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Point of care testing for cholesterol measuring: A rapid review and presentation of the scientific evidence

Supporting primary care in the prevention and management of cardiovascular disease

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Document Abbreviations

Researcher Initials

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List of abbreviations in alphabetical order:

Abbreviation	Word/phrase
AAC	Accelerated Access Collaborative
AHSN NENC	Academic Health Science Network North East and North Cumbria
CEP	Centre for Evidence-based Purchasing
CLIA	Clinical Laboratory Approval Amendments
CRMLN	Cholesterol Reference Method Laboratory Network
CV	Coefficient of Variance
CVD	Cardiovascular disease
EQA	External quality assurance
FDA	Food and Drug Administration
HDL	High density lipoprotein
ICC	Intra Class Correlation coefficient
IFU	Instructions for Use
LDL	Low density lipoprotein
PHE	Public Health England
POCT	Point of care test
MRD	Mean relative difference
MARD	Mean absolute relative difference
NCEP	National Cholesterol Education Program
NICE	The National Institute for Health and Care Excellence
NPT	Near patient testing
RCT	Randomised controlled trial
RUP	Rapid Uptake Products
SE	Sensitivity
SME	Small or medium-sized enterprise
SP	Specificity
SR	Systematic review
TC	Total Cholesterol
TG	Triglyceride

Executive summary

Background

Cardiovascular disease (CVD) is a priority clinical area in the NHS long-term plan. The NHS Health Check is a screening program providing health check-ups for adults aged between 40 and 74. It is designed to spot early signs of various diseases, including heart disease, to identify people who would benefit from a CVD preventive program. It is delivered in primary care settings, supported by laboratory and point of care testing capabilities. The early identification of people at high risk of CVD, allows for behaviour change support, which can lead to improved patient outcomes.

In 2009, the Centre for Evidence-based Purchasing (CEP), part of the Policy and Innovation Directorate of the NHS Purchasing and Supply Agency, produced a buyers' guide for all commercially available lipid measurement systems for point-of-care total cholesterol and/or HDL cholesterol testing. In 2021, the Academic Health Science Network North East and North Cumbria (AHSN NENC) approached the NIHR Newcastle MIC to collaborate on producing an updated version on this document with a specific focus on aspects of the Market Review and clinical evidence.

Objectives

The objectives of this report are to:

1. Systematically identify the currently available POCTs for measuring cholesterol and their associated, published clinical and analytical evidence.
2. Extract and present the key studies and accuracy characteristics of the identified POCTs, as derived from the published clinical and analytical evidence.

Methods

MEDLINE and EMBASE were searched using a predefined search strategy. Firstly, we performed two searches to systematically identify all the currently available POCTs for measuring cholesterol. The first search was a *verbatim* repeat of that used in the 2009 CEP buyers guide, but restricted by year from 2009 onwards. The second search was a modified version of the first search, which leveraged validated search filters for the

key terms, but not restricted by year. Both these searches were run on 16th August 2021. The final search criteria were any the POCT's names elicited in the initial searches, this was run on the 11 October 2021. In addition to these systematic searches, NH at the AHSN NENC, extracted the technical specifications of the included POCTs. These are represented in Results, POCTs Technical Specifications. A targeted review for the device user manuals and instructions for use for the above identified devices was also carried out.

Results

The buyers' guide from 2009 summarised evidence on 6 commercially available lipid measurement systems for point-of-care, at that time there were only available published evidence on 4 of the devices. We identified 37 POCTs from our systematic searching, and 44 studies associated with 16 of these POCTs met the inclusion criteria and were extracted in this report. Below is a summary table of the POCTs and their associated evidence:

Table 1: POCTs identified through systematic searching in alphabetical order

POCT	N° Studies	POCT	N° Studies	POCT	N° Studies
Accutrend Plus	6	Element Multi*	0	PixoTest POCT Lipid System	1
Afinion 2 Analyzer	0	GreenCare Lipid	1	Pointcare M3i	0
Afinion AS100	2	HealthCube	1	Qucare	1
Aina Lipids	1	HumaSens 2.0 Plus	0	Quikread Go	0
Allegro	0	LipidoCare	0	Reflotron Plus**	2
BeneCheck Plus	0	LipidPlus	0	SimplexTAS 101	0
CardioChek PA	10	LipidPro*	0	Skyla HB1	0
CardioChek Plus	1	Mission Ultra	0	Skyla Hi	0
Cholestech LDX	21	Mission Cholesterol	1	Spotchem EZ/EL	0
Clini5	0	MS-S200	0	Swasthya Sahayak Pro	0
Cobas b101	3	MS-S300	0	VERI-Q MULTI	0
CR3000	2	Multicare-In	0		
Elemark	3	PiccoloXpress	2		

