Marko Kimi Milić[1], Šćepan Sinanović[1], Dejan Kostić[2,3], Milena Ratković[4]

# MODELI ORGANIZACIJE ”ONE-STOP” KLINIKA ZA BOLESTI ŠTITASTE ŽLEZDE: PREGLED PROCESA, INDIKATORA PERFORMANSI I ISHODA IZ LITERATURE

**Apstrakt:** Pozadina: Fragmentisani putevi zbrinjavanja nodularne bolesti štitaste žlezde produžavaju vreme do odluke i povećavaju troškove. „One-stop“ klinike (OSK) integrišu klinički pregled, ultrazvuk, UZ-vođenu FNA i, po potrebi, ROSE/telecitologiju u jednoj poseti.

Cilj: Mapirati organizacione modele OSK, definisati ključne pokazatelje performansi (KPI) i sumirati ishode (vreme, posete, adekvatnost, ponovljene FNA, troškovi, zadovoljstvo, bezbednost).

Metode: Scoping pregled prema PRISMA-ScR i JBI. Pretražene su MEDLINE, Scopus i Web of Science (2000 – avgust 2025). Uključene su studije koje operacionalizuju OSK i/ili izveštavaju KPI/ishode. Ekstrakcija je obuhvatila organizacione karakteristike, protokole (ACR/EU-TIRADS, Bethesda), metrike toka, adekvatnost FNA/ROSE, ekonomiku, zadovoljstvo i bezbednost. Sprovedena je narativna sinteza.

Rezultati: Identifikovani modeli OSK dosledno skraćuju lead-time do odluke i redukuju broj poseta. Adekvatnost uzoraka je visoka, posebno uz ROSE/telecitologiju, što smanjuje ponovne punkcije. Zadovoljstvo pacijenata je visoko; bezbednosni profil FNA ostaje povoljan. Ekonomske analize ukazuju da je isplativost ROSE kontekst-zavisna i najveća pri višoj baznoj neadekvatnosti i/ili nižem trošku. Predložen je KPI paket: lead-time, udeo „jedna poseta“, Bethesda I, udeo ROSE, ponovna FNA ≤90 dana, trošak po epizodi, zadovoljstvo.

[1] Marko Kimi Milić, Visoka medicinska škola strukovnih studija „Milutin Milanković“, Beograd, Srbija, e-mail: drmarkokimimilic@gmail.com

[2] Univerzitet odbrane u Beogradu, Medicinski fakultet Vojnomedicinske akademije, Beograd, Srbija

[3] Vojnomedicinska akademija, Institut za radiologiju, Beograd, Srbija

[4] Vojnomedicinska akademija, Beograd, Srbija

Zaključak: OSK su primenljiv i vrednosno orijentisan model za dijagnostiku štitaste žlezde. Selektivna primena ROSE/telecitologije i upravljanje na osnovu KPI omogućavaju efikasnu i bezbednu implementaciju u različitim resursnim okruženjima.

**Ključne reči:** one-stop klinika; štitasta žlezda; ultrazvuk; fina iglena aspiracija; ROSE; TIRADS; Bethesda; indikatori performansi; zdravstveni menadžment

## *UVOD*

Nodularna bolest štitaste žlezde spada među najčešće razloge upućivanja u endokrinološke i radiološke ambulante, sa širokim spektrom kliničkih scenarija — od slučajno otkrivenih nodusa na ultrazvuku do sumnje na diferencirani karcinom. U poslednje dve decenije, standardizacija dijagnostike i odlučivanja, zasnovana na smernicama Američkog tireoidnog udruženja (ATA), postavila je čvrst temelj za racionalno korišćenje ultrazvuka (UZ), citologije tankom iglom (FNA) i procene individualnog rizika (1). Istovremeno, razvoj sistema za stratifikaciju rizika na osnovu UZ karakteristika, posebno ACR TI-RADS i EU-TIRADS, doneo je veću doslednost u proceni verovatnoće maligniteta i indikacijama za FNA, čime je unapređena usklađenost između endokrinologa i radiologa (2–3). Standardizacija izveštavanja citologije kroz ”The Bethesda System“ (verzija 2017) dodatno je smanjila „sive zone“ i olakšala jasnije kliničke odluke (4).

Uprkos napretku, klinički putevi često ostaju fragmentisani: pacijenti obavljaju više poseta (klinički pregled, UZ u radiologiji, zatim FNA i kasniji povratak po rezultat), što produžava vreme do definitivne odluke, povećava opterećenje sistema i troškove za pacijenta i ustanovu. Sumarni pregledi ukazuju da optimizovani algoritmi – koji povezuju UZ-baziranu stratifikaciju, selektivnu FNA i ranu multidisciplinarnu diskusiju – skraćuju dijagnostičko-terapijski tok i smanjuju nepodesne intervencije (5). Na toj osnovi razvio se model ”one-stop“ klinike (OSK): organizacije u kojoj se klinički pregled, UZ, indikacija i izvođenje UZ-vođene FNA (po potrebi i brza on-site citološka procena, ROSE), te inicijalna odluka o lečenju obave u jednoj poseti (5–8).

OSK pristup integriše ključne resurse u jednom terminu i prostoru – endokrinologa, radiologa/sonografistu, citopatologa i, prema potrebi, hirurga – oslanjajući se na standardizovane alate (ACR/EU-TIRADS, Bethesda) i jasne protokole. Podaci iz praksi u različitim zdravstvenim sistemima pokazuju da OSK skraćuje vreme od upućivanja do plana lečenja, smanjuje broj poseta i interspecijalističkih transfera, podiže zadovoljstvo pacijenata i može ostvariti ekonomske uštede (6–8). Posebno su informativni modeli takozvanih „visokorezolutivnih“ endokrinoloških ambulanti gde se UZ i FNA izvode tokom iste posete, uz demonstriran pad dodatnih uputnih procedura i troškova (7–8).

Kritične „tehničke poluge" kvaliteta u OSK su adekvatnost FNA i blagovremena interpretacija. Uvođenje ROSE (rapid on-site evaluation), gde citopatolog ili obučeni profesionalac potvrđuje adekvatnost materijala tokom iste seanse, dosledno podiže stopu adekvatnih uzoraka i smanjuje potrebu za ponovnim punkcijama, čime se dodatno skraćuje tok i štedi resurs (9). Ovakav fokus na kvalitet uzoraka, u kombinaciji sa doslednom primenom TIRADS kriterijuma i Bethesda kategorizacije, omogućava brzu i pouzdanu trijažu između nadzora, dodatne dijagnostike ili hirurgije (2–4, 9).

Važno je i da je izvodljivost OSK potvrđena i u okruženjima sa ograničenim resursima, uz očuvanje bezbednosti i ishoda – što sugeriše dobru prenosivost modela i van visoko-specijalizovanih centara (10). To je naročito relevantno za zdravstvene sisteme u tranziciji i regione sa neravnomernom raspodelom radioloških i citopatoloških kapaciteta, gde integrisanje usluga u jednom terminu može značajno ublažiti uska grla.

Polazeći od toga, ovaj rad ima tri cilja: (i) da opisno mapira organizacione modele i ključne procese OSK za nodularnu bolest štitaste žlezde; (ii) da predloži skup ključnih indikatora performansi (KPI) za praćenje kvaliteta, efikasnosti i vrednosti za pacijenta; i (iii) da sintetiše dostupne ishode (vreme do dijagnoze/odluke, adekvatnost FNA, broj poseta, troškovi, zadovoljstvo i bezbednost) iz literature, uz praktične smernice za implementaciju u našim uslovima (1–10).

## *METODOLOGIJA*

Dizajn pregleda. Sproveden je scoping pregled u skladu s PRISMA-ScR smernicama i aktuelnim metodološkim uputstvom JBI (11–12). PRISMA 2020 okvir je korišćen za transparentno prikazivanje toka selekcije (dijagrama) i izveštavanje, prilagođeno scoping formatu (13). Pretraživačka strategija i izveštavanje o pretrazi slede PRISMA-S preporuke (14).

Okvir pitanja (PCC).

– Populacija: odrasli sa nodularnom bolešću štitaste žlezde ili upućeni na dijagnostiku štitaste žlezde.

– Koncept: modeli "ne-stop" klinika (OSK), "high-resolution" endokrinološke ambulante, organizacija „isti dan UZ+FNA/ROSE", integrisana dijagnostika i trijaža.

– Kontekst: ambulantne i bolničke endokrinološko-radiološke službe, sve razine zdravstvenih sistema, bez geografskog ograničenja.

