PRD: Modul Queue Management - Pengurusan Giliran

Kod PRD: KLINIK-Queue-PR2026-01-pengurusan-giliran **Modul:** Queue Management **Submodul:** Aliran Pesakit **Tarikh Dicipta:** 2026-01-13 **Versi:** 1.0 **Pemilik Produk:** Pengurusan Klinik **Stakeholder:** Semua Staf (Kerani, Jururawat, Doktor, Ahli Farmasi), Pesakit

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1. Ringkasan Eksekutif

1.1 Objektif

Sistem Queue Management bertujuan untuk mengoptimumkan aliran pesakit di Poliklinik Al-Huda dengan pengurusan nombor giliran digital, paparan menunggu yang informatif, voice announcement, estimated wait time, dan analytics untuk mengurangkan masa menunggu pesakit serta meningkatkan kecekapan operasi klinik.

1.2 Skop

- Multi-queue dengan kategori berbeza (Pendaftaran, Konsultasi per doktor, Farmasi, Makmal, Billing)
- Nombor giliran dengan prefix mengikut kategori (R-001, D1-001, F-001)
- Kiosk self-service untuk ambil nombor giliran
- Paparan digital di waiting area dengan voice announcement (TTS)
- Web dashboard untuk staf panggil nombor giliran
- Priority queue untuk OKU, warga emas, ibu mengandung, emergency, VIP
- Estimated wait time (EWT) calculation dan display
- Auto-transfer queue antara stesen (Konsultasi → Farmasi → Billing)
- SMS/WhatsApp notification bila hampir dipanggil
- Comprehensive analytics dan reporting
- Integration dengan modul Pendaftaran (auto-generate queue selepas daftar)
- Multi-counter/room support

1.3 Out of Scope

- Hardware procurement (kiosk, TV) - klinik sediakan
- Voice recognition untuk panggilan
- Mobile app untuk pesakit (Fasa 1 - fokus SMS/WhatsApp notification)
- Appointment-based queue dengan time slots (guna Modul Temujanji sedia ada)

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2. Pernyataan Masalah

2.1 Masalah Semasa

1. **Pesakit menunggu lama tanpa kepastian:** Tiada sistem giliran formal, pesakit tidak tahu berapa lama perlu menunggu
2. **Kekacauan di waiting area:** Pesakit tidak pasti bila giliran mereka, menyebabkan pertanyaan berulang kepada staf
3. **No-show tidak dikesan:** Pesakit yang tidak hadir semasa dipanggil tidak dikesan dengan sistematik
4. **Tiada data untuk penambahbaikan:** Tiada analytics tentang masa menunggu, peak hours, atau bottlenecks
5. **Staf terpaksa jerit panggil nama:** Kaedah lama yang tidak profesional dan inefficient
6. **Pesakit priority tidak diprioritikan:** Warga emas, OKU, ibu mengandung tidak diberi keutamaan

2.2 Impak

- Patient experience yang buruk (frustrasi, ketidakpuasan)
- Kehilangan pesakit kepada klinik lain
- Beban kerja staf meningkat (jawab pertanyaan berulang)
- Tiada data untuk optimize operasi
- Imej klinik tidak profesional

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3. User Stories

3.1 User Stories Utama

1. **Sebagai Pesakit**, **saya mahu** mengambil nombor giliran dengan mudah di kiosk self-service **supaya** saya tidak perlu beratur panjang untuk daftar **bila** saya sampai di klinik **saya sepatutnya** boleh pilih jenis perkhidmatan dan dapat slip nombor dengan estimated wait time

2. **Sebagai Pesakit**, **saya mahu** melihat nombor giliran semasa dan anggaran masa menunggu di paparan digital **supaya** saya tahu berapa lama perlu menunggu dan boleh plan masa saya **bila** saya menunggu di waiting area **saya sepatutnya** nampak nombor yang dipanggil, nombor saya, dan estimated wait time

3. **Sebagai Pesakit**, **saya mahu** dengar voice announcement bila nombor saya dipanggil **supaya** saya tidak terlepas giliran walaupun tidak perhatikan paparan **bila** giliran saya sampai **saya sepatutnya** dengar announcement "Nombor D1-015, sila ke Bilik Doktor 1"

4. **Sebagai Pesakit**, **saya mahu** menerima SMS/WhatsApp bila hampir giliran saya **supaya** saya boleh bersiap sedia walaupun sedang berehat di tempat lain **bila** tinggal 3 nombor lagi **saya sepatutnya** terima notification "Giliran anda hampir tiba, sila bersiap"

5. **Sebagai Kerani Front Desk**, **saya mahu** sistem auto-generate nombor giliran selepas pesakit selesai mendaftar **supaya** saya tidak perlu manually issue nombor **bila** pendaftaran selesai **saya sepatutnya** pesakit terus dapat nombor giliran yang sesuai (berdasarkan temujanji atau walk-in)

6. **Sebagai Kerani Front Desk**, **saya mahu** boleh issue nombor priority untuk pesakit khas (OKU, warga emas) **supaya** mereka tidak perlu menunggu lama **bila** pesakit senior atau OKU datang **saya sepatutnya** boleh assign priority queue dengan satu klik

7. **Sebagai Doktor/Jururawat**, **saya mahu** panggil nombor giliran dengan satu klik di dashboard **supaya** saya tidak perlu jerit atau keluar bilik **bila** saya siap untuk pesakit seterusnya **saya sepatutnya** klik "Panggil Seterusnya" dan sistem auto-announce dan update paparan