*Link to manufacturer not available
**Planned removal from the UK Market in May 2022

Out of all the studies, 12 were diagnostic accuracy studies mainly with low risk of bias (QUADAS - 2), 3/12 had medium risk of bias. The majority of included evidence (21+10+6/58=63.8%) was on three POCTs (Cholestech LDX, CardioChek PA, Accutrend Plus).

19 (51.4%) of the devices identified stated either Total Cholesterol Accuracy or Total Cholesterol Precision in their IFUs and user manuals. 4 out of these 19 devices (21.1%) met the National Cholesterol Education Program (NCEP) required standard of evidence for bias and precision (bias≤3%).

Table 2 Manufacturer Stated Performance

Device	IFU Available?	Measurement Range (mmol/l)	Stated Total serum Cholesterol Accuracy (TC Bias)	Stated Total Cholesterol Precision (%CV)	Meets NCEP standard of evidence for bias and precision?
Accutrend Plus	Yes	TC: 3.88 - 7.76	5.17 mmol/L: -4.4% 6.21 mmol/L: -1.8%	2.9-5.5	No
Afinion AS100*	Yes	TC: 2.59 - 12.95 TG: 0.51 - 7.35 HDL: 0.39 - 2.60	Not Reported	2.3-4.4	No
Aina Lipids	Yes	TC: 2.59-7.76 TG: 0.56-5.08 HDL: 0.65-2.20	Not Reported	3.4-4.3	No
CardioChek PA	Yes	TC: 2.59-10.36 TG: 0.57-5.65 HDL: 0.39-2.59	Unknown Concentration: -2.3%	0	Yes*
CardioChek Plus	Yes	TC: 2.59-10.36 TG: 0.57-5.65 HDL: 0.39-2.59	Unknown Concentration: -1.7%	0.2	Yes*
Cholestech LDX	Yes	TC: 2.59 - 12.95 TG: 0.51 - 7.35 HDL: 0.39 - 2.59	5.17 mmol/L: -1%	2.4-3.5	No
Cobas b101	Yes	TC: 1.28 - 12.95 TG: 0.51 - 7.35 HDL: 0.39 - 2.59	5.17 mmol/L: -2.1% 6.21 mmol/L: -1.8%	1.6-2.2	Yes
Piccolo Xpress	Yes	TC: 0.52-13.5 TG: 023-5.65 HDL: 0.39-2.59	Unknown Concentration: -0.5%	2.2-2.6	Yes
Reflotron Plus	Yes		Information not available	Information not available	No**
PixoTest POCT Lipid System	Yes		Information not available	Information not available	No
Qucare	Yes		Information not available	Information not available	No

GreenCare Lipid	Yes		Not Reported	3.6-3.9	No
Mission Cholesterol	No		IFU not available	IFU not available	Yes*
HealthCube	No		IFU not available	IFU not available	Unknown
Elemark	No		IFU not available	IFU not available	Unknown
CR3000	No		IFU not available	IFU not available	Unknown

*Cholesterol Reference Method Laboratory Network (CRMLN) Certified. **NCEP standard of evidence for bias and precision: Bias ≤ 3%, %CV ≤ 3%

Conclusions

This multi-step systematic review identified 44 studies associated with the 16 POCTs, which met the inclusion criteria; 12 of which were diagnostic accuracy studies with low risk of bias. Studies were mainly comparing capillary blood used with POCT and venous blood for laboratory testing, but also other comparisons were reported. Generally, the identified studies would compare POCT vs laboratory reference and a few compared POCT vs POCT.

There was an approximate 6-fold increase in the POCTs identified for measuring cholesterol since the CEP buyers review in 2009, from 6 to 37 POCTs.

