Intracardiac pacemaker implantation was first described a half century ago; the same authors first reported on transtelephonic monitoring (TTM) of such devices a dozen years later (1,2). Follow-up of the pacemaker patient was recognized as critical, particularly in view of the uncertain reliability associated with leads and generators. Tracking device longevity and function have remained an important problem (3,4), compounded by the development of more widespread indications for pacemakers (5), increasingly complex devices, and mounting advisories that attest to an ever-present threat of premature device failure (6,7). Ironically, the population at risk of device malfunction has expanded due to medical and technological advances resulting in greater patient and pacemaker longevity. Device follow-up technology has also evolved, inevitably raising the question “how are pacemaker patients and their devices best monitored?”

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In-person monitoring has long been the gold standard for device follow-up, allowing history taking, physical examination, electrocardiography, radiography, interrogation, and reprogramming (8). Automaticity in devices, such as automatic threshold assessment, may alert the physician to the need for intensified follow-up and device adjustments and may reduce the frequency or duration of office visits. It cannot, however, supplant direct patient/pacemaker evaluation (9).

TTM facilitated the direct patient encounter by allowing fewer visits and serving as the first form of remote monitoring. During nonmagnet electrocardiographic assessment, TTM displays the patient’s free-running rhythm (intrinsic or paced) and whether appropriate sensing is present. Magnet electrocardiographic assessment evaluates effective pacing capture and provides the magnet rate of the device, useful in tracking generator depletion. Problems with telephone interference must be acknowledged, and only real-time information is available: no correlation may be made between past events or symptoms and the present transmission. Very importantly, TTM allows interpersonal interaction, history taking, and communication as to ongoing patient symptoms or concerns and medication changes.

Early studies with TTM demonstrated its utility in monitoring device depletion (10). A subsequent multicenter study demonstrated that TTM was accurate, with a positive predictive value of 93% for pacemaker failure (11). Guidelines for monitoring were established by the Centers for Medicare and Medicaid Services, which have not been updated for 25 years (5,12). Others have indicated that device problems could be identified throughout the life of a device and may be missed by TTM and that the existing Medicare guidelines may be inadequate for follow-up (13). What has become increasingly clear is that TTM may be useful for detecting battery depletion (14), but is significantly less effective in detecting all complications when compared with in-office pacemaker follow-up (15). This led to the recommendations by the Canadian Working Group on Cardiac Pacing that direct patient follow-up rather than TTM was desirable (16). Worldwide surveys in the past have demonstrated a 60% prevalence of TTM use in pacemaker follow-up, although current figures are lacking (17).

Remote monitoring and interrogation for follow-up of implantable cardioverter-defibrillators (ICDs), as opposed to pacemaker devices, are relatively new. Depending on the manufacturer, monitoring is enabled via Internet-based systems or through radiofrequency transmission from a transmitter in the ICD via telephone to a service center. Remarkably, the feasibility of the technique was only first reported 5 years ago in a prospective study (18), but its application to ICD follow-up has become widespread. In contrast to TTM, a host of information is afforded by this new technology, both real-time and historical (19). In particular, all information that may be interrogated from devices during the office setting is retrievable with remote monitoring of ICDs, with the caveat that remote manual testing or reprogramming of devices is not currently available.
Surprisingly, remote monitoring of pacemakers with this same technology has not been as widely used. In this issue of the Journal, Crossley et al. (20) present the results of the PREFER (Pacemaker Remote Follow-up Evaluation and Review) study, the first trial designed to evaluate prospectively the efficacy of remote pacemaker interrogation, traditional TTM, and in-person pacemaker evaluation using conventional Centers for Medicare and Medicaid Services guidelines (5,12). They observed an earlier time to first diagnosis of clinically actionable events (5.7 months vs. 7.7 months) in remote monitoring compared with TTM. Perhaps more importantly, only 2% of such events were identified by TTM (the remainder found during office visits) compared with 66% of such events in patients using the remote monitoring approach.

These findings support the impression that the primary benefit afforded by TTM is the close evaluation of generator longevity, which, given advances in technology and automaticity, assumes importance predominantly as the device nears its elective replacement indicator. TTM detected few clinically actionable events. Evaluation of pacemaker sensing and/or capture or, alternatively, detection of paroxysmal arrhythmias may be more problematic using TTM given the brief “window” afforded by real-time telemetry. In contrast, remote monitoring allowed the transmission of a host of details, both past and present, regarding pacemaker function and arrhythmias not retrievable through conventional TTM.

The timely and abundant information afforded by remote monitoring of pacemakers in particular (and cardiovascular implantable electronic devices [CIEDs] in general) is striking and clearly has an impact on previous guidelines for device follow-up (5,12,16). It must be recognized, however, that the present study (20) describes the utility of only 1 proprietary system: the applicability of these findings to other manufacturers is unclear (and not all devices allow remote monitoring). In contrast, TTM remains universally applicable.

Of separate concern is the definition of clinically actionable events (not synonymous with clinically important events). Undoubtedly, most practitioners would value the earlier recognition of elective replacement indicator or significant changes in threshold, impedance, and percentage of ventricular pacing; ironically, such detections reflect a minority of the events reported in the present study. In contrast, it is less clear what constitutes an arrhythmia burden significant enough to warrant intervention (how much nonsustained ventricular tachycardia and what duration or rate of atrial fibrillation). Most important, the authors have not demonstrated that actions taken in response to their remote detections had any effect on overall morbidity or mortality. No specific information is included regarding the timing and type of actions taken after clinically actionable event detection.

CIED follow-up must address various goals that are patient related (optimizing quality of life), CIED related (optimizing device function), and disease related (monitoring arrhythmias and hemodynamic status). Paradigms for CIED follow-up may also reflect patient preference, geographic isolation from direct follow-up, the patient’s underlying medical condition, CIED reliability, associated advisories, available follow-up resources, and cost considerations. This has led to a revisiting of guidelines for CIED monitoring (21). Is TTM an outdated modality? Is remote monitoring to become the preferred approach? Although in-person monitoring has served as the mainstay of follow-up, it is time to explore how TTM and remote monitoring may best be used to enhance the lives of patients with CIEDs and those responsible for their care.

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REFERENCES


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