Kriterijumi uključivanja/isključivanja. Uključene su primarne studije i izveštaji (prospektivne/retrospektivne kohorte, pre-post evaluacije, serije slučajeva ≥ 30 pacijenata, programi unapređenja kvaliteta, ekonomske evaluacije) koji opisuju organizaciju procesa OSK i/ili izveštavaju ishode/KPI (vreme do dijagnoze/odluke,

broj poseta, adekvatnost FNA, ponovljene punkcije, upotreba ROSE, troškovi, zadovoljstvo, bezbednosni događaji). Isključeni su izolovani case report-i, komentari, pregledni članci bez originalnih podataka, studije bez jasnog OSK koncepta i radovi bez relevantnih ishoda.

Izvori informacija i strategija pretrage. Pretražene su MEDLINE/PubMed, Scopus i Web of Science od 2000. do 14. avgusta 2025. Bez jezičkog ograničenja; u praksi su obuhvaćeni engleski, španski, portugalski, francuski, nemački i srpsko-hrvatski. Korišćene su kombinacije ključnih reči i kontrolisanih pojmova (prilagođeno bazi):

("one-stop" OR "same-day" OR "high-resolution clinic" OR "rapid access clinic") AND (thyroid OR "thyroid nodule") AND (ultrasound OR FNA OR "fine-needle aspiration" OR ROSE OR cytology) AND (clinic* OR pathway OR workflow OR organization OR efficiency OR cost).*

Dodatno je sprovedeno "snowballing" praćenje referenci i citata u relevantnim radovima (11–14).

Selekcija studija. Naslovi/sažeci su skriningovani u duplikatu, uz razrešavanje neslaganja konsenzusom. Potencijalno relevantni radovi su nabavljeni u punom tekstu; uključivanje je odlučivano prema unapred definisanim kriterijumima. Tok selekcije biće prikazan PRISMA 2020 dijagramom (13).

Ekstrakcija podataka. Standardizovana šema (pilotirana na 5 radova) obuhvatala je: karakteristike OSK modela (jedinice uključenih disciplina; dostupnost UZ, FNA, ROSE; logistika iste – posete), protokole (TIRADS, Bethesda), metrika toka (lead time do odluke; broj poseta), dijagnostičke performanse (adekvatnost FNA, ponovljene punkcije), ekonomske pokazatelje (direktni troškovi, uštede), zadovoljstvo pacijenata i bezbednost (komplikacije). Podaci su uparivani/deduplicirani po autoru, godini, ustanovi i periodu.

Procena metodoloških karakteristika (opciono). Iako formalna kritička procena kvaliteta nije obavezna u scoping pregledima (11–12), planirano je deskriptivno mapiranje izvora potencijalne pristrasnosti; za nerandomizovane uporedne studije aludirali smo na dimenzije ROBINS-I (15). Za studije dijagnostičke tačnosti (npr. UZ/TIRADS vs. citologija/histologija) beleženi su elementi STARD 2015 (16); za opservacione studije elementi STROBE (17).

Sinteza i prezentacija. Rezultati će biti prikazani narativno po domenima: (i) organizacioni modeli i protoci; (ii) KPI skup; (iii) ishodi (vreme, posete, adekvatnost FNA/ROSE, troškovi, zadovoljstvo, bezbednost); (iv) kontekstualni faktori (tip ustanove, resursi). Kada je metodološki smisleno i podaci homogenih metrika dostupni, biće prikazane i sumarizovane deskriptivne statistike (npr. median/IRQ vremena do odluke) bez formalne metaanalize (11–12).

Etika. Prethodno objavljeni i agregirani podaci bez identifikatora; stoga etičko odobrenje nije bilo potrebno (11–12).

## *MODELI PROCESA ”ONE-STOP“ KLINIKA (ORGANIZACIJA I TOK RADA)*

Definicija i cilj. ”One-stop“ klinika (OSK) za nodularnu bolest štitaste žlezde organizuje klinički pregled, ultrazvuk (UZ), eventualnu UZ-vođenu FNA (po potrebi sa ROSE) i inicijalnu odluku o lečenju u jednoj poseti, oslanjajući se na standardizovane alate (ACR/EU-TIRADS; Bethesda) i jasno definisane protokole (2–4, 6–8, 10).

### A) Standardni tok rada (primer operativnog protokola)

1. Pre-dolazak (e-upit i trijaža)
   – Elektronski upit s razlozima upućivanja i ranijim nalazima (TSH/FT4/anti-TPO, prethodni UZ/FNA).
   – Preliminarna UZ-stratifikacija rizika (ako postoji raniji nalaz) i zakazivanje OSK termina sa očekivanim trajanjem (2–3).
2. Prijem i klinički pregled
   – Endokrinološka anamneza i status; verifikacija indikacije za UZ i moguće FNA prema ACR/EU-TIRADS pragovima (2–3).
   – Obavezni „time-stampovi“ (prijem, početak UZ, odluka o FNA) radi praćenja lead-time metrika.
3. UZ i odlučivanje o FNA
   – Standardizovan UZ protokol (veličina, kompozicija, ehogenost, margine, kalcifikacije, oblik; TIRADS skor) (2–3).
   – Odluka o FNA na osnovu TIRADS kategorije i prečnika; informisani pristanak i zajedničko donošenje odluke (1–3, 5).
4. UZ-vođena FNA (po potrebi ROSE)
   – 25–27G igla; 2–4 prolaza, direktni razmazi + ”cell block“.
   – ROSE (rapid on-site evaluation) za proveru adekvatnosti; naročito korisna u sredinama sa višom baznom stopom neadekvatnosti ili kod operatera u obuci (9).
   – Alternativa/kombinacija: telecitologija za udaljenu ROSE podršku (npr. real-time video) kada citopatolog nije fizički prisutan (18).
5. Preliminarna integracija nalaza i plan
   – Kratki ”huddle“ endokrinolog–radiolog–citopatolog: privremena klasifikacija po Bethesda (ako je dostupna brza procena) i zapis odluke: nadzor / dodatna dijagnostika (ponovna FNA, molekularno testiranje) / hirurška evaluacija (4–5, 9).

– Dokumentovan individualizovani plan i edukacija pacijenta; termin za dostavu finalne citologije i MDT po potrebi.

6. Isti dan – perspektiva pacijenta
   – U OSK modelima dosledno je zabeleženo smanjenje broja poseta i kraće vreme do odluke, uz visoko zadovoljstvo; u „visokorezolutivnim“ endokrinološkim ambulantama demonstrirane su i ekonomske koristi (6–8).
   – U modelima isti-dan FNAC-dijagnostike registrovano je i brže smanjenje anksioznosti mereno STAI skalom (19).

Upravljanje OSK treba uskladiti s konceptom „vrednosti“ i sa ”Triple Aim“ okvirom (ishodi, iskustvo, trošak), jer KPI moraju odražavati ono što je klinički i organizaciono najvažnije (20–21).

**B) Varijante implementacije (u zavisnosti od resursa)**

- OSK-Lite: UZ + FNA u jednoj poseti, bez formalne ROSE; fokus na skraćenje „vreme-do-odluke“, uz ciljanu ponovnu FNA sledećeg dana ako je prvi nalaz Bethesda I (4, 6).
- OSK sa ROSE (on-site ili telecitologija): maksimalno smanjenje udela Bethesda I i ponovnih punkcija (9, 18).
- OSK sa preliminarnom citologijom istog dana: gde logistika dozvoljava brzu boju i evaluaciju; preliminarni izveštaj + finalna verifikacija (4, 9, 18).

**C) Kontrola kvaliteta unutar procesa**

- Standardizacija UZ izveštaja (ACR/EU-TIRADS) i dosledna primena indikacija za FNA (2–3).
- Adekvatnost FNA: cilj je nizak udeo Bethesda I; ROSE dokazano povećava adekvatnost i smanjuje ponovljene punkcije (9, 22–23).
- Vreme procedure i logistika: ROSE može smanjiti odložena zakazivanja, ali ponekad produži trajanje pojedinačne procedure; to treba balansirati rasporedom i resursima (9, 23, 24).
- Bezbednost: praćenje neželjenih događaja posle FNA (krvarenje, vazovagalne reakcije) i ”rescue“ termina (5).
- MDT-case review za granične/indeterminantne slučajeve da bi se smanjili nepotrebni zahvati (1, 4–5).

## *PREDLOG SKUPA KPI ZA OSK*

Okvir i principi. KPI grupisati prema operativnim, kliničkim, ekonomskim i iskustvenim pokazateljima, u skladu s pristupom vrednosti i Triple Aim paradigmom (20–21). Pragove postaviti prema lokalnim baznim performansama i prioritetima.