There is a wide range in device performance, as stated by both the manufacturer and from the literature with only 4 devices identified meeting the requirements of the NCEP standard of evidence for bias and precision (bias≤3%). Manufacturer performance data, user manuals and IFUs were unable to be sourced for 14 out of 37 devices (37.8%).

There are limitations to this work: (1) This review was limited to analytical and clinical validity/diagnostic accuracy evidence. Other types of evidence, such as clinical utility and health economics, were not considered, but may have a role to play in policy making; (2) The evidence has been presented in a descriptive form (only) and has not been fully synthesised through a meta-analysis of each POCT. Both (1-2) were products of the scope of the current work; (3) The search strategy was a complex multi-step process and is likely not easily repeatable.

Future Work Recommendations

It may also be useful to broaden the scope of these searches to include clinical utility and health economic studies. Future work in the NIHR Newcastle MIC will look to find ways to simplify and formularise this type of multi-step searching, so that searches can be subjected to simpler updates and validation. A simpler, formulaic approach to searching for current POCTs and other devices may have broader value to clinicians, researchers, industry developers and policy makers.

Background

Point of care testing and point of care tests

Point of care testing, otherwise referred to as near patient testing (NPT), is testing near the patient rather than in a laboratory (e.g. in a patients' homes, primary care, pharmacies, outpatient clinics, by the beside in hospitals, …). Point of care tests (POCTs) that measure biomarkers in blood typically use relatively small volumes of capillary whole blood taken from a finger-prick. The results are rapidly available and may allow for faster management/decision making, earlier initiation and/or optimisation of treatment, reduced incidence of complications, increased patient satisfaction, etc. [2-6] and so have the potential to improve patient outcomes.

POCTs for cholesterol measurement include a range of hand-held devices and desktop analysers. They utilise disposable, dry-reagent technology to measure total cholesterol in a small sample of whole blood. Some of these systems are capable of measuring other lipids such as high-density lipoprotein (HDL) cholesterol, triglycerides, low density lipoprotein (LDL) cholesterol and associated analytes [7].

CVD risk factor assessment & cholesterol

Heart and circulatory disease, also known as cardiovascular disease (CVD), causes a quarter of all deaths in the UK and is the largest cause of premature mortality in deprived areas [8, 9]. The NHS Long Term Plan identifies CVD as the single biggest area where the NHS can save lives in the next ten years [8]. Risk factors associated with CVD broadly classified as non-modifiable or modifiable, with blood cholesterol considered a key modifiable risk factor.

Public Health England (PHE) is coordinating the NHS Health Check prevention programme, which is a screening programme providing health check-ups for adults aged between 40-74. It is designed to spot early signs of various diseases, including heart disease, with a view to identifying people who would benefit from a CVD preventive program. It is delivered in primary care settings, supported by laboratory

and point of care testing capabilities. The early identification of people at high risk of CVD, allows for behaviour change support, which can lead to improved patient outcomes.

The National Institute for Health and Care Excellence`s (NICE) endorsed guidelines [10] are in approximate alignment with the NHS Health Check programme and suggests a measurement of the non-fasting sample for total cholesterol, HDL-C, non-HDL-C, LDL-C, triglycerides concentrations. The non-HDL cholesterol measurement is then used to calculate a patient risk for developing CVD using the QRISK cardiovascular risk assessment tool together with other risk factors for primary prevention [10]. The NHS and Accelerated Access Collaborative (AAC) Rapid Uptake Products (RUP) are working in partnership to deliver the Lipid programme which focuses on lipid management optimisation to reduce death and disability due to premature CVD [11].

Concerns have been raised about the reliability of POCT results compared to laboratory testing [12, 13]. Poor accuracy of POCTs for cholesterol could lead to either false reassurance or over-diagnosis and -treatment, thus potentially committing a patient to lifetime therapy. This might undermine the clinical- and cost-effectiveness of the NHS Health Check programme [6].

2009 CEP buyers guide, the AHSN NENC, and the NIHR Newcastle MIC

In 2009, the Centre for Evidence-based Purchasing (CEP), part of the Policy and Innovation Directorate of the NHS Purchasing and Supply Agency, produced a buyers' guide for all commercially available lipid measurement systems for point-of-care total cholesterol and/or HDL cholesterol testing ([7]). It includes technical, operational, economic and purchasing considerations that are important when selecting a suitable system and highlights those devices suitable for the NHS health checks programme. In its Market Review section, it lists the cholesterol POCTs currently available on the UK market, lists their advantages and disadvantages, and outlines their performance claims.