8. **Sebagai Doktor/Jururawat**, **saya mahu** recall nombor jika pesakit tidak datang **supaya** saya boleh panggil semula sebelum skip **bila** pesakit tidak respond **saya sepatutnya** boleh klik "Panggil Semula" sehingga 3 kali sebelum mark sebagai no-show

9. **Sebagai Ahli Farmasi**, **saya mahu** pesakit auto-transfer ke queue farmasi selepas selesai konsultasi **supaya** aliran pesakit lancar tanpa pesakit perlu ambil nombor baru **bila** doktor selesai dengan pesakit **saya sepatutnya** pesakit automatik masuk queue farmasi dengan priority maintained

10. **Sebagai Pengurus Klinik**, **saya mahu** melihat analytics masa menunggu dan peak hours **supaya** saya boleh optimize staff allocation dan reduce wait time **bila** saya review laporan mingguan **saya sepatutnya** nampak average wait time, peak hours, bottlenecks, dan staff performance

11. **Sebagai Staf**, **saya mahu** lihat senarai pesakit dalam queue saya dengan maklumat asas **supaya** saya boleh prepare untuk pesakit seterusnya **bila** saya buka dashboard **saya sepatutnya** nampak nama pesakit, umur, sebab lawatan untuk beberapa nombor seterusnya

12. **Sebagai Warga Emas/OKU**, **saya mahu** mendapat keutamaan dalam queue **supaya** saya tidak perlu menunggu lama seperti pesakit biasa **bila** saya daftar **saya sepatutnya** auto-assigned ke priority queue berdasarkan umur atau status OKU

3.2 Edge Cases

1. **Sebagai Staf**, **saya mahu** skip pesakit yang tidak hadir selepas 3 panggilan **supaya** queue tidak terhenti dan pesakit lain tidak menunggu lama **bila** pesakit tidak respond **saya sepatutnya** boleh mark sebagai no-show dan proceed ke nombor seterusnya

2. **Sebagai Staf**, **saya mahu** hold pesakit sementara (waiting for lab result) **supaya** saya boleh serve pesakit lain dahulu dan recall kemudian **bila** pesakit perlu tunggu lab result **saya sepatutnya** boleh hold dan recall kemudian tanpa hilang giliran

3. **Sebagai Staf**, **saya mahu** transfer pesakit ke queue lain (misalnya, ke doktor pakar lain) **supaya** pesakit tidak perlu ambil nombor baru **bila** perlu tukar doktor **saya sepatutnya** boleh transfer dengan maintain priority dalam queue baru

4. **Sebagai Pesakit**, **saya mahu** delay giliran saya jika saya belum ready **supaya** saya tidak terlepas giliran **bila** saya terima SMS "giliran hampir" tetapi masih di kantin **saya sepatutnya** boleh reply untuk delay 10 minit dan sistem adjust queue
5. **Sebagai Pengurus Klinik**, **saya mahu** sistem auto-notify jika queue terlalu panjang **supaya** saya boleh ambil tindakan (buka kaunter tambahan) **bila** wait time > 30 minit **saya sepatutnya** terima alert

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4. Keperluan Fungsian

4.1 Queue Configuration

FR-1: Sistem mesti support multiple queue types dengan konfigurasi berbeza:

Queue Type	Prefix	Counter/Room	Priority Support
Pendaftaran	R	Kaunter 1, 2, 3	Ya
Konsultasi Doktor 1	D1	Bilik Doktor 1	Ya
Konsultasi Doktor 2	D2	Bilik Doktor 2	Ya
Konsultasi Doktor 3	D3	Bilik Doktor 3	Ya
Farmasi	F	Kaunter Farmasi	Ya
Makmal	L	Bilik Makmal	Ya
Billing	B	Kaunter Billing	Ya

FR-2: Sistem mesti support queue configuration:

- Nama queue
- Prefix (2 characters max)
- Counter/Room assignments
- Operating hours
- Average service time (untuk EWT calculation)
- Max queue size (optional limit)
- Auto-transfer destination (contoh: D1 → F → B)

FR-3: Nombor giliran format: `[Prefix]-[3-digit sequential]`, reset setiap hari pada 00:00

4.2 Nombor Giliran Generation

FR-4: Sistem mesti support multiple channels untuk generate nombor giliran:

A) Kiosk Self-Service:

- Touchscreen interface (user-friendly, large buttons)
- Language selection (BM, English, Mandarin)
- Pilih jenis queue (Jumpa Doktor, Ambil Ubat, Bayar Bil)
- Untuk temujanji: Scan IC atau input IC untuk auto-detect appointment
- Print slip nombor dengan:
  - Nombor giliran (large font)
  - Nama queue
  - Estimated wait time
  - Tarikh dan masa issue
  - Barcode/QR code (untuk scan di counter)
  - Bilangan orang di hadapan

B) Kerani Issue:

- Generate nombor via web dashboard
- Auto-issue selepas pendaftaran selesai (integration dengan Modul Pendaftaran)
- Option untuk print slip atau no print

FR-5: Untuk pesakit dengan temujanji, sistem mesti auto-assign ke queue doktor yang betul berdasarkan appointment data

4.3 Priority Queue

FR-6: Sistem mesti support priority levels:

Priority	Label	Criteria	Visual Indicator
1	Emergency	Case emergency	Red badge
2	OKU	Orang Kurang Upaya	Blue badge
3	Warga Emas	Umur ≥ 60 tahun	Gold badge
4	Ibu Mengandung	Pregnant	Pink badge
5	VIP	VIP patient	Purple badge
6	Normal	Standard patient	No badge

FR-7: Priority auto-assignment:

- Warga emas (≥60 tahun): Auto-assign berdasarkan DOB dari patient record
- Temujanji: Slightly higher priority than walk-in
- Manual override oleh staf untuk OKU, ibu mengandung, emergency

FR-8: Priority queue logic:

- Priority patients dipanggil lebih awal
- Ratio configurable (contoh: setiap 3 normal, panggil 1 priority)
- Emergency bypasses semua queue

4.4 Queue Display (Paparan Digital)

FR-9: Sistem mesti provide display interface untuk TV/monitor di waiting area:

Display Components:

- Header: Nama klinik, tarikh, masa semasa
- Main display: Nombor yang sedang dipanggil (large font, per queue type)
- Counter/Room info: "Nombor D1-015, sila ke Bilik Doktor 1"
- Queue list: Nombor-nombor seterusnya dalam queue (5-10 nombor)
- Estimated wait time: "Anggaran masa menunggu: 15 minit"
- Announcements area: Notis atau promosi klinik

FR-10: Display features:

- Auto-refresh (real-time update)
- Fullscreen mode untuk TV
- Customizable layout dan colors (branding klinik)
- Multi-language support (BM, English, Mandarin)
- Visual alert bila nombor dipanggil (flash/highlight)

FR-11: Voice announcement (TTS - Text-to-Speech):

- Announce bila nombor dipanggil
- Format: "Nombor [Nombor Giliran], sila ke [Counter/Room]"
- Multi-language (BM, English, Mandarin configurable)

- Volume adjustable
- Option untuk repeat announcement

4.5 Staff Dashboard (Calling Interface)

FR-12: Web dashboard untuk staf dengan features:

Queue View:

- Senarai nombor dalam queue (current queue assigned to this counter/room)
- Patient info preview: Nama, IC (masked), umur, priority badge
- Waiting time per patient

Actions:

- **Call Next** - Panggil nombor seterusnya (auto-select based on priority logic)
- **Call Specific** - Panggil nombor tertentu (skip others)
- **Recall** - Panggil semula nombor yang sama (max 3 times)
- **Serving** - Mark sebagai sedang dilayan
- **Complete** - Mark sebagai selesai, trigger auto-transfer jika configured
- **No-Show** - Mark sebagai tidak hadir (selepas 3 recall)
- **Hold** - Tahan sementara (waiting for something)
- **Transfer** - Pindah ke queue lain
- **Cancel** - Batalkan nombor giliran

FR-13: Keyboard shortcuts untuk efficiency:

- `N` - Call Next
- `R` - Recall
- `C` - Complete
- `S` - No-Show

4.6 Queue Status & Lifecycle

FR-14: Queue ticket status flow:

```
[Generated/Waiting]
       ↓
  [Called] ←→ [Recall] (max 3x)
       ↓
  [Serving]
       ↓
  [Completed] → [Auto-Transfer to next queue] → [Waiting in new queue]
       or
  [No-Show] (selepas 3 recall tanpa response)
       or
  [Cancelled]
       or
  [On-Hold] → [Recall from Hold]
```

FR-15: Status definitions:

Status	Description
Waiting	Dalam queue, menunggu dipanggil
Called	Dipanggil, menunggu pesakit datang
Serving	Pesakit sedang dilayan

Completed	Perkhidmatan selesai
No-Show	Tidak hadir selepas 3 panggilan
Cancelled	Dibatalkan oleh staf atau pesakit
On-Hold	Ditahan sementara (contoh: tunggu lab result)
Transferred	Dipindahkan ke queue lain

4.7 Estimated Wait Time (EWT)

FR-16: Sistem mesti calculate EWT berdasarkan:

- Average service time per queue type (configurable, default values)
- Number of patients ahead in queue
- Number of active counters/rooms serving
- Historical data (learning over time)

FR-17: EWT formula (basic):

```
EWT = (Patients Ahead × Average Service Time) / Active Counters
```

FR-18: Display EWT:

- On slip: "Anggaran masa menunggu: 15 minit"
- On display: Real-time update
- On patient notification: Update bila EWT changes significantly

4.8 Auto-Transfer Queue

FR-19: Sistem mesti support auto-transfer selepas service selesai:

Configurable flows:

- Konsultasi (D1/D2/D3) → Farmasi (F) → Billing (B)
- Konsultasi → Makmal (L) → Konsultasi (return) → Farmasi → Billing
- Pendaftaran → Konsultasi

FR-20: Auto-transfer behavior:

- Maintain priority level
- Add to new queue dengan status "Waiting"
- Notify patient via SMS/display jika new EWT > threshold (contoh: > 10 minit)

FR-21: Manual transfer option:

- Staf boleh transfer ke any queue
- Reason required (optional)

4.9 Patient Notification

FR-22: SMS/WhatsApp notification triggers:

Trigger	Message
Queue number issued	"Nombor giliran anda: D1-015. Anggaran menunggu: 20 minit"
Approaching (3 numbers away)	"Giliran anda hampir tiba (3 lagi). Sila bersiap di waiting area"
Called	"Nombor D1-015 dipanggil. Sila ke Bilik Doktor 1 sekarang"