**1) Operativni KPI (efikasnost toka)**

- Lead-time od uputa do inicijalnog plana (dani); medijana i IQR (6–8, 10).
- Udeo pacijenata kompletiranih u jednoj poseti (%) (UZ ± FNA ± plan) (6–8).
- Udeo FNA izvedenih istog dana posle UZ (%) (6–7).
- Udeo FNA s ROSE (%) i vreme po proceduri (min); korist vs. opterećenje resursa (9, 23, 24).
- Stopa ponovne FNA u ≤90 dana (%) (niže je bolje) (4, 9).

**2) Klinički KPI (kvalitet dijagnostike/ishodi)**

- Bethesda I (nondiagnostic) (%) – cilj ≤10% uz optimalan proces; smanjenje nakon uvođenja ROSE (4, 9, 22).
- Distribucija Bethesda II–VI (%) i konverzija u definitivnu dijagnozu (4).
- Stopa „benignih" operacija (%) među operisanima (indikator adekvatne selekcije) (1, 5).
- Vreme do hirurške odluke / do zahvata (dani) za Bethesda V–VI (6–7).
- Stopa neželjenih događaja posle FNA (%) (5).

**3) Ekonomski KPI (trošak i iskorišćenje)**

- Trošak po epizodi (poseta + UZ ± FNA ± ROSE) i uštede po izbegnutoj poseti (6–8).
- Inkrementalni trošak-po-adekvatnoj FNA sa i bez ROSE; cost-effectiveness zavisi od bazne adekvatnosti i cene ROSE (22–23).

  – Pragovi u praksi: rutinska ROSE teži da nije isplativa ako je bazna adekvatnost bez ROSE ≥ 85% i/ili su troškovi ROSE visoki; postaje isplativa pri nižoj baznoj adekvatnosti ili nižem trošku ROSE (23).

**4) Iskustvo pacijenta**

- Zadovoljstvo (Likert/NPS) nakon posete OSK (7–8).
- Promena anksioznosti (STAI-6) pre/posle posete u modelima sa isti-dan dijagnostikom (19).

Implementaciona napomena: KPI automatizovati iz HIS/RIS/LIS (time-stampovi, šifre procedura, citologija); mesečni ”run-chart“ pregledi i kvartalni MDT audit (20–21).

## *ISHODI ”ONE-STOP“ KLINIKA IZ LITERATURE*

Sažetak nalaza. U ”one-stop“/visokorezolutivnim endokrinološkim ambulantama za nodularnu bolest štitaste žlezde dosledno se beleži manje poseta i kraće vreme do odluke, uz dobru dijagnostičku adekvatnost, visoko zadovoljstvo pacijenata i racionalizaciju troškova. Efekti su najizraženiji kada su UZ-stratifikacija rizika (ACR/EU-TIRADS) i standardizovana FNA (po potrebi sa ROSE/telecitologijom) ukomponovani u isti dolazak (6–9, 19, 22–23, 25–27, 32).

**1) Vreme i efikasnost toka**

Uvođenje ”one-stop“ modela (UZ + isti-dan US-FNA u endokrinološkoj/hirurškoj ambulanti) smanjuje broj dolazaka i medijanu vremena do plana lečenja (npr. 42→14 dana) (6). U nacionalnim iskustvima „visokorezolutivnih“ klinika drugi kontrolni pregled je u 21–42% slučajeva postao nepotreban, a zahtevi upućeni radiologiji za tiroidealni UZ značajno su opali, uz merljive uštede (7–8). Analize kliničkih puteva dodatno ukazuju da je „usko grlo“ često upravo zakazivanje UZ u radiologiji, koje OSK model premošćava integracijom UZ u prvu posetu (25).

**2) Dijagnostički kvalitet (adekvatnost i ponovljene FNA)**

Sistematske i institucionalne analize pokazuju da ROSE smanjuje udeo Bethesda I i optimizuje broj prolaza, iako se efekat razlikuje po kontekstu (9, 22, 26–27). U velikoj seriji ROSE je skratio vreme procedure i broj uboda (27), dok metaanalize potvrđuju poboljšanje adekvatnosti (9, 22). Uvođenje telecitologije može smanjiti neadekvatnost na ~2–4% i tako približiti učinak ”on-site“ citopatologa u centrima bez njegove stalne fizičke dostupnosti (32).

**3) Iskustvo pacijenata**

Modeli sa isti-dan FNAC dijagnozom dovode do brzog pada anksioznosti (STAI) i zadržavaju visoku dijagnostičku tačnost (19). U anketama, zadovoljstvo korisnika u visokorezolutivnim ambulantama je visoko (prosečno ~4/5) (8).

**4) Ekonomika**

Osim direktnih ušteda zbog manjeg broja pregleda i eksternih UZ (7–8), cost-effectiveness analiza za ROSE pokazuje da je isplativost kontekst-zavisna: ROSE je verovatnije isplativ tamo gde je bazna neadekvatnost viša i/ili su troškovi ROSE niži (23, 28). U suprotnom, selektivna primena (npr. za „teške“ nodule ili tokom obuke) može biti racionalnija (22–23, 26–28).

**5) Bezbednost**

US-vođena FNA je bezbedna procedura sa vrlo niskim stopama ozbiljnih neželjenih događaja (29–30). U velikoj kohorti CNB (kao dopunske metode) ukupne komplikacije su ~0,8%, a ozbiljne ~0,06% (31). U OSK okruženju, standardizovani protokoli informisanog pristanka i post-proceduralno praćenje doprinose bezbednosti (5, 29–31).

Zaključak: OSK za štitastu žlezdu, kada su protokoli usklađeni sa ACR/EU-TI-RADS i Bethesda, uz selektivnu upotrebu ROSE/telecitologije, donosi bržu, vrednosno orijentisanu dijagnostiku uz visoko zadovoljstvo i kontrolisane troškove, bez narušavanja bezbednosti (6–9, 19, 22–23, 25–32).

## *DISKUSIJA*

Tumačenje ključnih nalaza. U skladu sa nalazima iz više zdravstvenih sistema, model ”one-stop“ (OSK) za nodularnu bolest štitaste žlezde donosi kraće vreme do odluke, manje poseta i racionalizovane troškove, bez kompromisa u bezbednosti (6–8, 10, 22–23, 29–31). Efekti su najizraženiji kada su ACR/EU-TIRADS i Bethesda dosledno primenjeni, a ROSE/telecitologija korišćeni selektivno za kontekste sa većim rizikom neadekvatnosti uzorka (2–4, 9, 18, 22–23, 32). Ovakva organizacija je u skladu sa principima vrednosti u zdravstvu i Triple Aim paradigme (20–21).

Implikacije za kliničku praksu. Za ustanove sa ograničenim kapacitetima radiologije i citopatologije OSK „premošćava“ uska grla integracijom UZ i (po potrebi) FNA u istu posetu; to smanjuje odlaganja i nepotrebne transferne korake (6–8, 25). ROSE dokazano povećava adekvatnost i smanjuje ponovljene punkcije, ali rutinska primena nije univerzalno najracionalnija; ekonomski modeli pokazuju zavisnost isplativosti od bazne stope neadekvatnosti i cene ROSE, što govori u prilog ciljanoj (selektivnoj) primeni – npr. kod operatera u obuci, cističnih/tehnički zahtevnih nodusa ili kada je bazna neadekvatnost visoka (9, 22–23). Telecitologija je održiva alternativa tamo gde on-site citopatolog nije dostupan, uz snižavanje neadekvatnosti ka vrednostima 2–4% (18, 32).

Organizacioni zahtevi. OSK traži jasan protokol ulogâ (endokrinolog–radiolog–citopatolog), standardizovane UZ izveštaje (TI-RADS), rutinsko evidentiranje vremenskih oznaka (time-stamp) i ugrađene liste za Bethesda klasifikaciju (2–4). Za „isti-dan“ tok potrebna je tehnička priprema (setovi igala, bojenja za brzu procenu) i logistički slotovi za ROSE/telecitologiju (9, 18, 22–23, 32). Bezbednosni profil FNA ostaje povoljan uz standardizovan pristanak i postproceduralni nadzor (29–31).

Praćenje performansi i upravljanje na osnovu podataka. Predloženi KPI okvir treba vezati za vrednost za pacijenta (20) i Triple Aim (21): lead-time do odluke, udeo kompletiranih epizoda u jednoj poseti, Bethesda I (%), udeo FNA sa ROSE, stope ponovne FNA, trošak po epizodi i zadovoljstvo. Operativno, promene je najjednostavnije nadzirati mesečnim run-chart prikazima, sa pragovima za brzu reakciju tima (35). Kod pada performansi (npr. porast Bethesda I) prvi korak je ”oot-cause“ analiza: tehnika uzorkovanja, broj prolaza, raspoloživost ROSE/telecitologije, obuka osoblja (9, 22–23, 35).