In 2021, the Academic Health Science Network North East and North Cumbria (AHSN NENC) approached the NIHR Newcastle MIC to collaborate on producing an updated version of the buyers' guide, with a focus on the Market Review section, that is, identifying available POCTs and their associated diagnostic evidence as the focus of the current report.

Objectives

The aim of this report is to provide an impartial overview of POCTs for cholesterol available on the market that could be used in primary care as a part of NHS Health Check requirement. This report covers a summary of published evidence in tabular form and technical specifications about the identified POCTs.

The objectives of this report are:

1. To systematically identify the currently available POCTs for measuring cholesterol and their associated, published clinical evidence.
2. To extract and present the key test, study and accuracy characteristics of the identified POCTs, as derived from the published clinical and analytical evidence.

This review includes published studies and publicly available technical evidence that is important when selecting a suitable system for the NHS Health checks programme. This review does not include over the counter, single use disposable total cholesterol measurement kits for self-testing.

Methods

A literature search was conducted to identify the POCT brand names, evidence extraction and technical specifications of the included POCTs was conducted. MEDLINE and EMBASE were systematically searched using a predefined search strategy. Firstly, we re-ran the search from the 2009 CEP Buyer's Guide to systematically identify all the currently available POCTs for measuring cholesterol up to 2009. Then we modified the search by utilising the same key terms, however, without restrictions. After this phase a long list of POCTs were extracted and evaluated

based on pre-set criteria. The final search was for the shortlisted POCT's names elicited in the initial searches. Relevant studies from all searches that met the inclusion criteria were extracted and results presented in a tabular form. In addition to these systematic searches, NH at the AHSN NENC, extracted the technical specifications of the included POCTs. These are represented in Results, POCTs Technical Specifications. The strategy is outlined in Figure 1.

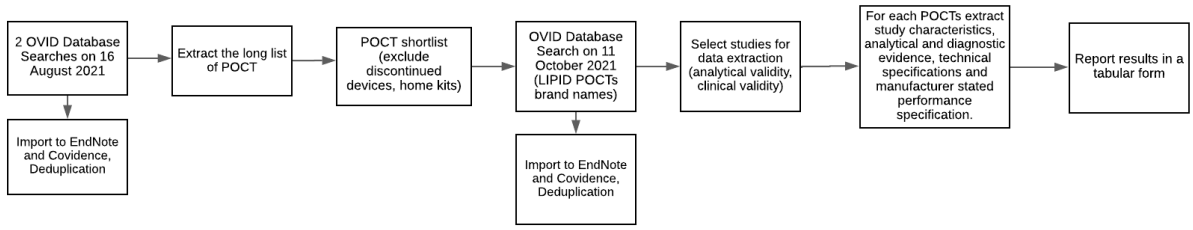


Figure 1: Study flow

Search methods

MEDLINE and EMBASE were systematically searched using a predefined search strategy to identify all the currently available POCTs for measuring cholesterol. The first search was a *verbatim* repeat of that used in the 2009 CEP buyers guide (conceptualised as A: [POCT] and B [lipid/cholesterol]) but restricted by year from 2009 onwards. The second search was a modified version of the first search, with the key terms (conceptualised as A: [POCT] and B [lipid/cholesterol] and C [primary care]), without restrictions. Searches were limited to these terms appearing in the title, abstract or keywords and to papers available in English. We have considered all research articles in humans. Both these searches were run on 16th August 2021. The final search was for the POCT names derived from the initial searches. This was run on 11th October 2021 without any limits (all searchable fields). Devices already in use but discontinued were not part of the search.

Further studies were identified through snowballing, either by reviewing the references of relevant papers or by searching for further publications by relevant authors. The results were downloaded to Endnote [14], then uploaded, de-duplicated and screened in COVIDENCE [15].

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) statement. The PRISMA

flow chart and the complete line-by-line search strategy is shown in Appendix 1. Following the systematic reviews, a targeted review for the device user manuals and instructions for use for the above identified devices was carried out (TH).

