

UK PATENT APPLICATION

CLERKY - AI-POWERED CLINICAL DECISION SUPPORT PLATFORM

Application Type: Standard Patent Application

Classification: Medical Device Software (Class IIa)

Field of Invention: Computer-Implemented Medical Systems, Artificial Intelligence in Healthcare, Clinical Decision Support

Priority Date: October 17, 2023

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1. TECHNICAL FIELD

This invention relates to computer-implemented medical systems, specifically an artificial intelligence-powered clinical decision support platform that provides real-time analysis of clinical documentation against evidence-based medical guidelines to enhance healthcare decision-making and patient safety.

2. BACKGROUND OF THE INVENTION

2.1 Problem Statement

Healthcare professionals face increasing challenges in maintaining adherence to the rapidly expanding corpus of evidence-based medical guidelines. Current systems suffer from several critical limitations:

- Manual Guideline Consultation:** Healthcare professionals must manually search through extensive guideline databases during patient consultations, causing delays and potential oversights.
- Fragmented Decision Support:** Existing clinical decision support systems typically address single guidelines or narrow clinical domains, failing to provide comprehensive multi-guideline analysis.
- Static Documentation Review:** Current systems lack real-time, intelligent analysis of clinical documentation against current best practice guidelines.
- Limited Learning Integration:** Existing solutions do not provide interactive learning mechanisms that adapt to user decisions and preferences.
- Poor Workflow Integration:** Most clinical decision support tools operate as standalone systems that disrupt clinical workflows rather than enhancing them.

2.2 Prior Art Limitations

Existing clinical decision support systems, while providing some guidance, fail to offer:

- Real-time, intelligent analysis of free-text clinical documentation
- Multi-guideline simultaneous analysis with parallel processing
- Interactive recommendation systems with comprehensive user decision tracking
- Multi-provider AI integration with automatic failover capabilities

- Structured clinical documentation enhancement based on AI-generated suggestions
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3. SUMMARY OF THE INVENTION

3.1 Overview

The present invention provides a novel AI-powered clinical decision support platform ("Clerky") that addresses the aforementioned limitations through several innovative technical solutions:

3.2 Key Technical Innovations

Innovation 1: Smart AI Service Management

Instead of relying on a single AI service that might become unavailable or expensive, Clerky connects to multiple AI providers and allows users to specify their preferred AI model to optimise for price and accuracy. If one service is down or slow, the system instantly switches to another provider without interruption. This approach ensures doctors always get fast, reliable responses while keeping costs manageable by using the most efficient service available at any given time.

Innovation 2: Comprehensive Medical Guideline Analysis

When a doctor enters a clinical case, Clerky simultaneously checks it against hundreds of relevant medical guidelines rather than forcing the doctor to search through them manually. The system currently contains, at present, circa 300 guidelines focused on obstetrics and gynaecology, and can be expanded to other medical specialties. It intelligently identifies which guidelines are most relevant to the specific case and presents them in order of importance, allowing healthcare professionals to quickly access the most applicable evidence-based recommendations.

Innovation 3: Interactive Decision Support Interface

Rather than simply providing static recommendations, Clerky creates an interactive experience where doctors can review each AI-generated suggestion and choose to accept it, reject it, or modify it to better fit their clinical judgment. The system tracks these decisions to maintain a comprehensive record of how recommendations were applied. Each suggestion is presented with supporting evidence, and doctors can customize the recommendations in real-time to match their specific clinical context and patient needs.

Innovation 4: AI-Generated Documentation Suggestions

Clerky uses AI providers to analyse clinical notes against specific medical guidelines and generate categorised improvement suggestions. The system provides structured recommendations organised by importance level (Very Important to Unimportant) that healthcare professionals can review, accept, reject, or modify. When suggestions are accepted or modified, they are automatically applied to update the clinical documentation, helping ensure better alignment with evidence-based guidelines. The decisions of the user with respect to the particular context and guideline are stored to allow for iterative progress of advice generation.

