Embedding remote monitoring of cardiac implantable electronic devices into routine care - organizational enablers and early outcomes

Ivica Benko[1,2]*, Ivona Filipović[1], Magdalena Drljačić[1], Mateja Lovrić[1], Marina Žanić[1], Marina Budetić[1], Nikolina Slamek[1], Mirela Adamović[1], Marija Grlić[1]

[1]Dubrava University Hospital, Zagreb, Croatia
[2]University of Applied Health Sciences, Zagreb, Croatia

KEYWORDS: remote monitoring, cardiac implantable electronic devices, nurse led model, implementation.

CITATION: Cardiol Croat. 2025;20(11-12):299. | https://doi.org/10.15836/ccar2025.299

***ADDRESS FOR CORRESPONDENCE:** Ivica Benko, Klinička bolnica Dubrava, Avenija Gojka Šuška 6, HR-10000 Zagreb, Croatia. / Phone: +385-1-2902-545 / E-mail: ibenko@kbd.hr

ORCID: Ivica Benko, https://orcid.org/0000-0002-1878-0880 • Ivona Filipović, https://orcid.org/0009-0000-7291-6219 Magdalena Drljačić, https://orcid.org/0009-0004-8530-9230 • Mateja Lovrić, https://orcid.org/0000-0003-1457-6521 Marina Žanić, https://orcid.org/0000-0001-5123-8586 • Marina Budetić, https://orcid.org/0000-0002-1165-7097 Nikolina Slamek, https://orcid.org/0000-0002-2975-8793 • Mirela Adamović, https://orcid.org/0000-0003-4922-7436 Marija Grlić, https://orcid.org/0000-0002-4288-9659

Introduction: Remote monitoring (RM) of cardiac implantable electronic devices shortens time to clinical decision from 22 to 4.6 days and reduces cardiovascular hospital stay from 4.0 to 3.3 days[1]. RM can reduce in-hospital device evaluations by about 45% and detect clinically relevant events within less than 2 days[2]. Network-based follow-up has been associated with improved survival compared with clinic-only care[3]. We describe organizational challenges in introducing RM and early outcomes from a high-voltage (HV) device cohort.

Patients and Methods: This was a single-center implementation integrating RM into routine workflow. A nurse-led coordination model was created with triage protocols, escalation pathways, electronic medical records templates, informed consent and General Data Protection Regulation-compliant data handling. The first 14 implantable cardioverter-defibrillator (ICD) / cardiac resynchronization therapy defibrillator patients were enrolled over four months. Alerts were reviewed on working days with predefined thresholds for intervention or recall.

Results: Within the first four months, two device-related interventions were performed based on RM alerts and two patients were urgently recalled. One patient with heart failure presented with a new arrhythmia, and another experienced appropriate ICD therapy. No adverse events were linked to RM processes. Specially trained nurses managed alert handling and documentation with electrophysiology oversight.

Conclusion: A structured nurse-led RM program for HV devices is feasible and safe, translating literature-proven benefits into clinical practice. Specially educated nurses can reliably manage daily RM operations, ensuring timely interventions and reduced outpatient load. Broader adoption requires formal education pathways, certification by professional societies and clear administrative and legal governance.

RECEIVED:
October 1, 2025

ACCEPTED:
October 22, 2025

LITERATURE

1. Crossley GH, Boyle A, Vitense H, Chang Y, Mead RH; CONNECT Investigators. The CONNECT (Clinical Evaluation of Remote Notification to Reduce Time to Clinical Decision) trial: the value of wireless remote monitoring with automatic clinician alerts. J Am Coll Cardiol. 2011 Mar 8;57(10):1181-9. https://doi.org/10.1016/j.jacc.2010.12.012
2. Varma N, Epstein AE, Irimpen A, Schweikert R, Love C; TRUST Investigators. Efficacy and safety of automatic remote monitoring for implantable cardioverter-defibrillator follow-up: the Lumos-T Safely Reduces Routine Office Device Follow-up (TRUST) trial. Circulation. 2010 Jul 27;122(4):325-32. https://doi.org/10.1161/CIRCULATIONAHA.110.937409
3. Saxon LA, Hayes DL, Gilliam FR, Heidenreich PA, Day J, Seth M, et al. Long-term outcome after ICD and CRT implantation and influence of remote device follow-up: the ALTITUDE survival study. Circulation. 2010 Dec 7;122(23):2359-67. https://doi.org/10.1161/CIRCULATIONAHA.110.960633