Inclusion and exclusion criteria

The primary outcome of the screening process was to identify papers reporting a brand name of POCTs measuring lipids. All device brand names were extracted and reviewed. Shortlisted devices met the following criteria: 1) were still in production 2) were intended for professional use and 3) could measure lipids as per NICE guidelines [10]. To be included, studies had to compare test results of the POCT to the laboratory result or to another POCT. Only peer-reviewed articles published in English were included. Retrieved systematic reviews were only used as reference to the primary sources. Primary studies evaluating the analytical and clinical validity (diagnostic accuracy studies) of POCTs measuring cholesterol (lipid panel) as a secondary outcome were also considered for inclusion. Articles were excluded if the study was not original research, if the study type, outcome, or setting were wrong, not in English or not in humans. Articles were excluded if brand names of used POCTs evaluated were not clearly reported or if results from different POCTs were pooled and analysed together.

Selection of studies

The literature search and study selection were performed independently by two researchers, JS and CM. If they did not reach agreement, the opinion of a third investigator (WJ) was obtained. COVIDENCE [15] was used for a better systematic management of the identified evidence. After removing duplicates, titles and abstracts of all identified publications were screened according to the pre-defined inclusion/exclusion criteria reported above. The included full text articles were reviewed to determine eligibility for inclusion. Studies were included if they reported relevant results on analytical validity or clinical validity/diagnostic accuracy. See Appendix 2 for detailed Inclusion/Exclusion Criteria.

Data extraction

Relevant data from identified papers was extracted to an Excel workbook. Each sheet in the Excel workbook included one POCT. For each study, basic characteristics (Author, Year, Location, Link to the paper), study type and design, clinical setting, population, and sample size, POCT sample type, comparator, results, key findings, and a total risk of bias assessment were retrieved.

A data extraction form was developed and piloted using a smaller number of studies. Data extraction was performed by JS, CM, TH, RD and CW. The NIHR Newcastle MIC team established an agreed upon extraction method prior to commencing the extraction process. Studies were included if they reported relevant results on analytical validity or clinical validity/diagnostic accuracy. See Appendix 2 for detailed Inclusion/Exclusion Criteria. Extracted results were summarised in tabular form for each POCT.

A second data extraction form was developed to extract manufacturer stated Total Cholesterol Accuracy (TC Bias) and Stated Total Cholesterol Precision (TC % CV) from the user manuals and instructions for use.

Risk of bias assessment

The methodological quality of the included studies was assessed using QUADAS 2 tool [16] for diagnostic accuracy studies. We summarised the overall risk of bias and reported it in the tables in the results section. Studies with sum of 10 or less were considered prone to bias and were classified as being at high risk of bias, studies with 10 to 15 were classified as being at medium risk of bias, studies with 15 to 20 were classified as being at low risk of bias. This threshold was chosen by the authors. See Appendix 4 for detailed QUADAS-2. We did not identify an appropriate tool for the critical assessment of analytical validity studies.

Results

The buyers' guide from 2009 summarised evidence on 6 commercially available lipid measurement systems for point-of-care (Accutrend Plus, BeneCheck PLUS, CardioChek PA, Cholestech LDX, PiccoloXpress and Reflotron Plus). There were no published studies or reports available for BeneCheck PLUS, this remained unchanged. We also identified an additional 2 published studies for PiccoloXpress which were not reported in the buyer`s guide from 2009. Repeating the exercise in 2021, we identified 45 studies associated with 16 POCTs which met the inclusion criteria and were extracted in this report (see Table 2). Below is a summary table of the POCTs and their associated evidence:

Table 3: POCTs that met the inclusion criteria and were extracted in this report, 2009 and 2021

POCT	Nº Studies (2009)	Nº Studies (2021)
Cholestech LDX	13	21 (7 duplications)
Reflotron Plus	7	2 (1 duplications)
CardioChek PA	5	10 (2 duplications)
Accutrend Plus	3	6 (1 duplications)
BeneCheck PLUS	0	0
PiccoloXpress	0	2
Cobas b101	NA	3
Elemark	NA	3
Afinion AS100	NA	2
CR3000	NA	2
Aina Lipids	NA	1
CardioChek Plus	NA	1
GreenCare Lipid	NA	1
HealthCube	NA	1
Mission Cholesterol	NA	1
PixoTest POCT Lipid System	NA	1
Qucare	NA	1

NA – not applicable

The evidence is unevenly distributed across POCTs, with most of the included evidence (37/58=63.8%) focused on three POCTs (Cholestech LDX, CardioChek PA, Accutrend Plus). The majority of POCTs had one to three published studies reporting on their

performance. Out of all studies, 12 were diagnostic accuracy studies and the remaining 32 analytical validity studies. See Appendix 3 for details.