Ograničenja dokaza. Većina dostupnih studija su opservacione (pre-post, serije slučajeva) i heterogene su po definicijama ishoda, što ograničava metaanalitičko sintezovanje i nameće rizike pristrasnosti (15, 17). Studije dijagnostičke tačnosti ne primenjuju uvek STARD elemente, a ekonomske evaluacije variraju po perspektivi i obuhvatu troškova (16, 22–23). Potrebne su multicentrične, prospektivne evaluacije sa harmonizovanim definicijama KPI i transparentnim ekonomskim modelima.

Preporuke za implementaciju u našim uslovima.

1. Fazno uvođenje OSK sa jasno definisanim protokolom UZ/FNA, evidencijom ”time-stamp“ i standardizovanim TI-RADS/Bethesda izveštavanjem (2–4).
2. Selektivna ROSE (ili telecitologija) usmerena na „teške“ nodule i/ili programe obuke; periodična reevaluacija isplativosti (9, 18, 22–23, 32).
3. KPI paket: lead-time, Bethesda I, ponovna FNA ≤90 dana, udeo „jedna poseta“, trošak po epizodi, zadovoljstvo; run-charts sa kvartalnim MDT auditom (20–21, 35).
4. Okviri implementacije: planiranje i evaluaciju strukturirati kroz CFIR domene (intervencija, unutrašnji/spoljašnji kontekst, pojedinci, proces) i RE-AIM (doseg, efikasnost, usvajanje, implementacija, održivost) radi translacije i skaliranja (33–34).

Istraživačke praznine. Nedostaju standardizovani pragovi za „ciljanje“ ROSE u OSK, robustne procene uticaja OSK na „benigne“ operacije i dugoročne ishode, kao i komparativne studije različitih modela telecitologije (9, 18, 22–23, 32).

## *ZAKLJUČAK*

U sopstvenoj oceni, model ”one-stop“ klinike (OSK) za nodularnu bolest štitaste žlezde predstavlja najracionalniji način da se dijagnostički tok učini bržim, preglednijim i predvidljivijim za pacijenta i tim. Integracija kliničkog pregleda, standardizovanog ultrazvuka i, po potrebi, UZ-vođene FNA sa brzim očitavanjem adekvatnosti (ROSE/telecitologija) u jednoj poseti prirodno eliminiše nepotrebne korake i smanjuje varijabilnost procesa.

Smatramo da je ključ uspeha OSK dosledna primena TI-RADS/Bethesda protokola, zajedničko donošenje odluka u okviru kompaktne, ko-lokirane (ili virtuelno uvezane) endokrinološko-radiološko-citopatološke jedinice i aktivno upravljanje vremenom kroz obavezne ”time-stampove“. Takva organizacija omogućava timu da svakodnevno vidi gde nastaju uska grla i da pravovremeno interveniše.

ROSE i/ili telecitologiju preporučujemo selektivno: kod tehnički zahtevnih nodusa, operatera u obuci i u okruženjima sa višom baznom stopom neadekvatnosti. Time se balansira dodatni angažman resursa sa dobitkom u adekvatnosti i smanjenju ponovnih punkcija.

Predlažemo pragmatičan KPI paket za rutinsko praćenje učinka OSK: (1) lead-time od uputa do inicijalnog plana, (2) udeo epizoda završenih u jednoj poseti, (3) Bethesda I (%), (4) udeo FNA sa ROSE, (5) ponovna FNA u ≤ 90 dana, (6) trošak po epizodi i (7) zadovoljstvo pacijenata. Kao polazne ciljne vrednosti za prvi godišnji ciklus sugerišemo: lead-time ≤ 14 dana, ≥ 70% epizoda završenih u jednoj poseti, Bethesda I ≤ 10%, ponovna FNA ≤ 10%, i prosečna ocena zadovoljstva ≥ 4/5; nakon stabilizacije procesa ciljeve treba postrožavati.

Za ustanove sa ograničenim resursima zagovaramo fazni pristup: OSK-Lite (UZ + FNA u jednoj poseti, bez rutinske ROSE) kao pilot, potom ciljano uvođenje ROSE/telecitologije i širenje na pun OSK model uz kvartalne revizije protokola i KPI.

Istraživački prioriteti, po našem mišljenju, obuhvataju razvoj standardizovanih definicija KPI za OSK, evaluaciju uticaja OSK na „benigne“ operacije i dugoročne ishode, te robustne ekonomske modele koji uključuju perspektivu pacijenata i platiša. Verujemo da su ovi koraci dovoljni da OSK postane održiv standard prakse u kliničkim sredinama sličnim našoj.

## *Literatura*

1. Haugen BR, Alexander EK, Bible KC, et al. 2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid. 2016; 26(1): 1–133. doi:10.1089/thy.2015.0020
2. Tessler FN, Middleton WD, Grant EG, et al. ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee. J Am Coll Radiol. 2017; 14(5): 587–595. doi:10.1016/j.jacr.2017.01.046

3. Russ G, Bonnema SJ, Erdogan MF, Durante C, Ngu R, Leenhardt L. EU-TIRADS. Eur Thyroid J. 2017; 6(5): 225–237. doi:10.1159/000478927
4. Cibas ES, Ali SZ. The 2017 Bethesda System for Reporting Thyroid Cytopathology. Thyroid. 2017; 27(11): 1341–1346. doi:10.1089/thy.2017.0500
5. Durante C, Grani G, Lamartina L, Filetti S, Mandel SJ, Cooper DS. The Diagnosis and Management of Thyroid Nodules: A Review. JAMA. 2018; 319(9): 914–924. doi:10.1001/jama.2018.0898
6. Patel R, Skandarajah A, Gorelik A, et al. One-stop thyroid nodule clinic with same-day fine-needle aspiration cytology improves efficiency of care. ANZ J Surg. 2018; 88(4): 354–358. doi:10.1111/ans.13833
7. Carral F, Ayala MC, Jiménez AI, García C. Care and economic impact of thyroid ultrasound examination at single visits to endocrinology clinics (ETIEN 1). Endocrinol Nutr. 2016; 63(2): 64–69. doi:10.1016/j.endonu.2015.10.008
8. Díaz-Soto G, Torres B, López Gómez JJ, et al. Economic impact of and satisfaction with a high-resolution thyroid nodule clinic. Endocrinol Nutr. 2016; 63(8): 414–420. doi:10.1016/j.endonu.2016.04.005
9. Witt BL, Schmidt RL. Rapid onsite evaluation improves the adequacy of fine-needle aspiration for thyroid lesions: meta-analysis. Thyroid. 2013; 23(4): 428–435. doi:10.1089/thy.2012.0211
10. Krishna A, Mishra SK, Mishra A, et al. One-stop thyroid clinic in a low- and middle-income country. S Afr J Surg. 2022; 60(3): 189–194. doi:10.17159/2078-5151/SAJS3633
11. Tricco AC, Lillie E, Zarin W, et al. PRISMA-ScR. Ann Intern Med. 2018; 169(7): 467–473. doi:10.7326/M18-0850
12. Peters MDJ, Marnie C, Tricco AC, et al. JBI guidance for scoping reviews. JBI Evid Synth. 2020; 18(10): 2119–2126. doi:10.11124/JBIES-20-00167
13. Page MJ, McKenzie JE, Bossuyt PM, et al. PRISMA 2020 statement. BMJ. 2021; 372: n71. doi:10.1136/bmj.n71
14. Rethlefsen ML, Kirtley S, Waffenschmidt S, et al. PRISMA-S. Syst Rev. 2021; 10(1): 39. doi:10.1186/s13643-020-01542-z
15. Sterne JAC, Hernán MA, Reeves BC, et al. ROBINS-I. BMJ. 2016; 355: i4919. doi:10.1136/bmj.i4919
16. Bossuyt PM, Reitsma JB, Bruns DE, et al. STARD 2015. BMJ. 2015; 351: h5527. doi:10.1136/bmj.h5527
17. von Elm E, Altman DG, Egger M, et al. STROBE. PLoS Med. 2007; 4(10): e296. doi:10.1371/journal.pmed.0040296
18. Post R, Chai SM, Wang L, et al. Telecytology ROSE with real-time streaming: comparative study. Diagn Cytopathol. 2023; 51(11): E383–E391. doi:10.1002/dc.25228
19. Lodewijk L, Vriens MR, Vorselaars WMC, et al. Same-Day FNAC reduces anxiety and maintains accuracy. Endocr Pract. 2016; 22(5): 561–566. doi:10.4158/EP151036.OR
20. Porter ME. What is value in health care? N Engl J Med. 2010; 363(26): 2477–2481. doi:10.1056/NEJMp1011024
21. Berwick DM, Nolan TW, Whittington J. The Triple Aim: care, health, and cost. Health Aff (Millwood). 2008; 27(3): 759–769. doi:10.1377/hlthaff.27.3.759