Innovation 5: Reliable Multi-Service Architecture

The system is built with multiple backup systems to ensure it remains available when healthcare professionals need it most. By connecting to several different AI services simultaneously, Clerky can continue operating even if one or more services experience problems. The system monitors performance and costs across all providers, automatically routing requests to the most efficient service while maintaining backup options. This redundant approach ensures consistent availability and optimal performance for time-sensitive clinical decision-making.

4. DETAILED DESCRIPTION OF THE INVENTION

4.1 System Architecture

The invention comprises a distributed architecture with the following novel components:

4.1.1 Frontend Application Layer

- **Single-Page Web Application:** 7,710-line JavaScript application (`script.js`)
- **Firebase Authentication:** Secure user authentication and session management
- **Real-time Processing:** Instant analysis and recommendation display with live status updates
- **Interactive Elements:** Accept/reject/modify interface for AI recommendations with decision tracking
- **Session Management:** Persistent clinical consultation tracking with Firestore integration
- **Responsive Design:** Optimised interface for healthcare professional workflows

4.1.2 Server API Layer

- **Express.js Backend:** 7,721-line Node.js server (`server.js`) hosted on Render.com
- **Multi-Provider AI Integration:** Intelligent routing between multiple AI service providers
- **GitHub Integration:** Automated guideline ingestion and version control via GitHub API
- **Firebase Admin SDK:** Secure database operations and user management
- **RESTful API Design:** Comprehensive endpoints for guideline processing and AI analysis

4.1.3 AI Processing Engine

```
// AI routing based on user preferences
async function routeToAI(prompt, userId = null) {
  // Get user's preferred AI provider
  const provider = userId ? await getUserAIPreference(userId) : 'default';

  // Select model based on provider preference
  const model = getModelForProvider(provider);

  // Send request to selected AI provider
  return await sendToAI(prompt, model, null, userId);
}
```

4.1.3 Guideline Intelligence System

- **Automated Guideline Processing:** Conversion of PDF guidelines to structured, searchable format
- **Metadata Enhancement:** AI-powered extraction of guideline metadata and clinical relevance
- **Dynamic Updating:** Automatic synchronisation with latest guideline versions
- **Contextual Indexing:** Advanced indexing for rapid retrieval and relevance matching

4.1.4 Clinical Analysis Pipeline

```
// Multi-guideline parallel processing
async function multiGuidelineDynamicAdvice(selectedGuidelines) {
  // Process guidelines in parallel with error isolation
  const guidelinePromises = selectedGuidelines.map(async (guideline) => {
    try {
      // Call dynamicAdvice API for individual guideline
      const response = await fetch('/dynamicAdvice', {
        method: 'POST',
        body: JSON.stringify({
          transcript: window.latestAnalysis.transcript,
          analysis: window.latestAnalysis.analysis,
          guidelineId: guideline.id,
          guidelineTitle: guideline.title
        })
      });
      return await response.json();
    } catch (error) {
      return { success: false, error: error.message, guideline: guideline.id };
    }
  });

  // Wait for all parallel processing to complete
  const results = await Promise.all(guidelinePromises);
  return results;
}
```

4.2 Novel Algorithmic Innovations

4.2.1 AI-Powered Guideline Matching Process

The system employs a streamlined AI-powered process for identifying relevant guidelines:

1. **Comprehensive Data Submission:** Full clinical transcript and complete guideline database sent to AI provider
2. **AI-Based Categorisation:** AI service analyses content and categorises guidelines into "Most Relevant", "Potentially Relevant", "Less Relevant", and "Not Relevant"
3. **Response Processing:** System parses AI response using fuzzy string matching to map AI recommendations back to original guideline database
4. **User Interface Presentation:** Guidelines presented to user with relevance scores and interactive selection options

4.2.2 Interactive Decision Tracking System

```
// User decision tracking and storage system
function handleSuggestionAction(suggestionId, action) {
  // Find the suggestion data
  const suggestion = currentSuggestions.find(s => s.id === suggestionId);

  // Record the decision for current session
  userDecisions[suggestionId] = {
    action: action,
    suggestion: suggestion,
    timestamp: new Date().toISOString()
  };

  // Update UI to show decision
  updateSuggestionStatus(suggestionId, action);
  updateDecisionsSummary();
}

// Apply all user decisions to transcript
async function applyAllDecisions() {
  const decisionsData = {};
  Object.entries(userDecisions).forEach(([suggestionId, decision]) => {
    decisionsData[suggestionId] = {
      action: decision.action,
      modifiedText: decision.modifiedText || null
    };
  });

  // Send decisions to server for transcript modification
  await fetch('/applyDynamicAdvice', {
    method: 'POST',
    body: JSON.stringify({
      sessionId: currentAdviceSession,
      decisions: decisionsData
    })
  });
}
```

