Date: November 30 2023

Canadian Heart Rhythm Society Device Committee

RE: Update to the June 2021 High Battery Impedance Advisory in INGENIO™, VITALIO™, and ADVANTIO™ dual chamber (DR) extended life (EL) pacemakers and INLIVEN™, INTUA™, and INVIVE™ cardiac resynchronization therapy pacemakers (CRT-Ps)

Nature of the Advisory: In 2021 Boston Scientific reported on malfunctions in a subset of INGENIO family devices manufactured in between 2011 and 2018. Affected dual chamber INGENIO family EL pacemakers and CRT-Ps may transition to Safety Mode during interrogation attempts by either a programmer or a LATITUDE communicator. This occurs when the battery exhibits high internal impedance, e.g. later in the device life-cycle but prior to reaching the Explant battery indicator. This increased battery impedance may cause a device to exhibit transient voltage decreases during periods of high-power consumption associated with telemetry communication via a programmer or a LATITUDE communicator. If the battery voltage drops below a minimum threshold during communication attempts, the device will temporarily halt telemetry, and a system reset will be performed. If three (3) system resets occur within a 48-hour period, the device will immediately enter Safety Mode to maintain back-up pacing with pre-defined, non-programmable settings [unipolar RV (or BiV) sensing/pacing at VVI @ 72.5 ppm with high output (5.0V at 1.0 ms)]. Although therapy is still provided, the reset to unipolar pacing and sensing when in Safety Mode may result in adverse effects via myopotential oversensing-associated pacing inhibition, loss of AV/VV synchrony, and phrenic nerve stimulation. Moreover, replacement is required as the device is non-programmable.

Since the original communication additional information has become apparent:

1. The occurrence rate for the device to exhibit a high battery impedance and initiate Safety Mode behavior is up to 8% at 9 years, 12% at 10 years, and 49% at 11 years.
2. Most Safety Mode behavior reports are associated with telemetry operations. However, approximately 3.5% of reports are unrelated to interrogations by an external device (e.g. programmer, LATITUDE Communicator, or LATITUDE Consult)
3. There have been 15 reports of a pause in pacing of up to 20 seconds in older devices with less battery capacity during telemetry operations with an external device.
4. There have been three (3) deaths in pacemaker-dependent patients associated with this behavior; all were within the recommended replacement interval, and none occurred in Canada.
5. When Safety Mode is initiated due to high battery impedance, previously reported battery time remaining estimates are invalid because they were determined without accounting for Safety Mode's increased outputs or the battery's high impedance state.

Scope of the problem:

All INGENIO family of DR EL pacemakers and CRT-Ps are potentially susceptible to this latent battery condition and subsequent initiation of Safety Mode prior to reaching the Explant battery indicator. The advisory initially comprised of approximately 48,000 active dual chamber INGENIO family pacemakers and CRT-Ps built with the Extended Life (EL) battery, of which approximately 38,000 remain in service. In Canada, approximately 6700 devices were in-service in 2021 and now approximately 5700 remain in

service. Importantly - the INGENIO family of Standard Life (SL) devices are not affected by this advisory. The SL devices are built with a different battery and have not exhibited this behavior.

It was previously estimated that one third of these devices will experience Safety Mode prior to reaching explant battery indicator, which has been revised to up to half of affected devices at 11 years of operation. While no identified serious adverse clinical events were observed in the initial 65 reports associated with this anomaly, subsequent information suggests that the potential for life-threatening harm for the affected population is 1 in 769 (0.13%) at 11 years, which can be mitigated if devices are replaced per the recommendations below.

UPDATED Response of the CHRS Device Committee:

- As part of this formal advisory, we recommend that patients be notified about this issue.
- Prophylactic device generator replacement is recommended in certain high-risk individuals at risk of harm, and in consideration of a shared decision-making process. Patients in whom prophylactic replacement may be considered are those where device reset to Safety Mode may not be well tolerated and may result in clinical deterioration via loss of AV/VV synchrony, phrenic nerve stimulation, or via myopotential oversensing-associated pacing inhibition (e.g. dependent patients).
    - For patients at risk of harm with dual chamber EL pacemakers, consider replacement with a longevity remaining of 4 years or less.
    - For patients at risk of harm with a CRT-Pacemaker, consider replacement with a longevity remaining of 3 years or less.
- Patients not electing to have prophylactic replacement should be followed in clinic at least every 12 months until one-year-remaining and then follow-up every three (3) months thereafter until replacement is indicated. Remote Monitoring should continue but limited to alarm notification only (i.e. no remote visits)
    - In clinic interrogation is preferable to remote monitoring visits given the potential to trigger safety mode in susceptible situations. Moreover, in clinic interrogation will allow immediate recognition of reversion to safety mode rather than it is occurring at home.
    - However, remote monitoring should be pursued between in clinic visits to enable early notification of safety mode reversion.
- In cases where Safety Mode is reached (or inability to interrogate the device or to transmit data is encountered) urgent replacement should be performed, as the previously reported battery time remaining estimates are unreliable as they do not account for Safety Mode's increased outputs nor the battery's high impedance state.
    - Pacemaker-dependent patients should be admitted to hospital and **their pacemaker replacement performed promptly.**
    - In non-pacemaker dependent patients, replacement should be planned **in ≤ 1 week.**
    - Note: patients will be in unipolar mode during device replacement, and thus precautions need to be taken given potential loss of pacing with can removal from the pocket.
- The CHRS device committee may update these recommendations should more data become available.

CHRS Device Committee

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