22. Pastorello RG, de Almeida DC, de Morais RM, et al. Impact of ROSE on thyroid FNAB: meta-analysis. Cancer Cytopathol. 2018; 126(12): 995–1006. doi:10.1002/cncy.22051
23. Zanocco K, Pitelka-Zengou L, Dalal S, et al. Cost-effectiveness of on-site adequacy for initial US-guided FNA. Ann Surg Oncol. 2013; 20(8): 2462–2467. doi:10.1245/s10434-013-2954-1
24. O'Malley ME, Weir MM, Hahn PF, et al. US-guided FNA: adequacy & time with/without immediate cytology. Radiology. 2002; 222(2): 383–387. doi:10.1148/radiol.2222010201
25. Sifontes-Dubón M, García-López JM, González-Ortega N, Pazos-Couselo M. Clinical pathway timings & delays in thyroid cancer. J Clin Med. 2021; 10(23): 5681. doi:10.3390/jcm10235681
26. Michael CW, Kameyama K, Kitagawa W, Azar N. ROSE: benefits, challenges, solutions. Gland Surg. 2020; 9(5): 1708–1715. doi:10.21037/gs-2019-catp-23
27. Jiang D, Zang Y, Jiang D, Zhang X, Zhao C. Value of ROSE for US-guided thyroid FNA. J Int Med Res. 2019; 47(2): 626–634. doi:10.1177/0300060518807060
28. Pearson LN, Layfield LJ, Eapen GA, Michael CW. Cost-effectiveness of ROSE by non-pathologists. Cancer Cytopathol. 2018; 126(10): 839–845. doi:10.1002/cncy.22047
29. Park JY, Choi W, Hong AR, et al. Harms of thyroid FNA: systematic review. Endocrinol Metab (Seoul). 2023; 38(1): 104–116. doi:10.3803/EnM.2023.1669
30. Lee YH, Baek JH, Jung SL, et al. US-guided FNA: basics and practical points. Korean J Radiol. 2015; 16(2): 391–401. doi:10.3348/kjr.2015.16.2.391
31. Ha EJ, Baek JH, Lee JH, et al. Complications after US-guided core-needle biopsy (n=6,169). Eur Radiol. 2017; 27(3): 1186–1194. doi:10.1007/s00330-016-4461-9
32. Lin DM, Tracht J, Rosenblum F, et al. Telecytology ROSE reduced unsatisfactory rates. Am J Clin Pathol. 2020; 153(3): 342–345. doi:10.1093/ajcp/aqz164
33. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. CFIR framework. Implement Sci. 2009; 4: 50. doi:10.1186/1748-5908-4-50
34. Glasgow RE, Vogt TM, Boles SM. RE-AIM framework. Am J Prev Med. 1999; 16(1): 50–57. doi:10.1016/S0749-3797(99)00158-0
35. Perla RJ, Provost LP, Murray SK. The run chart: learning from variation. BMJ Qual Saf. 2011; 20(1): 46–51. doi:10.1136/bmjqs.2010.044843

Marko Kimi Milić[1], Šćepan Sinanović[1], Dejan Kostić[2,3], Milena Ratković[4]

# ORGANIZATIONAL MODELS OF ”ONE-STOP” CLINICS FOR THYROID DISEASE: A REVIEW OF PROCESSES, PERFORMANCE INDICATORS, AND OUTCOMES FROM THE LITERATURE

**Abstract:** Background: Fragmented care pathways for thyroid nodular disease prolong time to decision and increase costs. “One-stop” clinics (OSCs) integrate clinical evaluation, ultrasound, ultrasound-guided fine-needle aspiration (FNA) and, when appropriate, rapid on-site evaluation (ROSE)/telecytology in a single visit.

Objective: To map organizational models of OSCs, define key performance indicators (KPIs), and summarize outcomes (time, visits, adequacy, repeat FNA, costs, patient satisfaction, safety).

Methods: Scoping review following PRISMA-ScR and JBI guidance. MEDLINE, Scopus, and Web of Science were searched (2000–August 2025). We included studies that operationalized OSCs and/or reported KPIs/outcomes. Data extraction covered organizational features, protocols (ACR/EU-TIRADS, Bethesda), flow metrics, FNA/ROSE adequacy, economics, satisfaction, and safety. Narrative synthesis was performed.

Results: Identified OSC models consistently shorten lead time to decision and reduce the number of visits. Sample adequacy is high–especially with ROSE/telecytology–thereby lowering repeat FNA rates. Patient satisfaction is high; the safety profile of FNA remains favourable. Economic analyses indicate that the cost-effectiveness of ROSE is context-dependent and greatest when baseline inadequacy is higher and/or ROSE costs are lower. A KPI set is proposed: lead time, proportion of “single-visit”

[1] Marko Kimi Milić, High Medical College of Professional Studies “Milutin Milanković”, Belgrade, Serbia, e-mail: drmarkokimimilic@gmail.com

[2] Univerity of Defence in Belgrade, Medical Faculty of the Military Medical Academy, Belgrade, Serbia

[3] Military Medical Academy in Belgrade, Institute of Radiology, Belgrade, Serbia

[4] Military Medical Academy, Belgrade, Serbia

completions, Bethesda I rate, ROSE utilization, repeat FNA ≤ 90 days, cost per episode, and satisfaction.

Conclusion: OSCs are an applicable, value-oriented model for thyroid diagnostics. Selective use of ROSE/telecytology and KPI-driven management enable efficient and safe implementation across diverse resource settings.

**Keywords:** one-stop clinic; thyroid; ultrasound; fine-needle aspiration; ROSE; TIRADS; Bethesda; performance indicators; health management.

## *INTRODUCTION*

Thyroid nodular disease is among the most common reasons for referral to endocrinology and radiology clinics, spanning a wide spectrum of clinical scenarios–from incidentally detected nodules on ultrasound to suspected differentiated carcinoma. Over the past two decades, diagnostic standardization and decision-making based on the American Thyroid Association (ATA) guidelines have established a firm foundation for the rational use of ultrasound (US), fine-needle aspiration cytology (FNA), and individualized risk assessment (1). At the same time, the development of ultrasound-based risk stratification systems–particularly ACR TI-RADS and EU-TI-RADS–has brought greater consistency to estimating the probability of malignancy and determining indications for FNA, thereby improving alignment between endocrinologists and radiologists (2–3). Standardization of cytology reporting through The Bethesda System (2017 version) has further reduced "grey zones" and enabled clearer clinical decisions (4).

Despite these advances, clinical pathways often remain fragmented: patients make multiple visits (clinical examination, US in radiology, then FNA and a later return for results), which prolongs time to a definitive decision and increases system burden and costs for both patient and institution. Summary reviews indicate that optimized algorithms–which link US-based risk stratification, selective FNA, and early multidisciplinary discussion–shorten the diagnostic–therapeutic pathway and reduce inappropriate interventions (5). On this basis, the "one-stop" clinic (OSC) model emerged: an organization in which clinical examination, US, the indication for and performance of US-guided FNA (with rapid on-site cytologic evaluation, ROSE, when needed), and the initial treatment decision are completed in a single visit (5–8).

The OSC approach integrates key resources in one time slot and setting–an endocrinologist, a radiologist/sonographer, a cytopathologist, and, when necessary, a surgeon–relying on standardized tools (ACR/EU-TIRADS, Bethesda) and clear protocols. Data from practice across different health systems show that OSCs shorten the time from referral to treatment plan, reduce the number of visits and inter-special-

ty transfers, improve patient satisfaction, and can generate economic savings (6–8). Particularly informative are models of so-called "high-resolution" endocrinology clinics in which US and FNA are performed during the same visit, with demonstrated reductions in additional referral procedures and costs (7–8).

The critical "technical levers" of quality in OSCs are FNA adequacy and timely interpretation. Implementing ROSE–whereby a cytopathologist or trained professional confirms specimen adequacy during the same session–consistently increases the adequacy rate and reduces the need for repeat aspirations, thereby further shortening the pathway and conserving resources (9). This focus on sample quality, combined with consistent application of TI-RADS criteria and Bethesda categorization, enables rapid and reliable triage among surveillance, additional diagnostics, or surgery (2–4, 9).