4.2.3 AI-Generated Documentation Suggestions

The system provides AI-powered suggestions for clinical documentation improvement:

- **Guideline-Based Analysis:** AI providers compare clinical notes against specific guideline content
- **Categorised Recommendations:** Suggestions organised by importance (Very Important, Somewhat Important, Less Important, Unimportant)
- **Interactive Review Interface:** Accept/reject/modify interface for each AI-generated suggestion
- **Transcript Modification:** Accepted and modified suggestions applied to update clinical documentation

4.3 Technical Implementation Details

4.3.1 Data Processing Pipeline

Guideline Ingestion and Processing:

1. **PDF Upload:** Healthcare administrators upload guideline PDFs via web interface to `/uploadGuideline` endpoint
2. **GitHub Integration:** Files automatically stored in GitHub repository with version control

3. **Automated Processing:** GitHub Actions workflows triggered to extract and process PDF content
4. **Firestore Synchronization:** `/syncGuidelinesWithMetadata` endpoint compares GitHub vs. database counts and synchronizes new content
5. **Metadata Enhancement:** AI-powered extraction of guideline metadata, organization, and clinical relevance

Clinical Analysis Workflow:

1. Input Processing:

- Multi-format clinical text input (copy-paste, file upload, direct typing)
- Real-time sanitization and standardization
- Clinical content analysis via AI provider APIs

2. Guideline Matching:

- Parallel processing across Firestore guideline database
- Weighted relevance scoring using AI-powered analysis
- Text similarity-based matching for guideline selection

3. Multi-Provider AI Analysis:

- Intelligent routing between multiple AI service providers
- Automatic failover on provider unavailability or quota limits
- Structured prompt engineering for clinical contexts
- Quality validation and response processing

4. Interactive Recommendation Generation:

- Priority-based recommendation ranking with evidence grading
- Accept/Reject/Modify user interface for each suggestion
- Real-time user decision tracking and storage
- Bulk operations for efficiency in clinical workflows

4.3.2 Decision Tracking and Storage System

The system implements a comprehensive decision tracking mechanism:

```
async function processUserDecisions(decisions, sessionId) {
  const processedDecisions = {};

  for (const [suggestionId, decision] of Object.entries(decisions)) {
    processedDecisions[suggestionId] = {
      action: decision.action,
      timestamp: decision.timestamp,
      sessionId: sessionId,
      modifiedText: decision.modifiedText || null
    };
  }

  return await storeDecisionHistory(processedDecisions);
}
```

4.4 Database and Knowledge Management

4.4.1 Guideline Database Architecture

- **Comprehensive Coverage:** At present, circa 300 medical guidelines from authoritative sources (NICE, BJOG, RCOG, etc.)
- **Structured Storage:** Firebase Firestore with optimised indexing for rapid retrieval
- **Version Control:** Automated tracking of guideline updates and versioning
- **Content Processing:** Multi-stage processing pipeline:

```
// Guideline synchronization and processing
async function syncGuidelinesWithMetadata() {
  const guidelines = await getGuidelinesList(); // From GitHub
  for (const guideline of guidelines) {
    const content = await getFileContents(`guidance/condensed/${guideline}`);
    const summary = await getFileContents(`guidance/summary/${guideline}`);
    const keywords = extractKeywords(summary);
    await storeGuideline({
      id: generateCleanDocId(guideline),
      content: content,
      summary: summary,
      keywords: keywords,
      metadata: await enhanceGuidelineMetadata(guideline)
    });
  }
}
```

4.4.2 Clinical Knowledge Representation

The system employs a structured knowledge representation scheme:

- **Categorical Organization:** Guidelines organized by medical specialty with searchable metadata
- **Content Indexing:** Comprehensive indexing of guideline content for rapid text-based retrieval
- **Evidence Integration:** Preservation of evidence levels from source guidelines
- **Clinical Context Matching:** Text similarity-based association of guidelines with clinical scenarios

5. CLAIMS

Independent Claims

Claim 1: A computer-implemented system for providing clinical decision support comprising:

- A clinical text analysis engine configured to process free-text clinical documentation using multiple AI service providers;
- A guideline database containing a plurality of medical guidelines in structured, searchable format;
- A multi-guideline analysis engine configured to simultaneously analyze clinical input against multiple relevant guidelines using parallel processing;
- An artificial intelligence recommendation system configured to generate prioritized clinical recommendations based on guideline analysis;
- An interactive user interface configured to present recommendations and capture user decisions through accept/reject/modify functionality;
- A decision tracking system configured to store user decisions and apply them to modify clinical documentation.

Claim 2: The system of claim 1, wherein the multi-guideline analysis engine further comprises:

- A relevance scoring algorithm configured to rank guidelines based on clinical context using AI-powered analysis;
- A text similarity matching system configured to identify relevant guidelines using fuzzy string matching;
- A parallel processing engine configured to analyze multiple guidelines simultaneously for comprehensive coverage.

Claim 3: The system of claim 1, wherein the artificial intelligence recommendation system comprises:

- A multi-provider AI integration layer supporting multiple AI service providers;
- An automatic failover mechanism configured to switch between AI providers upon service interruption;
- A cost optimization engine configured to route requests to optimal AI providers based on performance and cost metrics.

Dependent Claims

Claim 4: The system of claim 1, wherein the clinical text analysis engine is configured to:

- Process clinical documentation using AI-powered analysis to identify significant clinical issues;
- Generate AI-powered suggestions for documentation enhancement based on guideline analysis;
- Provide interactive interfaces for reviewing and applying documentation improvements.

Claim 5: The system of claim 1, wherein the decision tracking system is configured to:

- Track user acceptance, rejection, and modification of AI recommendations in real-time;
- Store individual user decisions for current clinical session processing;
- Apply user decisions to modify clinical transcript based on accepted and modified suggestions.

Claim 6: The system of claim 1, further comprising an AI-enhanced documentation system configured to:

- Generate documentation improvement suggestions based on AI analysis of guideline requirements;
- Provide interactive recommendation interfaces with accept/reject/modify functionality;
- Deliver real-time AI-powered feedback on clinical documentation enhancement opportunities.

Claim 7: A computer-implemented method for providing clinical decision support comprising the steps of:

- Receiving clinical documentation in natural language format;
- Processing the clinical documentation using AI-powered analysis from multiple service providers;
- Identifying relevant medical guidelines from a database using AI-based categorization;
- Analyzing the clinical documentation against multiple identified guidelines simultaneously using parallel processing;
- Generating prioritized recommendations using artificial intelligence analysis from multiple AI service providers;
- Presenting interactive recommendations to a user interface with accept/reject/modify functionality;
- Capturing user decisions regarding presented recommendations for current session processing;
- Applying user decisions to modify clinical documentation based on accepted and modified suggestions.

Claim 8: The method of claim 7, wherein identifying relevant medical guidelines comprises:

- Submitting clinical content and complete guideline database to AI service provider;
- Receiving AI-generated categorization of guidelines by relevance level;
- Processing AI response using fuzzy string matching to map recommendations to database entries;
- Presenting categorized guidelines to user for selection and analysis.

Claim 9: The method of claim 7, wherein generating prioritized recommendations comprises:

- Submitting structured prompts to multiple AI service providers;
- Implementing automatic failover between AI providers;
- Validating AI responses for clinical appropriateness;
- Ranking recommendations based on evidence strength and clinical relevance.