Below we provide technical specifications for each of the included POCTs (see POCTs Technical Specifications). Following this, we provide a table for each POCT, extracting evidence on either analytical validity or diagnostic accuracy. For each study we provide basic characteristics (Author, Year, Location, Link to the paper), study type and design, clinical setting, population and sample size, POCT sample type, comparator, results, and key findings. For diagnostic accuracy studies we also provide an overall risk of bias assessment. Studies reporting several POCTs are listed under each corresponding POCT.

POCTs Technical Specifications

In addition to systematic searches, NH at the AHSN NENC, extracted the technical specifications of the included POCTs.

Table 4: Lipid POCTs technical specification and market review

	LipidPlus Analyzer (MD550)	**Aina Lipids**	**Afinion AS100**
Manufacturer	Jant Pharmacal	Jana Care	Alere/Abbott

Description	Requires test strips, a capillary rod, and a disposable, single-use lancing device, which is designed to allow individuals, regardless of training, to obtain accurate lipid panel and glucose readings. Automatic code recognition by RFID-tag and Color-tag. LCD or printer output.	Diagnostic sensor and smartphone application that plugs into any smartphone and analyzes HbA1c, blood glucose, hemoglobin, creatinine, and lipids from a capillary blood sample in only minutes. The device can be used by patients for self-monitoring as well as by healthcare providers for mass screening and point-of-care testing.	The Alere Afinion AS100 Analyzer makes it fast and easy to test quantitative determinations of HbA1c, Lipid Panel, ACR, and CRP. The Analyzer and test cartridges have been precision engineered with each test cartridge containing an integrated sample collection device and all necessary reagents for a single test. Includes colour touch display.
Tests	Total Cholesterol, Triglycerides, Glucose	HbA1c, blood glucose, hemoglobin, creatinine, and lipids	HbA1c, Lipid Panel, ACR, CRP
Price	$210-$325	< $50	£1,200 (NICE, 2016)
Reagent Price		$1 per test	£3.50 per test
Sample Voulme / Type		5 µL (whole blood capillary or venous)	1.5 µL Capillary blood or anticoagulated venous blood
Measurement time	> 2 minutes	3 minutes	3 minutes
Measuring range		TC: 2.59 to 10.34 mmol/L HDL: 0.65 to 2.20 mmol/L TG: 0.56 to 5.08 mmol/L	
Heamatocrit Range			
Memory	200 individual test results		500 patient results + 500 control results
Power supply	AAA Battery	1x 1.5V AAA Battery Battery Life of at least 200 Tests	Mains power
Weight			5 kg
Dimensions			32 cm x 17 cm x 17 cm

...continued	CardioChek Plus	CR3000	Elemark
Manufacturer	PTS Diagnostics	Callegari	BBB Technologies Inc.
Description	The CardioChek analyzers are one of the fastest, cost-efficient, and user-friendly methods to accurately determine lipid values. Handheld and battery-powered, CardioChek analyzers require a small blood sample from a simple fingerstick. In as little as 90 seconds, CardioChek test systems provide values using the same technology as clinical laboratories.	Liquid chemical photometric absorbance system with centrifuge. Wet chemistry application assures accuracy and precision comparable to laboratory equipment. Three three reading cells in the instrument.	BBB Elemark is an Android-powered real time blood testing device. Reflectance Photometry. Automatically uploads results to the cloud and creates data analysis charts
Tests	10 tests including cholesterol & glucose	TOT Cholesterol, HDL Cholesterol, LDL Cholesterol, CHD, Triglycerides, Glucose, HbA1c	Full lipid profile TC. TG. HDL. LDL
Price	$892.59 - $990.50	€2970 - €3,534*	$500**
Reagent Price	$109 for 25 strips		
Sample Voulme / Type	15 to 40 µL whole blood	5–50 µl whole blood (average 10ul)	"single drop of blood"
Measurement time	90-Second Results for Full Lipid Panel	2-7 minutes (3 simultaneous tests)	Glucose 5 sec / Ketones 7 sec Other: 3 minutes
Measuring range	Choltsterol Test Strips: 0.64 to 2.20 mmol/L		
Heamatocrit Range			