Importantly, OSC feasibility has been confirmed in resource-limited settings while maintaining safety and outcomes–suggesting good transferability of the model beyond highly specialized centers (10). This is particularly relevant for health systems in transition and regions with uneven distribution of radiologic and cytopathologic capacity, where integrating services into a single appointment can significantly alleviate bottlenecks.

Building on this, the present paper has three aims: (i) to descriptively map organizational models and key processes of OSCs for thyroid nodular disease; (ii) to propose a set of key performance indicators (KPIs) to monitor quality, efficiency, and patient value; and (iii) to synthesize available outcomes (time to diagnosis/decision, FNA adequacy, number of visits, costs, satisfaction, and safety) from the literature, with practical guidance for implementation in our setting (1–10).

## *METHODOLOGY*

Review design. A scoping review was conducted in accordance with PRISMA-ScR guidelines and current JBI methodological guidance (11–12). The PRISMA 2020 framework was used for transparent presentation of the study selection flow (diagram) and reporting, adapted to the scoping format (13). The search strategy and search reporting followed PRISMA-S recommendations (14).

Question framework (PCC).

– Population: adults with thyroid nodular disease or referred for thyroid diagnostics.

– Concept: models of "one-stop" clinics (OSCs), "high-resolution" endocrinology clinics, same-day US+FNA/ROSE organization, integrated diagnostics and triage.

– Context: outpatient and inpatient endocrinology–radiology services, all levels of health systems, without geographic restriction.

Inclusion/exclusion criteria. We included primary studies and reports (prospective/retrospective cohorts, pre–post evaluations, case series ≥30 patients, quality-im-

provement programs, economic evaluations) that describe the organization of OSC processes and/or report outcomes/KPIs (time to diagnosis/decision, number of visits, FNA adequacy, repeat aspirations, ROSE utilization, costs, satisfaction, safety events). We excluded isolated case reports, commentaries, review articles without original data, studies without a clear OSC concept, and papers lacking relevant outcomes.

Information sources and search strategy. MEDLINE/PubMed, Scopus, and Web of Science were searched from 2000 to 14 August 2025. No language restrictions were applied; in practice, English, Spanish, Portuguese, French, German, and Serbo-Croatian were covered. We used combinations of keywords and controlled vocabulary (database-specific):

("one-stop" OR "same-day" OR "high-resolution clinic" OR "rapid access clinic") AND (thyroid OR "thyroid nodule") AND (ultrasound OR FNA OR "fine-needle aspiration" OR ROSE OR cytology) AND (clinic* OR pathway OR workflow OR organization OR efficiency OR cost).*

Reference and citation snowballing was additionally performed in relevant papers (11–14).

Study selection. Titles/abstracts were screened in duplicate, with disagreements resolved by consensus. Potentially relevant records were retrieved in full text; inclusion was decided against pre-specified criteria. The selection flow will be presented in a PRISMA 2020 diagram (13).

Data extraction. A standardized template (piloted on 5 studies) captured: OSC model characteristics (disciplines involved; availability of US, FNA, ROSE; same-visit logistics), protocols (TI-RADS, Bethesda), flow metrics (lead time to decision; number of visits), diagnostic performance (FNA adequacy, repeat aspirations), economic indicators (direct costs, savings), patient satisfaction, and safety (complications). Data were matched/deduplicated by author, year, institution, and period.

Assessment of methodological characteristics (optional). Although formal quality appraisal is not required in scoping reviews (11–12), we planned descriptive mapping of potential sources of bias; for non-randomized comparative studies we referenced ROBINS-I domains (15). For diagnostic accuracy studies (e.g., US/TI-RADS vs. cytology/histology) we noted STARD 2015 elements (16); for observational studies, STROBE elements (17).

Synthesis and presentation. Results will be presented narratively by domain: (i) organizational models and workflows; (ii) KPI set; (iii) outcomes (time, visits, FNA/ROSE adequacy, costs, satisfaction, safety); (iv) contextual factors (facility type, resources). Where methodologically appropriate and homogeneous metrics are available, descriptive statistics will be summarized (e.g., median/IQR for time to decision) without formal meta-analysis (11–12).

Ethics. Previously published and aggregated data without identifiers were used; therefore, ethics approval was not required (11–12).

## *PROCESS MODELS OF "ONE-STOP" CLINICS (ORGANIZATION AND WORKFLOW)*

Definition and aim. A one-stop clinic (OSC) for thyroid nodular disease organizes the clinical examination, ultrasound (US), US-guided FNA when indicated (with ROSE if needed), and the initial treatment decision within a single visit, relying on standardized tools (ACR/EU-TIRADS; Bethesda) and clearly defined protocols (2–4, 6–8, 10).

### A) Standard workflow (example operating protocol)

1) Pre-arrival (e-intake and triage)
   - Electronic intake form with reasons for referral and prior results (TSH/FT4/anti-TPO, prior US/FNA).
   - Preliminary US-based risk stratification (if a prior report exists) and scheduling of the OSC slot with expected duration (2–3).
2) Check-in and clinical assessment
   - Endocrine history and examination; verification of indication for US and potential FNA according to ACR/EU-TIRADS thresholds (2–3).
   - Mandatory time-stamps (check-in, start of US, FNA decision) to track lead-time metrics.
3) US and FNA decision-making
   - Standardized US protocol (size, composition, echogenicity, margins, calcifications, shape; TI-RADS score) (2–3).
   - FNA decision based on TI-RADS category and size; informed consent and shared decision-making (1–3, 5).
4) US-guided FNA (ROSE as needed)
   - 25–27G needle; 2–4 passes, direct smears + cell block.
   - ROSE (rapid on-site evaluation) to verify adequacy; especially useful where baseline inadequacy is higher or operators are in training (9).
   - Alternative/combination: telecytology to provide remote ROSE support (e.g., real-time video) when a cytopathologist is not physically present (18).
5) Preliminary integration of findings and plan
   - Brief huddle among endocrinologist–radiologist–cytopathologist: provisional Bethesda classification (if rapid assessment available) and documented decision: surveillance / additional diagnostics (repeat FNA, molecular testing) / surgical evaluation (4–5, 9).
   - Documented individualized plan and patient education; appointment to deliver final cytology and MDT as needed.

6) Same-day–patient perspective
   – OSC models consistently show fewer visits and shorter time to decision, with high satisfaction; "high-resolution" endocrinology clinics additionally demonstrate economic benefits (6–8).
   – In same-day FNAC diagnosis models, a faster decrease in anxiety measured by the STAI scale has been reported (19).

OSC management should be aligned with the concept of "value" and the "Triple Aim" framework (outcomes, experience, cost), because KPIs must reflect what is clinically and organizationally most important (20–21).

**B) Implementation variants (resource-dependent)**

- OSC-Lite: US + FNA in a single visit, without formal ROSE; focus on shortening time-to-decision, with targeted repeat FNA the next day if the initial result is Bethesda I (4,6).
- OSC with ROSE (on-site or telecytology): maximal reduction of Bethesda I proportion and repeat aspirations (9, 18).
- OSC with same-day preliminary cytology: where logistics allow rapid staining and evaluation; preliminary report + final verification (4, 9, 18).

**C) In-process quality control**

- Standardization of US reports (ACR/EU-TIRADS) and consistent application of FNA indications (2–3).
- FNA adequacy: aim for a low Bethesda I proportion; ROSE has been shown to increase adequacy and reduce repeat aspirations (9, 22–23).
- Procedure time and logistics: ROSE can reduce deferred rescheduling but may sometimes prolong the individual procedure; balance via scheduling and resources (9, 23–24).
- Safety: track post-FNA adverse events (bleeding, vasovagal reactions) and "rescue" slots (5).
- MDT case review for borderline/indeterminate cases to reduce unnecessary interventions (1, 4–5).

**PROPOSED KPI SET FOR OSCs**

Framework and principles. Group KPIs into operational, clinical, economic, and experience indicators, aligned with a value-based approach and the Triple Aim paradigm (20–21). Set thresholds according to local baseline performance and priorities.

**1) Operational KPIs (flow efficiency)**

- Lead time from referral to initial plan (days); report median and IQR (6–8, 10).
- Proportion of patients completed in a single visit (%) (US ± FNA ± plan) (6–8).
- Proportion of FNAs performed the same day after US (%) (6–7).
- Proportion of FNAs with ROSE (%) and procedure time (min); benefit vs. resource burden (9, 23–24).
- Repeat FNA rate within ≤90 days (%) (lower is better) (4, 9).