Claim 10: A non-transitory computer-readable storage medium containing instructions that, when executed by a processor, cause the processor to perform operations comprising:

- Analyzing clinical text input using multiple AI service provider APIs with automatic failover capabilities;
- Matching clinical content against a database of medical guidelines using AI-based categorization;
- Generating clinical recommendations using artificial intelligence analysis with parallel processing;
- Providing an interactive interface for user feedback on recommendations with accept/reject/modify functionality;

- Tracking user decisions and applying them to modify clinical documentation based on user selections.
-

6. TECHNICAL ADVANTAGES AND BENEFITS

6.1 Technical Superiority

Unprecedented Integration Depth

Unlike existing systems that provide isolated clinical decision support, this invention offers:

- Simultaneous multi-guideline analysis with parallel processing capabilities
- Real-time decision tracking and comprehensive audit trails
- AI-enhanced documentation improvement suggestions
- Seamless workflow integration without disrupting clinical practice

Advanced AI Architecture

The multi-provider AI system with intelligent routing provides:

- Enhanced reliability through automatic failover between AI providers
- Cost optimization through intelligent provider selection algorithms
- Improved performance through load balancing across multiple AI services
- Reduced vendor lock-in through provider abstraction and API routing

Novel Decision Support Mechanisms

The interactive recommendation system offers:

- Comprehensive decision tracking with accept/reject/modify functionality
- Real-time processing and immediate feedback capabilities
- Multi-provider AI analysis using structured prompt engineering
- Interactive decision application to modify clinical documentation

6.2 Clinical Impact

Patient Safety Enhancement

- Reduced medical errors through comprehensive guideline checking
- Improved diagnostic accuracy through multi-guideline validation
- Enhanced documentation quality reducing liability and improving patient care
- Real-time identification of potential safety concerns

Healthcare Efficiency

- Significant reduction in time required for guideline consultation
- Automated documentation enhancement reducing administrative burden
- Streamlined clinical decision-making process
- Improved educational outcomes for medical trainees

Quality Assurance

- Standardized care delivery based on evidence-based guidelines
 - Audit trail for clinical decision-making processes
 - Compliance monitoring and reporting capabilities
 - Continuous quality improvement through user feedback analysis
-

7. INDUSTRIAL APPLICABILITY

7.1 Healthcare Industry Applications

Primary Healthcare Settings

- General practice clinics for routine patient consultations
- Specialist clinics for complex diagnostic scenarios
- Emergency departments for rapid decision support
- Hospital wards for comprehensive patient management

Educational Applications

- Medical schools for clinical training and assessment
- Residency programs for supervised learning
- Continuing medical education for practicing clinicians
- Quality improvement initiatives in healthcare organizations

Healthcare Administration

- Quality assurance departments for compliance monitoring
- Risk management teams for patient safety initiatives
- Healthcare informatics departments for system integration
- Clinical audit teams for evidence-based practice verification

7.2 Market Demand Evidence

The invention addresses clearly demonstrated market needs:

- Growing regulatory requirements for evidence-based care
- Increasing complexity of medical guidelines and protocols
- Rising healthcare costs requiring efficiency improvements
- Healthcare workforce challenges requiring decision support tools

7.3 Technical Feasibility

The invention has been successfully implemented and tested:

- Working prototype with comprehensive functionality
- Validated database of circa 300 medical guidelines
- Demonstrated AI integration with multiple providers
- User interface testing with healthcare professionals
- Performance optimization for real-time clinical use

8. NOVELTY AND INVENTIVE STEP

8.1 Novelty Assessment

Unique Technical Combinations

The invention combines several technical elements in novel ways:

- Multi-provider AI architecture with intelligent routing and automatic failover

- Simultaneous multi-guideline analysis with parallel processing capabilities
- Interactive decision tracking system with comprehensive user decision management
- AI-enhanced clinical documentation improvement with structured recommendation interfaces

Non-Obvious Technical Solutions

The inventive step is evident in:

- Novel approach to handling AI provider diversity and reliability through intelligent routing
- Innovative solution to multi-guideline processing using parallel analysis techniques
- Unique user feedback integration for comprehensive decision tracking and audit trails
- Original approach to real-time clinical documentation enhancement using AI-powered suggestions

8.2 Technical Challenges Overcome

AI Reliability and Performance

- Solved the problem of AI provider dependency through multi-provider architecture
- Addressed cost optimization challenges through intelligent routing algorithms
- Overcame performance variability through adaptive load balancing

