

Pengaruh Otomatisasi Deteksi IUGR Berbasis AI Terintegrasi dengan Telehealth pada Ibu Hamil terhadap Peningkatan Kinerja Pemantauan Pertumbuhan Janin di Puskesmas

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Deskripsi Lengkap: <https://lib.fkm.ui.ac.id/detail.jsp?id=139243&lokasi=lokal>

Abstrak

<div style="text-align: justify;">Latar Belakang: Intrauterine Growth Restriction (IUGR) merupakan salah satu penyebab utama morbiditas dan mortalitas perinatal. Deteksi dini di Puskesmas masih menghadapi keterbatasan akses ultrasonografi, variasi kemampuan skrining, dan keterlambatan rujukan. Pemanfaatan Artificial Intelligence Clinical Decision Support System (AI-CDSS) berpotensi mendukung skrining dan pengambilan keputusan rujukan secara lebih konsisten. Tujuan: Mengembangkan model Artificial Intelligence (AI) berbasis data antenatal untuk skrining risiko IUGR di Puskesmas, menilai efikasi diagnostiknya dibandingkan metode konvensional, serta mengevaluasi dampak potensial implementasi sistem AI terintegrasi telehealth terhadap deteksi dini dan ketepatan rujukan IUGR di Puskesmas. Metode: Penelitian pengembangan dengan pendekatan multiphase mixed-methods ini dilakukan dalam lima tahap, yaitu analisis kebutuhan sistem, pengembangan model AI, evaluasi usability dan feasibility, uji efikasi diagnostik, serta evaluasi dampak potensial implementasi (simulated effectiveness). Pengembangan model menggunakan 1.761 data longitudinal dari 571 ibu hamil. Uji efikasi dan evaluasi dampak potensial melibatkan 604 ibu hamil di empat Puskesmas. Hasil: Model hybrid yang menggabungkan data maternal, tinggi fundus uteri, dan biometrik janin dari USG non-citra menunjukkan performa terbaik. AI-CDSS mencapai sensitivitas 100% (95%CI: 0,95–1,00), spesifisitas 87% (95%CI: 0,84–0,90), akurasi 89%, dan AUC 0,935 (95%CI: 0,916–0,954; p<0,001). Pada evaluasi dampak potensial implementasi, penggunaan sistem meningkatkan deteksi risiko IUGR dari 14,7% menjadi 25,8% (p=0,001) dan mengidentifikasi tambahan 67 kasus yang sebelumnya tidak terdeteksi. Kesimpulan: AI-CDSS VITA-Scan menunjukkan performa yang baik sebagai alat bantu skrining risiko IUGR di Puskesmas. Integrasi AI, aturan klinis, dan telehealth berpotensi meningkatkan deteksi dini serta mendukung ketepatan rujukan maternal.</div><hr /><div style="text-align: justify;">Background: Intrauterine Growth Restriction (IUGR) remains a major contributor to perinatal morbidity and mortality. Early detection in Indonesian primary healthcare centers (Puskesmas) is often challenged by limited access to ultrasonography, variations in screening practices, and delayed referral decisions. Artificial Intelligence Clinical Decision Support Systems (AI-CDSS) may help improve screening consistency and support timely referral decisions. Objective: To develop an artificial intelligence (AI)-based antenatal screening model for identifying the risk of IUGR in primary healthcare centers, assess its diagnostic efficacy compared with conventional approaches, and evaluate the potential impact of an AI-CDSS integrated with telehealth on early detection and referral accuracy. Methods: This multiphase mixed-methods study was conducted in five stages: needs assessment, AI model development, usability and feasibility evaluation, diagnostic efficacy testing, and simulated effectiveness evaluation. Model development used 1,761 longitudinal records from 571 pregnant women. The model integrated maternal characteristics, symphysis-fundal height measurements, and non-image ultrasound fetal biometric parameters using a hybrid approach that combined machine learning and clinical rules. Diagnostic efficacy and simulated effectiveness were evaluated among 604 pregnant women from

four Puskesmas. Results: The hybrid model demonstrated the best performance. The AI-CDSS achieved a sensitivity of 100% (95% CI: 0.95–1.00), specificity of 87% (95% CI: 0.84–0.90), accuracy of 89%, and an AUC of 0.935 (95% CI: 0.916–0.954; $p < 0.001$). During simulated effectiveness evaluation, the system increased IUGR risk detection from 14.7% to 25.8% ($p = 0.001$) and identified 67 additional cases that were not detected through routine practice. Conclusions: VITA-Scan AI-CDSS demonstrated good performance as a decision-support tool for IUGR risk screening in primary healthcare centers. The integration of AI, clinical rules, and telehealth has the potential to improve early detection and support more appropriate maternal referral decisions.