**2) Clinical KPIs (diagnostic quality/outcomes)**

- Bethesda I (nondiagnostic) (%): target ≤10% with an optimal process; reduction expected after introducing ROSE (4, 9, 22).
- Distribution of Bethesda II–VI (%) and conversion to a definitive diagnosis (4).
- Rate of "benign" surgeries (%) among operated cases (indicator of appropriate selection) (1, 5).
- Time to surgical decision / to procedure (days) for Bethesda V–VI (6–7).
- Post-FNA adverse event rate (%) (5).

**3) Economic KPIs (cost and utilization)**

- Cost per episode (visit + US ± FNA ± ROSE) and savings per avoided visit (6–8).
- Incremental cost per adequate FNA with vs. without ROSE; cost-effectiveness depends on baseline adequacy and the cost of ROSE (22–23).

  – Practical thresholds: routine ROSE tends not to be cost-effective if baseline adequacy without ROSE is ≥85% and/or ROSE costs are high; it becomes cost-effective with lower baseline adequacy and/or lower ROSE cost (23).

**4) Patient experience**

- Satisfaction (Likert/NPS) after the OSC visit (7–8).
- Change in anxiety (STAI-6) pre/post visit in same-day diagnostic models (19).

Implementation note: Automate KPI capture from HIS/RIS/LIS (time-stamps, procedure codes, cytology); use monthly run-chart reviews and quarterly MDT audits (20–21).

## *OUTCOMES OF "ONE-STOP" CLINICS FROM THE LITERATURE*

Summary of findings. In "one-stop"/high-resolution endocrinology clinics for thyroid nodular disease, studies consistently report fewer visits and shorter time to decision, together with good diagnostic adequacy, high patient satisfaction, and cost rationalization. Effects are most pronounced when US-based risk stratification (ACR/EU-TIRADS) and standardized FNA (with ROSE/telecytology where appropriate) are integrated into the same visit (6–9, 19, 22–23, 25–27, 32).

### 1) Time and flow efficiency

Implementing a "one-stop" model (US + same-day US-FNA in an endocrinology/surgical clinic) reduces the number of visits and shortens the median time to a treatment plan (e.g., 42→14 days) (6). In national experiences with high-resolution clinics, a second follow-up visit became unnecessary in 21–42% of cases, and radiology requests for thyroid US declined substantially, with measurable savings (7–8). Clinical pathway analyses further indicate that the key bottleneck is often scheduling US in radiology, which the OSC model overcomes by integrating US into the first visit (25).

### 2) Diagnostic quality (adequacy and repeat FNA)

Systematic and institutional analyses show that ROSE lowers the Bethesda I rate and optimizes the number of passes, although the effect varies by context (9, 22, 26–27). In a large series, ROSE shortened procedure time and reduced the number of needle passes (27), while meta-analyses confirm improved adequacy (9, 22). Introducing telecytology can reduce inadequacy to ~2–4%, approaching the performance of on-site cytopathology in centers without continuous on-site availability (32).

### 3) Patient experience

Models with same-day FNAC diagnosis lead to a rapid decrease in anxiety (STAI) while maintaining high diagnostic accuracy (19). Surveys show high user satisfaction in high-resolution clinics (mean ~4/5) (8).

### 4) Economics

Beyond direct savings from fewer appointments and fewer external US examinations (7–8), cost-effectiveness analyses for ROSE indicate that its value is context-dependent: ROSE is more likely to be cost-effective where baseline inadequacy is higher and/or ROSE costs are lower (23, 28). Otherwise, selective use (e.g., for "difficult" nodules or during training) may be more rational (22–23, 26–28).

**5) Safety**

US-guided FNA is a safe procedure with very low rates of serious adverse events (29–30). In a large cohort of core-needle biopsy (CNB) as an adjunct method, overall complications were ~0.8%, and serious events ~0.06% (31). In an OSC environment, standardized informed-consent protocols and post-procedural monitoring support safety (5, 29–31).

Conclusion: When protocols align with ACR/EU-TIRADS and Bethesda, and ROSE/telecytology is used selectively, OSCs for thyroid disease deliver faster, value-oriented diagnostics with high satisfaction and controlled costs, without compromising safety (6–9, 19, 22–23, 25–32).

***DISCUSSION***

Interpretation of key findings. In line with findings from multiple health systems, the "one-stop" (OSC) model for thyroid nodular disease yields shorter time to decision, fewer visits, and rationalized costs without compromising safety (6–8, 10, 22–23, 29–31). Effects are most pronounced when ACR/EU-TIRADS and Bethesda are applied consistently, and ROSE/telecytology is used selectively in contexts with a higher risk of inadequate samples (2–4, 9, 18, 22–23, 32). This organization aligns with the principles of value-based health care and the Triple Aim paradigm (20–21).

Implications for clinical practice. For institutions with limited radiology and cytopathology capacity, OSCs "bridge" bottlenecks by integrating US and (when needed) FNA into the same visit, thereby reducing delays and unnecessary handoffs (6–8, 25). ROSE has been shown to increase adequacy and reduce repeat aspirations, but routine use is not universally the most rational approach; economic models show that cost-effectiveness depends on baseline inadequacy rates and the cost of ROSE, arguing for targeted (selective) use–e.g., with operators in training, cystic/technically challenging nodules, or where baseline inadequacy is high (9, 22–23). Telecytology is a viable alternative where an on-site cytopathologist is not available, lowering inadequacy toward 2–4% (18, 32).

Organizational requirements. OSCs require a clear role protocol (endocrinologist–radiologist–cytopathologist), standardized US reports (TI-RADS), routine recording of time stamps, and embedded templates for Bethesda classification (2–4). For a same-day workflow, technical preparation (needle sets, rapid stains) and logistical slots for ROSE/telecytology are needed (9,18,22–23,32). The safety profile of FNA remains favorable with standardized consent and post-procedural monitoring (29–31).

Performance monitoring and data-driven management. The proposed KPI framework should be tied to patient value (20) and the Triple Aim (21): lead time to

decision, share of episodes completed in a single visit, Bethesda I (%), share of FNAs with ROSE, repeat FNA rates, cost per episode, and satisfaction. Operationally, the simplest way to track changes is via monthly run-chart displays, with thresholds for rapid team response (35). When performance declines (e.g., rising Bethesda I), the first step is a root-cause analysis: sampling technique, number of passes, availability of ROSE/telecytology, staff training (9, 22–23, 35).

Limitations of the evidence. Most available studies are observational (pre–post, case series) and heterogeneous in outcome definitions, which limits meta-analytic synthesis and introduces risks of bias (15,17). Diagnostic accuracy studies do not always implement STARD elements, and economic evaluations vary in perspective and cost components (16, 22–23). Multicenter, prospective evaluations with harmonized KPI definitions and transparent economic models are needed.

Recommendations for implementation in our setting.

1. Phased introduction of OSCs with a clearly defined US/FNA protocol, time-stamp capture, and standardized TI-RADS/Bethesda reporting (2–4).
2. Selective ROSE (or telecytology) focused on "difficult" nodules and/or training programs; periodic re-evaluation of cost-effectiveness (9, 18, 22–23, 32).
3. KPI package: lead time, Bethesda I, repeat FNA ≤90 days, single-visit completion rate, cost per episode, satisfaction; run-charts with quarterly MDT audit (20–21, 35).
4. Implementation frameworks: structure planning and evaluation using CFIR domains (intervention, inner/outer setting, individuals, process) and RE-AIM (reach, effectiveness, adoption, implementation, maintenance) for translation and scale-up (33–34).

Research gaps. We lack standardized thresholds for targeting ROSE within OSCs, robust estimates of OSC impact on "benign" surgeries and long-term outcomes, and comparative studies of different telecytology models (9, 18, 22–23, 32).

## *CONCLUSION*

In our view, the one-stop clinic (OSC) model for thyroid nodular disease is the most rational way to make the diagnostic pathway faster, clearer, and more predictable for both patients and the care team. Integrating the clinical examination, standardized ultrasound, and–where appropriate–US-guided FNA with rapid adequacy assessment (ROSE/telecytology) into a single visit naturally removes unnecessary steps and reduces process variability.

We consider the keys to OSC success to be the consistent application of TI-RADS/Bethesda protocols, shared decision-making within a compact, co-located (or virtually networked) endocrinology–radiology–cytopathology unit, and active time management using mandatory time stamps. Such an organization allows the team to see daily where bottlenecks arise and to intervene promptly.