Clinical Workflow Integration

- Resolved the challenge of intrusive clinical decision support through seamless interface design
- Addressed the problem of guideline complexity through intelligent relevance ranking
- Solved documentation quality challenges through automated assessment and enhancement

Decision Tracking and User Interface

- Overcame the challenge of static recommendation systems through interactive decision tracking interfaces
- Addressed user feedback challenges while maintaining evidence-based recommendation integrity
- Solved the problem of comprehensive decision management without compromising clinical workflow efficiency

9. FIGURES AND DIAGRAMS

Figure 1: System Architecture Overview

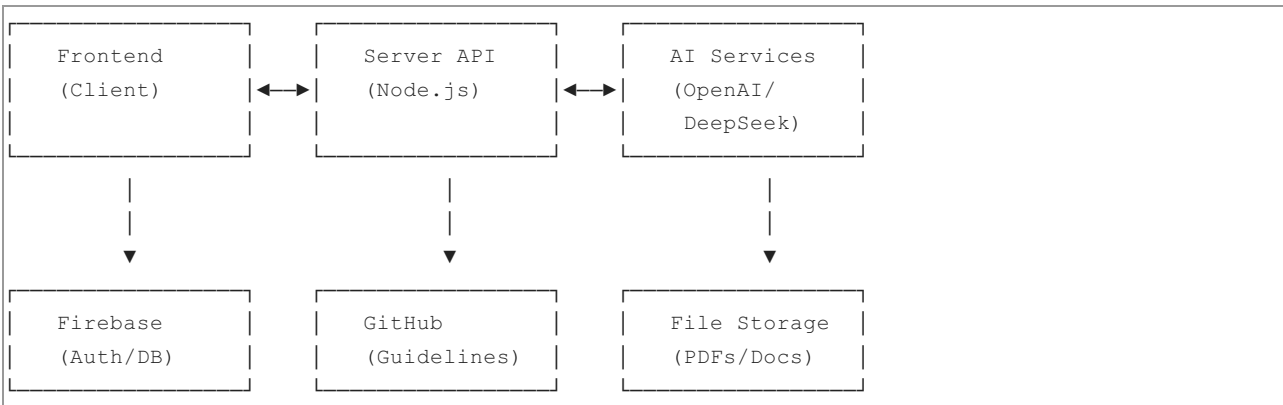


Figure 2: Clinical Analysis Workflow

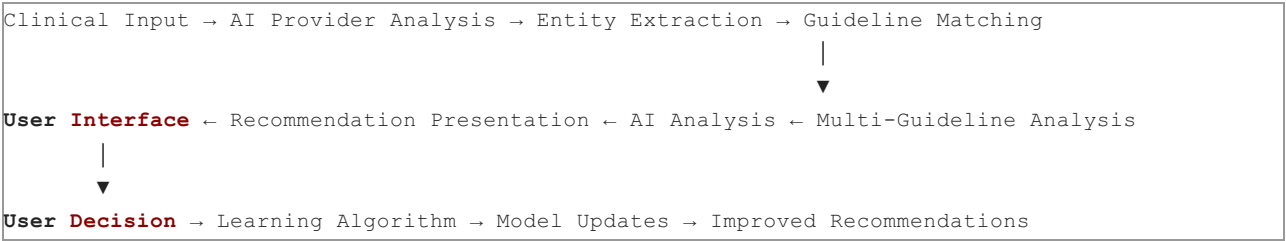
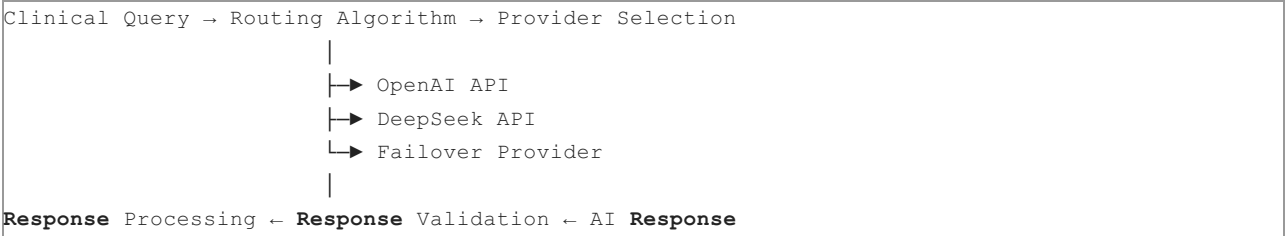


