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Cardiac Implantable Electronic Devices (CIEDs) provide undoubted net patient benefit but adverse risks and device failures, while of low rate, can be potentially severe, even life-threatening. Such risks are to be anticipated as devices rely on sophisticated engineering and complex manufacturing. Two to three decades ago during early expansion of the implantable cardioverter defibrillator (ICD) market, decisions regarding communication of observed risks had minimal input from the broad non-manufacturing stakeholder community. In 2005 there was a seismic shift in attitudes regarding such communication, prompted by events including the death of a young man with hypertrophic cardiomyopathy whose ICD failed to terminate exercise-induced ventricular fibrillation when it short-circuited during attempted shock delivery [1].

This incident termed by commentators the 'Guidant Affair' [1] led to formal recommendations regarding the communication of device-related problems. Specifically, if risk-relevant issues were discovered they should be communicated promptly, fully, and transparently to patients and their physicians [2]. One recommendation from the Heart Rhythm Society (HRS) Task Force was that manufacturers should each set up independent boards to consider issues potentially impacting safety and advise on external communication. We are the current members of the Patient Safety Advisory Board (PSAB) for one manufacturer that has maintained regular meetings with an evolving membership since inception in 2008. We felt it timely to describe our role and relationship with the manufacturer using a specific case as an example.

The index patient, resident in the EU, received a primary prevention EMBLEM subcutaneous ICD in May 2018 with no subsequent observed arrhythmias. The case review started in early 2022 when an unexpected observation was made during routine follow-up indicating ICD detection had been disabled following remote telemetry. Initial review concluded that LATITUDE interrogation had initiated simultaneously with a scheduled impedance measurement. By design, during such measurements detection is disabled for 700 msec to protect sensing circuits during delivery of the impedance-measurement pulse. Further analysis revealed that this coincidental action postponed impedance measurement for 24 hours during which period the ICD was unable to sense cardiac activity. This interplay between telemetry and impedance measurement was not anticipated, had not been seen before, and the patient suffered no adverse effects.

The manufacturer's review concluded that, while a software solution was deliverable, no immediate mitigation strategy was available, and furthermore, risks of patient-related harm were

within limits generally perceived as 'acceptable'. So, it was felt that no clinical action was necessary while the software solution was being developed. Following this initial evaluation, a meeting was held between manufacturer and the physicians managing this patient, and the quantitative risk assessment presented (appendix table 1). The patient's management team disagreed with the manufacturer's interpretation of relative risks, raising the possibility of taking all their EMBLEM patients off LATITUDE, and suggesting that a Field Safety Notice (FSN) should be issued immediately. Shortly thereafter, at our routinely scheduled semi-annual meeting, PSAB members concluded that while a FSN was unnecessary, the case should be followed closely, and that the board should be fully informed of any further instances. A few weeks later, the Competent Authority in the relevant jurisdiction also concluded that wider communication was needed. In light of this escalation, an ad hoc meeting of the PSAB was arranged by the inhouse safety team, where we reaffirmed our view that an FSN was ill-advised.

Our opinions were based on several factors: this software interaction had not been seen before; it could be readily corrected, with a technical solution already prototyped; most particularly, the worst-case harm assessment calculation, incorporating prior estimates of an average EMBLEM patient requiring defibrillation was exceedingly low and around 0.0159% per 24 hours (appendix table 1). Furthermore, we were concerned that a FSN might indeed result in actual harm, in that such a formal action by the company/regulators could induce doctors to remove patients from remote monitoring as was being considered in the case under review. Such a potentially adverse community action, we felt, had ample precedence, since prior extreme responses to FSNs had resulted in device or lead replacements and net patient harm [3]. While we acknowledged that hard data regarding the impact of remote monitoring on outcomes is incomplete, in our judgement the potential benefits of such monitoring e.g., earlier detection of actionable events, was very likely to outweigh the harm of discontinuing it. We also considered that managing the reinstitution of remote monitoring would likely also prove problematic. Our overall position therefore aligned with that of the manufacturer, namely, that issuing a FSN (an event perceived as highly significant by many clinicians), would be extraordinarily unlikely to prevent harm, and reasonably likely to induce harm.