No-Show warning	"Anda tidak hadir semasa dipanggil. Reply DELAY untuk 10 minit lagi atau nombor akan dibatalkan"
Transferred	"Anda telah dipindahkan ke Kaunter Farmasi. Nombor baru: F-045"

FR-23: Patient can reply:

- "DELAY" - Delay 10 minit (add back to queue dengan slight penalty)
- "CANCEL" - Cancel queue number

4.10 Integration dengan Pendaftaran

FR-24: Auto-generate queue number selepas pendaftaran:

- Check jika pesakit ada temujanji → Assign ke queue doktor yang betul
- Walk-in → Assign ke queue pendaftaran dahulu, then konsultasi
- Display queue number di pendaftaran confirmation screen

FR-25: Pass patient data ke queue:

- Patient ID
- Name (for staff dashboard)
- Age (for priority auto-assignment)
- Appointment info (if any)
- Reason for visit (for doctor preview)

4.11 Multi-Counter/Room Support

FR-26: Sistem mesti support:

- Multiple counters per queue type (Kaunter 1, 2, 3 untuk Pendaftaran)
- Multiple rooms per queue type (Bilik Doktor 1, 2, 3)
- Staf login ke specific counter/room
- Queue distribution across counters (round-robin atau load balancing)

FR-27: Display show counter/room info:

- "Nombor R-015, sila ke Kaunter 2"
- "Nombor D1-020, sila ke Bilik Doktor 1"

4.12 Reporting & Analytics

FR-28: Dashboard analytics (real-time):

- Current queue length per queue type
- Average wait time today (so far)
- Longest wait time
- Patients served today
- No-show count
- Active counters/rooms

FR-29: Historical reports:

1. **Wait Time Report:**
    - Average wait time by queue/day/hour
    - Wait time distribution (histogram)
    - Comparison: This week vs last week
2. **Peak Hours Analysis:**
    - Busiest hours of day
    - Busiest days of week

    - Heat map visualization
3. **Queue Throughput Report:**
    - Patients served per hour/day
    - Service time per patient
    - Throughput by queue type
4. **Staff Performance Report:**
    - Patients served per staff
    - Average service time per staff
    - Comparison across staff
5. **No-Show Report:**
    - No-show count and rate
    - No-show by queue type
    - Trend over time
6. **Patient Journey Report:**
    - Total time from registration to exit
    - Time spent at each station
    - Bottleneck identification

FR-30: All reports exportable to PDF and Excel

4.13 Kiosk Management

FR-31: Kiosk admin features:

- Enable/disable kiosk remotely
- Monitor kiosk status (online/offline, paper status)
- Configure kiosk options (available queue types)
- View kiosk usage statistics

FR-32: Kiosk error handling:

- Alert admin if paper low
- Alert admin if kiosk offline
- Fallback message: "Sila dapatkan nombor giliran di kaunter"

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5. Keperluan Teknikal

5.1 Arkitektur Sistem

Framework: Laravel 12 **Frontend:** Blade Templates + Bootstrap 5 + CoreUI **Real-time:** Laravel Echo + Pusher/Soketi (WebSocket) **Database:** MySQL 8.0 **Queue Processing:** Laravel Queue (Redis) **TTS:** Browser Speech Synthesis API atau Google TTS **SMS Gateway:** Twilio/MSG91 (integration dengan existing setup) **Pattern:** Service Layer + Repository Pattern

5.2 Struktur Database

Sistem ini memerlukan 10 jadual utama:

1. `queue_types` - Queue type configuration
2. `queue_counters` - Counter/Room master
3. `queue_tickets` - Individual queue tickets
4. `queue_calls` - Call history per ticket
5. `queue_transfers` - Transfer history
6. `queue_daily_stats` - Daily aggregated statistics

7. `queue_hourly_stats` - Hourly statistics
8. `queue_staff_assignments` - Staff to counter assignment
9. `queue_kiosks` - Kiosk configuration
10. `queue_notifications` - Notification log

Jadual: `queue_types`

Column	Type	Description
`id`	bigint UNSIGNED PK	Primary key
`code`	varchar(10) UNIQUE NOT NULL	Queue prefix (R, D1, F)
`name`	varchar(100) NOT NULL	Queue name (Pendaftaran)
`name_en`	varchar(100) NULL	English name
`name_zh`	varchar(100) NULL	Chinese name
`avg_service_time`	int DEFAULT 5	Average minutes per service
`max_queue_size`	int NULL	Max tickets per day (NULL = unlimited)
`priority_ratio`	int DEFAULT 3	Every N normal, call 1 priority
`auto_transfer_to`	bigint UNSIGNED NULL	FK → queue_types.id
`operating_start`	time NULL	Operating start time
`operating_end`	time NULL	Operating end time
`is_active`	boolean DEFAULT true	Active status
`display_order`	int DEFAULT 0	Order on display/kiosk
`created_at`	timestamp	Created timestamp
`updated_at`	timestamp	Updated timestamp

Jadual: `queue_counters`

Column	Type	Description
`id`	bigint UNSIGNED PK	Primary key
`queue_type_id`	bigint UNSIGNED NOT NULL	FK → queue_types.id
`code`	varchar(20) NOT NULL	Counter code (K1, K2, BD1)
`name`	varchar(100) NOT NULL	Counter name (Kaunter 1)
`name_en`	varchar(100) NULL	English name
`name_zh`	varchar(100) NULL	Chinese name
`location`	varchar(255) NULL	Physical location
`is_active`	boolean DEFAULT true	Active status
`created_at`	timestamp	Created timestamp
`updated_at`	timestamp	Updated timestamp