We recommend ROSE and/or telecytology selectively: for technically demanding nodules, operators in training, and settings with a higher baseline rate of inadequacy. This balances the additional resource commitment against gains in adequacy and reductions in repeat aspirations.

We propose a pragmatic KPI package for routine monitoring of OSC performance: (1) lead time from referral to initial plan, (2) proportion of episodes completed in a single visit, (3) Bethesda I (%), (4) proportion of FNAs with ROSE, (5) repeat FNA within ≤ 90 days, (6) cost per episode, and (7) patient satisfaction. As starting targets for the first year, we suggest: lead time ≤ 14 days, ≥ 70% of episodes completed in a single visit, Bethesda I ≤ 10%, repeat FNA ≤ 10%, and an average satisfaction score ≥ 4/5; after the process stabilizes, targets should be tightened.

For resource-limited institutions, we advocate a phased approach: OSC-Lite (US + FNA in a single visit, without routine ROSE) as a pilot, followed by targeted introduction of ROSE/telecytology and expansion to a full OSC model, with quarterly reviews of protocols and KPIs.

In our opinion, research priorities include developing standardized KPI definitions for OSCs, evaluating the impact of OSCs on "benign" surgeries and long-term outcomes, and building robust economic models that incorporate the perspectives of patients and payers. We believe these steps are sufficient for OSCs to become a sustainable standard of practice in clinical settings similar to ours.

### *References*

1. Haugen BR, Alexander EK, Bible KC, et al. 2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid. 2016; 26(1): 1–133. doi:10.1089/thy.2015.0020
2. Tessler FN, Middleton WD, Grant EG, et al. ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee. J Am Coll Radiol. 2017; 14(5): 587–595. doi:10.1016/j.jacr.2017.01.046
3. Russ G, Bonnema SJ, Erdogan MF, Durante C, Ngu R, Leenhardt L. EU-TIRADS. Eur Thyroid J. 2017; 6(5): 225–237. doi:10.1159/000478927
4. Cibas ES, Ali SZ. The 2017 Bethesda System for Reporting Thyroid Cytopathology. Thyroid. 2017; 27(11): 1341–1346. doi:10.1089/thy.2017.0500
5. Durante C, Grani G, Lamartina L, Filetti S, Mandel SJ, Cooper DS. The Diagnosis and Management of Thyroid Nodules: A Review. JAMA. 2018; 319(9): 914–924. doi:10.1001/jama.2018.0898
6. Patel R, Skandarajah A, Gorelik A, et al. One-stop thyroid nodule clinic with same-day fine-needle aspiration cytology improves efficiency of care. ANZ J Surg. 2018; 88(4):354–358. doi:10.1111/ans.13833
7. Carral F, Ayala MC, Jiménez AI, García C. Care and economic impact of thyroid ultrasound examination at single visits to endocrinology clinics (ETIEN 1). Endocrinol Nutr. 2016; 63(2): 64–69. doi:10.1016/j.endonu.2015.10.008

8. Díaz-Soto G, Torres B, López Gómez JJ, et al. Economic impact of and satisfaction with a high-resolution thyroid nodule clinic. Endocrinol Nutr. 2016; 63(8): 414–420. doi:10.1016/j.endonu.2016.04.005
9. Witt BL, Schmidt RL. Rapid onsite evaluation improves the adequacy of fine-needle aspiration for thyroid lesions: meta-analysis. Thyroid. 2013; 23(4): 428–435. doi:10.1089/thy.2012.0211
10. Krishna A, Mishra SK, Mishra A, et al. One-stop thyroid clinic in a low- and middle-income country. S Afr J Surg. 2022; 60(3): 189–194. doi:10.17159/2078-5151/SAJS3633
11. Tricco AC, Lillie E, Zarin W, et al. PRISMA-ScR. Ann Intern Med. 2018; 169(7): 467–473. doi:10.7326/M18-0850
12. Peters MDJ, Marnie C, Tricco AC, et al. JBI guidance for scoping reviews. JBI Evid Synth. 2020; 18(10): 2119–2126. doi:10.11124/JBIES-20-00167
13. Page MJ, McKenzie JE, Bossuyt PM, et al. PRISMA 2020 statement. BMJ. 2021; 372: n71. doi:10.1136/bmj.n71
14. Rethlefsen ML, Kirtley S, Waffenschmidt S, et al. PRISMA-S. Syst Rev. 2021; 10(1): 39. doi:10.1186/s13643-020-01542-z
15. Sterne JAC, Hernán MA, Reeves BC, et al. ROBINS-I. BMJ. 2016; 355: i4919. doi:10.1136/bmj.i4919
16. Bossuyt PM, Reitsma JB, Bruns DE, et al. STARD 2015. BMJ. 2015; 351: h5527. doi:10.1136/bmj.h5527
17. von Elm E, Altman DG, Egger M, et al. STROBE. PLoS Med. 2007; 4(10): e296. doi:10.1371/journal.pmed.0040296
18. Post R, Chai SM, Wang L, et al. Telecytology ROSE with real-time streaming: comparative study. Diagn Cytopathol. 2023; 51(11): E383–E391. doi:10.1002/dc.25228
19. Lodewijk L, Vriens MR, Vorselaars WMC, et al. Same-Day FNAC reduces anxiety and maintains accuracy. Endocr Pract. 2016; 22(5): 561–566. doi:10.4158/EP151036.OR
20. Porter ME. What is value in health care? N Engl J Med. 2010; 363(26): 2477–2481. doi:10.1056/NEJMp1011024
21. Berwick DM, Nolan TW, Whittington J. The Triple Aim: care, health, and cost. Health Aff (Millwood). 2008; 27(3): 759–769. doi:10.1377/hlthaff.27.3.759
22. Pastorello RG, de Almeida DC, de Morais RM, et al. Impact of ROSE on thyroid FNAB: meta-analysis. Cancer Cytopathol. 2018; 126(12): 995–1006. doi:10.1002/cncy.22051
23. Zanocco K, Pitelka-Zengou L, Dalal S, et al. Cost-effectiveness of on-site adequacy for initial US-guided FNA. Ann Surg Oncol. 2013; 20(8): 2462–2467. doi:10.1245/s10434-013-2954-1
24. O'Malley ME, Weir MM, Hahn PF, et al. US-guided FNA: adequacy & time with/without immediate cytology. Radiology. 2002; 222(2): 383–387. doi:10.1148/radiol.2222010201
25. Sifontes-Dubón M, García-López JM, González-Ortega N, Pazos-Couselo M. Clinical pathway timings & delays in thyroid cancer. J Clin Med. 2021; 10(23): 5681. doi:10.3390/jcm10235681
26. Michael CW, Kameyama K, Kitagawa W, Azar N. ROSE: benefits, challenges, solutions. Gland Surg. 2020; 9(5): 1708–1715. doi:10.21037/gs-2019-catp-23

27. Jiang D, Zang Y, Jiang D, Zhang X, Zhao C. Value of ROSE for US-guided thyroid FNA. J Int Med Res. 2019; 47(2): 626–634. doi:10.1177/0300060518807060
28. Pearson LN, Layfield LJ, Eapen GA, Michael CW. Cost-effectiveness of ROSE by non-pathologists. Cancer Cytopathol. 2018; 126(10): 839–845. doi:10.1002/cncy.22047
29. Park JY, Choi W, Hong AR, et al. Harms of thyroid FNA: systematic review. Endocrinol Metab (Seoul). 2023; 38(1): 104–116. doi:10.3803/EnM.2023.1669
30. Lee YH, Baek JH, Jung SL, et al. US-guided FNA: basics and practical points. Korean J Radiol. 2015; 16(2): 391–401. doi:10.3348/kjr.2015.16.2.391
31. Ha EJ, Baek JH, Lee JH, et al. Complications after US-guided core-needle biopsy (n=6,169). Eur Radiol. 2017; 27(3): 1186–1194. doi:10.1007/s00330-016-4461-9
32. Lin DM, Tracht J, Rosenblum F, et al. Telecytology ROSE reduced unsatisfactory rates. Am J Clin Pathol. 2020; 153(3): 342–345. doi:10.1093/ajcp/aqz164
33. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. CFIR framework. Implement Sci. 2009; 4: 50. doi:10.1186/1748-5908-4-50
34. Glasgow RE, Vogt TM, Boles SM. RE-AIM framework. Am J Prev Med. 1999; 16(1): 50–57. doi:10.1016/S0749-3797(99)00158-0
35. Perla RJ, Provost LP, Murray SK. The run chart: learning from variation. BMJ Qual Saf. 2011; 20(1): 46–51. doi:10.1136/bmjqs.2010.044843