Memory	50 results of each chemistry + 10 results for control tests		
Power supply	4 x AA battery	12 V DC – 3,5 A	
Weight	500g	1kg	
Dimensions	13cm x 8cm	25.5cm (w) x 27.3cm (l) x 7.4cm (h)	

...continued	HealthCube	LipidPro	Cholestech LDX
Manufacturer	HealthCubed	Infopia/Osang Healthcare	Alere/Abbott
Description	Results available on mobile phone app Includes ports for connecting blood pressure cuff, ECG cables, pulse oximeter probes & other parameters. Indian company rolling out across several states in India, Kenya, Angola. To begin operation in Senegal.	Measurements are normally taken from the finger but alternative site testing is allowed and it is intended for professional use. Uses the spectroscopy method for measuring. Based on the enzyme chromophoric reaction principle.	Efficient and economical point of care testing for cholesterol and related lipids, and blood glucose. Measures the levels of TC, HDL and triglycerides, calculates the TC/HDL ratio and estimates of LDL and VLDL.
Tests	30+ tests including glucose, haemoglobin, cholesterol, uric acid, (WBC differential count, HbA1C & lipid profile)	Total Cholesterol, HDL Cholesterol, Triglycerides and Glucose	TC, TC-Glucose, TC-HDL, TC-HDL-Glucose, Lipid Profile, and Lipid Profile+Glucose.
Price		$199.00*	£1,250 without printer
Reagent Price		$31.25 for 10 cholesterol strips*	Dual Test Cassettes(10cnt): £76.45= £7.65 per test Triple Panel Cassettes(10cnt): £85.0 =£8.50 per test
Sample Voulme / Type	5 µL for electrochemistry tests 50 µL for Rapid Card Tests	Capillary & venous	35-40µL
Measurement time	4-5 minutes	2 minutes	5 minutes or greater
Measuring range		TC: 2.59 to 10.34 mmol/L	

Heamatocrit Range			up to 52
Memory		200 of each test	Last result only
Power supply		2 x AAA battery	9v Power cord for main adapter (does not operate on battery power)
Weight	1.7 kg		1kg
Dimensions	25 x 20 x 65 cm		21cm x 12cm

...continued	Piccolo Xpress	Reflotron Plus	Cobas b101 System
Manufacturer	Abaxis Medical	Roche	Roche Diagnostics
Description	Delivers real-time blood chemistry diagnostic info within minutes: Piccolo is a fully-automated POC device suitable in inpatient and outpatient settings. Features 31 blood chemistry tests that range from liver, kidney and metabolic functions to lipids, electrolytes and other specialty analytes. These 31 tests are conveniently configured into 16 completely self-contained reagent discs.	In vitro diagnostic device with integrated printer, for the determination of clinical chemistry parameters using Reflotron Test reagent strips. It works on the principle of reflectance photometry and ensures rapid and reliable results while being easy to use. Allows the measurement of 16 parameters from whole blood, plasma or serum – including liver and pancreas enzymes, metabolites, blood lipids, hemoglobin and potassium.	Cobas b101 offers HbA1c and a complete lipid profile on one device. You can use either capillary blood, whole blood and plasma with fast and reliable results on a user-friendly large touchscreen, full keyboard and multiple language support. Intended for professional use in a clinical laboratory setting or point-of-care locations.
Tests	ALB, ALP, ALT, AMY, AST, BUN, Ca, CK, Cl-, CRE, GGT, GLU, K+, Na+, PHOS, TBIL, tCO2, TP, UA, CHOL, CHOL/HDL*, HDL, LDL*, nHDLc*, TRIG, VLDL, CRP, DBIL, CAC, LDH, Mg (* is a Calculated value)	Alkaline Phosphatase, Amylase, Bilirubin, Cholesterol, CK, Creatinine, GGT, Glucose, GOT (AST), GPT (ALT), HDL Cholesterol, Haemoglobin, K (Potassium), Pancreatic Amylase, Triglycerides, Urea, Uric Acid	HbA1c, lipids, and CRP testing: CHOL, HDL, LDL, TG, non-HDL, TC/HDL