Jadual: `queue_tickets`

Column	Type	Description
`id`	bigint UNSIGNED PK	Primary key
`ticket_number`	varchar(20) NOT NULL	Full number (D1-015)
`sequence`	int NOT NULL	Daily sequence (15)
`queue_type_id`	bigint UNSIGNED NOT NULL	FK → queue_types.id
`queue_date`	date NOT NULL	Queue date
`pesakit_id`	bigint UNSIGNED NULL	FK → pesakit.id (if registered)
`temujanji_id`	bigint UNSIGNED NULL	FK → temujanji.id (if appointment)
`priority_level`	tinyint DEFAULT 6	1=Emergency to 6=Normal
`priority_reason`	varchar(100) NULL	OKU, Warga Emas, etc
`status`	enum NOT NULL DEFAULT 'waiting'	waiting/called/serving/completed/no_show/cancelled/on_hold/transferred
`current_counter_id`	bigint UNSIGNED NULL	FK → queue_counters.id
`served_by`	bigint UNSIGNED NULL	FK → users.id
`issued_at`	timestamp NOT NULL	Issue timestamp
`called_at`	timestamp NULL	First call timestamp
`serving_at`	timestamp NULL	Start serving timestamp
`completed_at`	timestamp NULL	Completion timestamp
`call_count`	tinyint DEFAULT 0	Number of times called
`estimated_wait_time`	int NULL	EWT in minutes at issue time
`actual_wait_time`	int NULL	Actual wait (called_at - issued_at)
`service_time`	int NULL	Service time (completed_at - serving_at)
`source`	enum DEFAULT 'counter'	kiosk/counter/auto/mobile
`parent_ticket_id`	bigint UNSIGNED NULL	FK → queue_tickets.id (if transferred)
`notes`	text NULL	Staff notes
`created_at`	timestamp	Created timestamp
`updated_at`	timestamp	Updated timestamp

Index: UNIQUE(queue_type_id, queue_date, sequence) **Index:** idx_status_date ON (status, queue_date) **Index:** idx_pesakit ON (pesakit_id)

Jadual: `queue_calls`

Column	Type	Description

`id`	bigint UNSIGNED PK	Primary key
`ticket_id`	bigint UNSIGNED NOT NULL	FK → queue_tickets.id
`counter_id`	bigint UNSIGNED NOT NULL	FK → queue_counters.id
`called_by`	bigint UNSIGNED NOT NULL	FK → users.id
`call_type`	enum NOT NULL	initial/recall
`called_at`	timestamp NOT NULL	Call timestamp
`responded`	boolean DEFAULT false	Patient responded
`created_at`	timestamp	Created timestamp

Jadual: `queue_transfers`

Column	Type	Description
`id`	bigint UNSIGNED PK	Primary key
`from_ticket_id`	bigint UNSIGNED NOT NULL	FK → queue_tickets.id
`to_ticket_id`	bigint UNSIGNED NOT NULL	FK → queue_tickets.id
`from_queue_type_id`	bigint UNSIGNED NOT NULL	FK → queue_types.id
`to_queue_type_id`	bigint UNSIGNED NOT NULL	FK → queue_types.id
`transfer_type`	enum NOT NULL	auto/manual
`reason`	varchar(255) NULL	Transfer reason
`transferred_by`	bigint UNSIGNED NOT NULL	FK → users.id
`transferred_at`	timestamp NOT NULL	Transfer timestamp
`created_at`	timestamp	Created timestamp

Jadual: `queue_staff_assignments`

Column	Type	Description
`id`	bigint UNSIGNED PK	Primary key
`user_id`	bigint UNSIGNED NOT NULL	FK → users.id
`counter_id`	bigint UNSIGNED NOT NULL	FK → queue_counters.id
`assignment_date`	date NOT NULL	Assignment date
`start_time`	time NOT NULL	Shift start
`end_time`	time NULL	Shift end (NULL = still active)
`is_active`	boolean DEFAULT true	Currently active
`created_at`	timestamp	Created timestamp
`updated_at`	timestamp	Updated timestamp

Index: UNIQUE(user_id, counter_id, assignment_date)

Jadual: `queue_notifications`

Column	Type	Description
`id`	bigint UNSIGNED PK	Primary key
`ticket_id`	bigint UNSIGNED NOT NULL	FK → queue_tickets.id
`notification_type`	enum NOT NULL	issued/approaching/called/no_show_warning/transferred
`channel`	enum NOT NULL	sms/whatsapp
`recipient`	varchar(50) NOT NULL	Phone number
`message`	text NOT NULL	Message content
`status`	enum DEFAULT 'pending'	pending/sent/failed
`sent_at`	timestamp NULL	Sent timestamp
`error_message`	text NULL	Error if failed
`created_at`	timestamp	Created timestamp

5.3 Models (Eloquent)

Models yang perlu dicipta:

- QueueType
- QueueCounter
- QueueTicket
- QueueCall
- QueueTransfer
- QueueStaffAssignment
- QueueNotification
- QueueDailyStat
- QueueHourlyStat
- QueueKiosk

5.4 Services

Services:

- QueueService - Core queue operations
- QueueTicketService - Ticket generation, status update
- QueueDisplayService - Display data formatting
- QueueNotificationService - SMS/WhatsApp notifications
- QueueAnalyticsService - Statistics and reporting
- QueueTransferService - Handle transfers
- EWTCalculatorService - Estimated wait time calculation

