

A review of hand-held Electrocardiogram (ECG) recording devices

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Introduction: The advent of portable hand-held devices to record an electrocardiogram (ECG) in-clinic, has the potential to streamline patient assessment in many clinical environments. These ECG technologies are able to record one to six lead ECGs and enable rapid responses to clinical situations. These devices may also have a role in reducing interdepartmental movement of patients during the COVID-19 pandemic, by facilitating a one-stop shop for clinical evaluation. However despite their benefit, they can be more prone to artefact than a 12-lead ECG.

Purpose: To describe the currently available hand-held ECG technologies, their ease of use and diagnostic accuracy for rhythm assessment.

Method: An online review was conducted to identify new ECG technologies. Clinical colleagues were also surveyed for recommendations with respect to specifications, availability of alternative products, and informed of the inclusion /exclusion criteria. The review included devices which had built-in abnormal rhythm notification or display, were cost-effective and easy to use. Devices were automatically excluded if cutaneous skin electrodes were required, no in-built ECG display or notification, additional data transfer required to access ECG data or a high unit cost.

Results: An initial search uncovered nine devices, with five meeting inclusion /exclusion criteria. These devices were tabulated and compared predefined criteria (See table 1: ECG Technology comparisons). The analysis revealed that all devices utilised two finger placement on their recording electrodes to produce immediate ECG results – no cutaneous ECG application required. The KardiaMobile 6L™ had the largest number of beneficial features, namely multi-channel device, QTc interpretation, rapid diagnosis time and low cost. The intended use of hand-held devices is to detect AF. Four of five devices produced a snapshot ECG for rhythm identification on their display. However, AfibAlert™ devices provided an instant light alert if atrial fibrillation (AF) was detected. Instant check™, Dimitek™ and AfibAlert™ benefit from being complete stand-alone devices. In contrast, KardiaMobile devices have a built-in ECG display for instant review however, they require a smart phone or tablet to store and transfer the data. These devices support a reliable internal AF algorithm to obtain a high negative predicted value to safely rule out AF. Frequent premature atrial contractions (PACs) are often difficult to distinguish from AF and can lead to high false-positive rate. Hand-held devices are prone to artefact, however accurate visual assessment able to significantly reduce the amount of ECGs deemed uninterpretable.

Conclusions: Hand-held ECG technology has potential to become a useful, cost-effective tool during patient consultations, with rapid identification of clinically important arrhythmias. However, limitations exist across providers. A pilot trial of these devices is planned to assess further.

Abstract Figure.

Table 1: ECG Technology Comparisons

Device Name	Overview	Pro's	Con's	Costing	Number of Leads	Included/excluded
AliveCor - KardiaMobile	Two stainless steel finger electrodes Detects AF, SR, brady or Tachy 6L has increased ability to detects Atrial Flutter, PVCs and blocks Email recordings	<ul style="list-style-type: none"> • 30second to 5-minute recording • Displays ECG trace on smart device • Smoothing • ECGs seen remotely • Rhythm Management, with instant analysis 	<ul style="list-style-type: none"> • Requires smart phone • Not to use with PPM/ICD • Unable to comment on ectopic foci, Bragada or axis deviation 	<ul style="list-style-type: none"> • ~£100 	Single	Included
AliveCor - KardiaMobile 6L		<ul style="list-style-type: none"> • QTc Analysis 		<ul style="list-style-type: none"> • ~£150 	Six	Included
AfibAlert	Handheld two finger remote monitoring Detects presence of AF Data transferred via PC or mobile network	<ul style="list-style-type: none"> • Provides immediate alert via light system for AF 	<ul style="list-style-type: none"> • Does not display ECG trace • Unable to comment on ectopic foci, Bragada or axis deviation • Not recommended for PPM 	<ul style="list-style-type: none"> • ~£150 	Single	Included
Instant Check	Handheld two finger remote monitoring Used to spot-check for Irregular Rhythms	<ul style="list-style-type: none"> • Displays ECG recording • Rhythm Recognition 	<ul style="list-style-type: none"> • Requires PC to transfer data • Designed for single patient use • Unable to comment on ectopic foci, Bragada or axis deviation 	<ul style="list-style-type: none"> • ~£325 	Single	Included
Dimitek micro-ambulatory monitor	Fingertip/chest mode, electrode cable mode, holter mode	<ul style="list-style-type: none"> • Displays ECG trace • Rhythm Recognition 	<ul style="list-style-type: none"> • Requires PC to download data • Unable to comment on ectopic foci, Bragada or axis deviation 	<ul style="list-style-type: none"> • ~£200 	Single	Included