Figure 3: Multi-Provider AI Architecture



10. EXAMPLES AND EMBODIMENTS

Example 1: Obstetric Care Decision Support

Clinical Scenario: A healthcare professional enters a consultation note for a pregnant patient presenting with hypertension.

System Processing:

1. AI provider analysis identifies: pregnancy, hypertension, specific blood pressure readings
2. Guideline matching identifies relevant protocols: NICE Hypertension Guidelines, BJOG Preeclampsia Guidelines
3. Multi-guideline analysis detects potential preeclampsia risk
4. AI generates prioritized recommendations for additional assessments and monitoring

User Interaction:

1. System presents recommendations with importance categorization
2. User accepts blood pressure monitoring recommendation
3. User modifies suggested follow-up interval based on clinical judgment
4. System applies accepted and modified suggestions to update clinical documentation

Outcome: Enhanced clinical decision-making with comprehensive guideline compliance and updated documentation.

Example 2: Emergency Department Triage

Clinical Scenario: Emergency physician documenting patient with chest pain and shortness of breath.

System Processing:

1. Real-time analysis identifies cardiac risk factors
2. Multiple guidelines activated: NICE Chest Pain Guidelines, ACS Management Protocols
3. Risk stratification algorithms applied
4. Immediate action recommendations generated

Documentation Enhancement:

1. AI analysis identifies areas for improvement against cardiac guidelines

2. System generates categorized suggestions for additional documentation elements
 3. Healthcare professional reviews and selects which suggestions to implement
 4. Accepted suggestions automatically applied to update clinical documentation
-

11. PATENT PROSECUTION STRATEGY

11.1 Claim Strategy

Broad Coverage: Independent claims covering the core technical innovations

Defensive Patents: Dependent claims addressing specific technical implementations

Method Claims: Process claims covering the novel clinical analysis workflow

System Claims: Apparatus claims covering the distributed architecture

11.2 Prior Art Differentiation

Key Differentiators:

- Multi-provider AI architecture with intelligent routing
- Simultaneous multi-guideline analysis capability
- Interactive learning and adaptation mechanisms
- Real-time clinical documentation quality assessment

11.3 International Filing Strategy

Priority Markets:

- United Kingdom (primary filing)
 - United States (PCT application)
 - European Union (EPO filing)
 - Canada, Australia (healthcare technology markets)
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12. COMMERCIAL APPLICATIONS

12.1 Licensing Opportunities

Healthcare Organizations: Direct licensing for internal use

Electronic Health Record Vendors: Integration licensing for EHR systems

Medical Education Institutions: Educational licensing for training programs

Healthcare IT Companies: White-label licensing for broader distribution

12.2 Market Potential

UK Healthcare Market: £200+ billion annual market with growing digital transformation needs

Global Clinical Decision Support Market: \$1.8 billion market with 15% annual growth

Medical Education Technology: \$12.2 billion global market with strong AI adoption trends

13. CONCLUSION

This patent application presents a comprehensive and novel approach to clinical decision support through innovative AI-powered technology. The invention addresses critical healthcare challenges while providing significant technical advances over existing solutions.

The combination of multi-provider AI architecture, real-time multi-guideline analysis, and adaptive learning mechanisms represents a substantial technological leap in clinical decision support systems. The demonstrated clinical utility, technical feasibility, and strong market demand support the commercial viability and patent worthiness of this invention.

The technical innovations described herein are both novel and non-obvious, representing significant advances in medical informatics, artificial intelligence application in healthcare, and clinical workflow optimization.

Document Prepared By: CLERKYAI LTD (Pro Se Application)

Date: January 2025

Reference: Clerky Patent Application v1.0

Classification: Computer-Implemented Medical Systems, AI Healthcare Applications