research. The absence of consensus on screening interval (Q6) identifies a domain requiring flexibility and prospective evaluation rather than representing a study weakness. Finally, most long-term screening evidence originates from Western populations, necessitating cautious extrapolation to the Korean context, where disease epidemiology—characterized by a higher proportion of high-risk disease at diagnosis and a more recent rise in incidence—differs substantially. These findings should therefore be viewed as informing design principles for an organized screening framework rather than prescribing fixed national parameters.

CONCLUSIONS

This Delphi study identified expert consensus among Korean urologists that organized, invitation-based PSA screening—integrated with AS as the default for low-risk disease—is preferable to the current opportunistic model. The panel reached stable consensus on the conceptual and ethical framework for organized screening and on initiation at age 55, whereas consensus on the upper age limit for screening was late-emerging and is best reported as an individualized 75- to 80-year stopping range rather than as a single chronological age. The absence of consensus on screening interval supports risk-adapted rather than fixed-frequency approaches. These findings provide an evidence-informed foundation for designing a nationally organized PSA-based early detection framework tailored to the Korean epidemiologic context, but should be complemented by subsequent multidisciplinary input from preventive medicine, primary care, health economics, and patient perspectives before policy implementation.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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AUTHORS' CONTRIBUTIONS

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