5.5 Real-time Events (Broadcasting)

Events untuk real-time update:

Event	Channel	Trigger
TicketCalled	queue.display	Bila nombor dipanggil
QueueUpdated	queue.display	Bila queue berubah

CounterStatusChanged	queue.staff	Counter open/close
TicketStatusChanged	queue.ticket.{id}	Status update

---

6. Workflow

6.1 Workflow Pesakit Ambil Nombor (Kiosk)

```
Pesakit sampai di klinik
    ↓
Pesakit ke kiosk self-service
    ↓
Pilih bahasa (BM/EN/ZH)
    ↓
Pilih jenis perkhidmatan:
    - Jumpa Doktor (ada temujanji)
    - Jumpa Doktor (walk-in)
    - Ambil Ubat
    - Bayar Bil
    ↓
Jika ada temujanji:
    Scan IC atau input IC
        ↓
    Sistem cari temujanji hari ini
        ↓
    Confirm temujanji details
        ↓
    Auto-assign ke queue doktor yang betul
        ↓
Jika walk-in:
    Auto-assign ke queue pendaftaran (R)
        ↓
Sistem generate ticket:
    - Assign sequence number
    - Calculate EWT
    - Check priority (umur untuk warga emas)
    ↓
Print slip nombor giliran
    ↓
Send SMS confirmation (jika phone number available)
    ↓
Pesakit ambil slip, duduk di waiting area
```

6.2 Workflow Staff Panggil Nombor

```
Staf login ke dashboard
    ↓
Staf assign diri ke counter/room
    ↓
Staf klik "Panggil Seterusnya"
    ↓
Sistem select ticket:
    - Check priority ratio (setiap 3 normal, 1 priority)
    - Select highest priority waiting ticket
```

```
    ↓
Sistem update ticket:
    - status = 'called'
    - called_at = now()
    - current_counter_id = staf counter
    - call_count++
    ↓
Sistem broadcast events:
    - Update display (highlight called number)
    - Voice announcement (TTS)
    - Send SMS to patient
    ↓
Pesakit datang ke counter
    ↓
Staf klik "Mula Layanan"
    - status = 'serving'
    - serving_at = now()
    ↓
Staf layani pesakit
    ↓
Staf klik "Selesai"
    - status = 'completed'
    - completed_at = now()
    - Calculate actual wait time & service time
    ↓
Jika ada auto-transfer:
    - Create new ticket in destination queue
    - Link parent_ticket_id
    - Notify patient
    ↓
Dashboard ready untuk panggil seterusnya
```

6.3 Workflow No-Show

```
Staf panggil nombor
    ↓
Pesakit tidak datang (30 saat)
    ↓
Staf klik "Panggil Semula" (Recall)
    - call_count++ (max 3)
    - Create queue_calls record
    - Voice announcement again
    ↓
Masih tidak datang?
    ↓
If call_count < 3:
    Repeat recall
    ↓
If call_count >= 3:
    Staf klik "Tidak Hadir" (No-Show)
        - status = 'no_show'
        - Send SMS warning to patient
        ↓
    Sistem proceed ke nombor seterusnya
```

6.4 Workflow Auto-Transfer

```
Pesakit selesai di Konsultasi (D1)
    ↓
Staf klik "Selesai"
    ↓
Sistem check: D1 → F (auto-transfer configured)
    ↓
Sistem create new ticket di queue Farmasi (F):
    - Copy patient details
    - Maintain priority level
    - Set parent_ticket_id = D1 ticket
    - Calculate new EWT
    ↓
Sistem create queue_transfers record
    ↓
Sistem broadcast:
    - Update Farmasi queue display
    - Send SMS to patient dengan new number
    ↓
Pesakit proceed ke Farmasi waiting area
```

---

7. Keperluan UI/UX

7.1 Key Interfaces

1. Kiosk Interface (Touchscreen)

- Large buttons, easy to tap
- High contrast colors (for visibility)
- Multi-language toggle (BM/EN/ZH)
- Clear step-by-step flow
- Accessibility: Large fonts, simple icons

2. Public Display (TV)

- Fullscreen mode
- Auto-rotate between queue types (optional)
- Large fonts visible from distance
- Visual flash when number called
- Clock and date display
- Clinic branding (logo, colors)

3. Staff Dashboard (Web)

- Clean, minimal interface
- One-click actions (large buttons)
- Queue list dengan patient preview
- Keyboard shortcuts
- Real-time updates (no refresh needed)
- Counter/room status indicator

4. Admin Dashboard

- Queue configuration management
- Real-time monitoring (all queues)
- Analytics charts

- Staff assignment
- Kiosk management

5. Patient Slip

- Clear ticket number (large font)
- Queue name
- EWT
- Instructions
- Barcode/QR code
- Date/time

7.2 Design System

- Framework: Bootstrap 5 + CoreUI
- Icons: CoreUI Icons / Font Awesome
- Color Scheme: Calming medical colors (blues, greens)
- Responsive: Yes (staff dashboard on tablet)
- Accessibility: WCAG 2.1 compliance untuk kiosk

7.3 Voice Announcement Format

Bahasa Malaysia: "Nombor [D1-015], sila ke [Bilik Doktor 1]"

English: "Number [D1-015], please proceed to [Doctor Room 1]"

Mandarin: "号码 [D1-015]，请到 [诊所一]"