The HRS Task Force [2] recommends that, in addition to independent committees, co-ordination of risk assessment be conducted by a core of inhouse manufacturer-employed professionals, including physicians, with safety-focused expertise. This example illustrates how internal and

external safety oversight groups, the broader company, and managing physicians work together. Current PSAB membership includes experience in clinical electrophysiology, cardiac surgery, patient advocacy, ethics and statistics. Some members have served for several years with new members recruited usually following retirements or resignations, being guided by suggestions made by the current PSAB, and aimed at minimizing tendencies to *group think,* increasing diversity and extending geographical reach. We convene semi-annually either in-person or as during Covid-19 remotely, participate in ad hoc meetings as necessary, and regularly observe engineering and manufacturing facilities in person. PSAB members are mindful of their individual responsibilities to evaluate situations impartially and independently; our joint conclusions are then reached in camera through consensus. Members receive fair market rate remuneration for their time, along with travel and subsistence expenses but with defined established limits to remuneration.

While transparency is the key guiding principle, we do not want to inundate physicians and patients with details on cases or issues that we perceive as lacking clear clinical relevance. As a group, we would view such an unfiltered approach as potentially obfuscating the key information needed to ensure patient well-being [2 4]. So, the constantly repeated questions guiding our actions concern what, when and how information about product performance should be communicated externally. We have a low threshold to recommend issuing notices taking into account the severity of clinical implications, the frequency of event occurrence, and the availability of practicable mitigations [2].

In terms of improving procedures, we have occasionally considered currently configured FSN mechanisms too blunt an instrument to provide the range of desirable communications between manufacturers and the wider community. Issuance of FSNs are too often interpreted as serious, sternly mandated notifications implying a message that *action must be taken*. As stated, in the current case we felt strongly that an FSN would likely induce behavior resulting in net harm. We however believe that being permitted to communicate issues in a less alarming format in such instances might be useful allowing clinicians to make their own individualized risk/benefit assessments, without the external pressures implied by an FSN.

We conclude that an independent PSAB plays an important representative role in guiding both risk assessment and efficient communication ensuring that physicians and patients are informed

while minimizing unhelpful messaging [4]. Although the manufacturer is not bound by PSAB recommendations, when we have advised communication the company has done exactly that; we also review the wording of proposed communications and provide suggestions for edits to letters sent to the broader community. For the described processes to be effective multiple players evaluating evolving datasets must work together in concert. Based on our experience, we are convinced that the recommendation of the 2006 HRS Task Force [2] to set up independent oversight mechanisms has provided meaningful benefit.

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Online (Table 1): Cumulative likelihood of harm due to 24 hour pause in detection *

Lead measure Frequency	Interrogation Frequency	Implant Duration	Cumulative Likelihood Hazard	Cumulative Likelihood of Worst-Case Harm	
Every 3 days	Weekly	5 years	0.07%	0.00001%	1 in 9 million
Every 7 days	Weekly	5 years	0.03%	Less than 0.00001%	1 in 21 million
Every 3 days	Quarterly	5 years	0.005%		1 in 117 million
Every 7 days	Quarterly	5 years	0.002%		1 in 272 million
Every 3 days	Weekly	1 year	0.014%		1 in 45 million

* Likelihood is dependent on two factors: (i) the frequency of lead impedance measurements; (ii) the frequency of device interrogations. Harm is presented as hypothetical worst case defined as loos of ambulatory ventricular arrhythmia resulting in death. Harm calculation is based on the likelihood of an EMBLEM patient requiring defibrillation therapy to treat arrhythmia over a 24 period of 0.0159% [1]

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