---

8. Keperluan Keselamatan

8.1 Data Protection

- Patient data minimal on display (no full name, no IC)
- Staff dashboard: Masked IC (850101-XX-XXXX)
- Audit trail untuk semua ticket actions
- Ticket data retained untuk analytics (anonymized selepas 1 tahun)

8.2 Access Control

Public Access (No Auth):

- Kiosk interface
- Public display

Staff Access (Auth Required):

- Staff calling dashboard
- View queue list dengan patient info

Admin Access:

- Queue configuration
- Reporting
- Staff assignment
- System settings

8.3 Audit Trail

- Log all ticket status changes
- Log all calls and recalls
- Log staff assignments
- Log configuration changes

---

9. Keperluan Prestasi

9.1 Response Time

- Kiosk ticket generation: < 2 saat
- Display update (WebSocket): < 500ms
- Voice announcement: < 1 saat after call
- Staff dashboard load: < 1 saat
- Report generation: < 5 saat

9.2 Scalability

- Support 500+ tickets per day
- Support 10 concurrent queue types
- Support 20 concurrent counters
- Support 5 kiosks
- Support 50 concurrent staff users

9.3 Real-time Requirements

- WebSocket connection untuk display dan staff dashboard
- Fallback: Polling setiap 5 saat jika WebSocket fail
- Heartbeat check untuk kiosk status

---

10. Keperluan Ujian

10.1 Unit Testing

- QueueTicketService::generateTicket()
- EWTCalculatorService::calculate()
- QueueService::getNextTicket() (priority logic)
- QueueTransferService::transfer()

10.2 Feature Testing

- Ticket generation via kiosk flow
- Ticket generation via counter
- Call next with priority logic
- Recall and no-show flow
- Auto-transfer flow
- Notification sending

10.3 Integration Testing

- Integration dengan Pendaftaran (auto-generate ticket)
- Integration dengan SMS gateway
- WebSocket broadcasting

10.4 UAT Scenarios

- Pesakit walk-in full journey (daftar → konsultasi → farmasi → billing)
- Warga emas priority journey
- No-show scenario
- Peak hour simulation (multiple tickets)

---

11. Langkah Implementasi

Fasa 1: Setup & Core Database (1 minggu)

- [ ] Setup database schema (10 jadual)

- [ ] Create migrations
- [ ] Create models dengan relationships
- [ ] Seed queue types dan counters

Fasa 2: Ticket Generation (1 minggu)

- [ ] QueueTicketService
- [ ] Generate ticket logic
- [ ] Priority assignment
- [ ] EWT calculation
- [ ] Counter ticket generation page

Fasa 3: Staff Dashboard (1.5 minggu)

- [ ] Staff assignment to counter
- [ ] Queue list view
- [ ] Call next logic (dengan priority)
- [ ] Recall, complete, no-show actions
- [ ] Keyboard shortcuts

Fasa 4: Real-time & Display (1.5 minggu)

- [ ] WebSocket setup (Laravel Echo + Pusher/Soketi)
- [ ] Event broadcasting
- [ ] Public display page
- [ ] Auto-refresh logic
- [ ] Voice announcement (TTS)

Fasa 5: Kiosk Interface (1 minggu)

- [ ] Kiosk touchscreen UI
- [ ] Multi-language support
- [ ] IC scan untuk appointment
- [ ] Slip printing (PDF generation)

Fasa 6: Auto-Transfer & Notifications (1 minggu)

- [ ] Auto-transfer logic
- [ ] Transfer history
- [ ] SMS/WhatsApp notifications
- [ ] Notification templates
- [ ] Patient reply handling (DELAY, CANCEL)

Fasa 7: Integration dengan Pendaftaran (0.5 minggu)

- [ ] Event listener untuk pendaftaran selesai
- [ ] Auto-generate ticket
- [ ] Pass patient data ke queue

Fasa 8: Analytics & Reporting (1 minggu)

- [ ] Daily/hourly stats aggregation
- [ ] Real-time dashboard analytics
- [ ] Historical reports (6 reports)
- [ ] Export to PDF/Excel

Fasa 9: Admin & Configuration (0.5 minggu)

- [ ] Queue type CRUD
- [ ] Counter CRUD
- [ ] Kiosk management
- [ ] System settings

Fasa 10: Testing & UAT (1 minggu)

- [ ] Unit tests
- [ ] Feature tests
- [ ] UAT dengan staf
- [ ] Bug fixes

Fasa 11: Deployment (0.5 minggu)

- [ ] Deploy to production
- [ ] Configure kiosk devices
- [ ] Configure display TVs
- [ ] Training untuk staf

Anggaran Masa: 11 minggu (2.5-3 bulan)

---

12. Kriteria Kejayaan

12.1 Metrics

1. Average wait time reduction: ≥ 30% dalam 3 bulan
2. No-show detection rate: ≥ 95%
3. Patient satisfaction (survey): ≥ 4.0/5.0
4. Staff efficiency (patients served per hour): Increase ≥ 20%
5. System uptime: ≥ 99.5%

---

13. Risks & Mitigation

Risk	Impact	Probability	Mitigation
Kiosk hardware failure	HIGH	MEDIUM	Fallback to counter ticket generation; spare kiosk
WebSocket connection unstable	MEDIUM	MEDIUM	Polling fallback; monitor connection health
Voice announcement not heard	MEDIUM	LOW	Visual flash on display; SMS notification backup
Peak hour overload	HIGH	LOW	Queue size limits; horizontal scaling; caching
Patient miss notification	MEDIUM	MEDIUM	Multiple channels (display + voice + SMS); recall mechanism

---

14. Acceptance Criteria

14.1 Functional

- ✅ Multi-queue dengan prefix berbeza berfungsi
- ✅ Kiosk boleh issue ticket dengan print slip
- ✅ Display papar nombor dipanggil dengan voice announcement
- ✅ Staff dashboard boleh call, recall, complete, no-show
- ✅ Priority queue berfungsi (warga emas, OKU)

- ✅ EWT calculated dan displayed
- ✅ Auto-transfer antara queue berfungsi
- ✅ SMS/WhatsApp notification sent
- ✅ Integration dengan Pendaftaran (auto-generate ticket)
- ✅ Analytics dashboard accurate
- ✅ All 6 reports generate correctly

14.2 Non-Functional

- Performance: Ticket generation < 2 saat
- Real-time: Display update < 500ms
- Availability: 99.5% uptime
- Usability: Staff dapat guna dalam 5 minit training

---

15. Lampiran

15.1 Contoh Slip Nombor Giliran

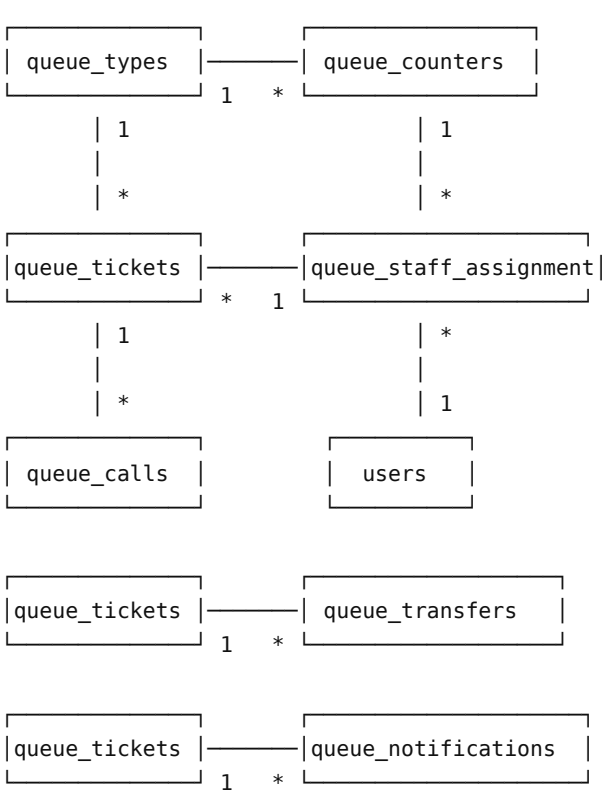
```
╔═══════════════════════════════════════╗
║       POLIKLINIK AL-HUDA              ║
║    Sistem Pengurusan Giliran          ║
╠═══════════════════════════════════════╣
║                                       ║
║          NOMBOR ANDA                  ║
║                                       ║
║         ┌─────────────┐               ║
║         │   D1-015    │               ║
║         └─────────────┘               ║
║                                       ║
║   Queue: Konsultasi Doktor 1          ║
║                                       ║
║   Anggaran Menunggu: 15 minit         ║
║   Di hadapan anda: 5 orang            ║
║                                       ║
║   Tarikh: 13/01/2026                  ║
║   Masa: 09:30 AM                      ║
║                                       ║
║   [||||||||||||||||||||]              ║
║   (Barcode untuk scan)                ║
║                                       ║
║   Sila tunggu di ruang menunggu.      ║
║   Perhatikan paparan dan              ║
║   dengar pengumuman.                  ║
╚═══════════════════════════════════════╝
```

15.2 Contoh Display Layout

```
┌─────────────────────────────────────────────────────────────┐
│  POLIKLINIK AL-HUDA           13 Jan 2026  09:45 AM         │
├─────────────────────────────────────────────────────────────┤
│                                                             │
│   ┌─────────────────────────────────────────────────────┐   │
│   │          NOMBOR YANG DIPANGGIL                      │   │
│   ├──────────────┬──────────────┬──────────────┬────────┤   │
│   │ PENDAFTARAN  │   DOKTOR 1   │   DOKTOR 2   │ FARMASI │   │
```

```
│  ├──────────────┼──────────────┼──────────────┼──────────┤  │
│  │    R-023     │    D1-015    │    D2-008    │  F-032   │  │
│  │  Kaunter 2   │ Bilik Dok 1  │ Bilik Dok 2  │  K.Far   │  │
│  └──────────────┴──────────────┴──────────────┴──────────┘  │
│                                                            │
│  ┌──────────────────────────────────────────────────────┐  │
│  │  SETERUSNYA                                          │  │
│  │  R: 024, 025, 026 | D1: 016, 017 | D2: 009 | F: 033  │  │
│  └──────────────────────────────────────────────────────┘  │
│                                                            │
│  Anggaran Menunggu:  Pendaftaran: 5 min | Doktor: 20 min   │
├────────────────────────────────────────────────────────────┤
│  NOTIS: Waktu operasi 8:00 AM - 5:00 PM. Terima kasih.     │
└────────────────────────────────────────────────────────────┘
```

15.3 Entity-Relationship Diagram



END OF PRD

Appendix: Change Log

Version	Date	Author	Changes
1.0	2026-01-13	System	Initial PRD creation