Price		Originally around £8000 however product is no longer manufactured. Refurbushed units are available for around £3000	£2,992
Reagent Price			10 strips range from £85-£110
Sample Voulme / Type	100 µl of whole blood, serum or plasma)	30µl whole blood (capillary and venous) plasma or serum	19 µL for lipids: Capillary, whole blood or plasma
Measurement time	30 seconds	2-3 minutes	
Measuring range			TC: 1.28–12.95 mmol/L TG: 0.50–7.35 mmol/L HDL: 0.38–2.60 mmol/L
Heamatocrit Range			
Memory			
Power supply			
Weight	13.61kg		5 kg
Dimensions	21cm x 14cm x 32cm		

...continued	Cardiochek Professional Analyser	Accutrend Plus	PixoTest POCT System
Manufacturer	Polymer Technology Systems (USA)	Roche Diagnostics	iXensor Co. Ltd.
Description	An easy-to-use point-of-care system ideal for multiple clinical settings. Approved in 2009 by the NHS.	Hand-held POC device for the key parameters. The meter is suitable for professional use as well as for self-testing (except for glucose). Test is based on the retention of blood cells by filtration via a glass fibre fleece when a drop of blood is applied to the test strip.	PixoTest POCT System integrates APP features and multiple IVD tests including HbA1c & Lipid. The PixoTest technology utilizes the lighting and image sensing module of the smartphone to detect the color change reaction on test strips. The image of the test strip is captured by the front camera and analyzed via the measurement algorithm to turn out a quantified result. It good integration of IVD and IT application.
Tests	Total cholesterol, high density lipid (HDL) cholesterol, triglycerides, and glucose (mmol/L). Can also calculate cholesterol ratios.	Cholesterol, Triglyceride, Glucose, Lactate	(Total cholesterol, HDL, Triglycerides and Calculated LDL
Price	£447.50 excl. VAT	Retail £100-£250 depending on options	
Reagent Price		25 strips for around £72 = £2.88 per test	
Sample Voulme / Type	15 – 40 µL	15–40 µL Capillary blood	35 µL Whole blood, fingertip blood & venous blood
Measurement time	Less than 2 minutes	Lipid: 3 minutes	Within 3 minutes

Measuring range		TC: 3.88–7.76mmol/L	TC: 2.59 to 12.93 mmol/L HDL: 0.64 to 2.46 mmol/L TG: 0.51 to 7.34 mmol/L
Heamatocrit Range			TC/TG:30–55%;HDL:30–52%
Memory	200 results	100 different measurements with date, time and flags	
Power supply			5000mAh battery, non-removable
Weight			131.3g
Dimensions			181 mm(L)x111mm(W)x53mm(H)

...continued	Mission Cholesterol	Qucare Multi Meter	GreenCare Lipid
Manufacturer	ACON Laboratories, Inc.	DFI Diagnostics	Green Cross Medical Science
Description	The easy to operate system consists of a portable meter that analyzes the intensity and color of light reflected from the reagent area of a test device, ensuring quick and accurate results.	Quantitative meter	GCare Lipid Analyzer is a compact, hand-held combined lipid and glucose POC device. Measurement is based on reading reflected values using LED and PD. GREENCARE LIPID measures the changes in the reaction color after blood is applied on the test strip and displays the corresponding cholesterol level.
Tests	Total Cholesterol (CHOL), High Density Lipoprotein Cholesterol (HDL), Triglycerides (TRIG)	TC/HDL/TG/LDL	TC, TG, and HDL-C, LDL-C value is calculated
Price	145€ (from Kurstjens, 2021)	150€ (from Kurstjens, 2021)	Price unavailable
Reagent Price	1€/strip	4.5€/strip	Price unavailable
Sample Voulme / Type	Collects capillary blood from fingertip blood testing for accurate results (10µL for an individual test and 35µL for a 3-1 test).	Whole blood(Capillary blood), 7 µL Serum	Capillary and venous blood samples, 40 µl

Measurement time	less than 2 minutes	2 minutes	150 s
Measuring range	TC: 2.59-12.93 mmol/L) HDL: 0.39-2.59 mmol/L TG: 0.51-7.34 mmol/L	TC: 2.59-11.64 mmol/L HDL: 0.65-2.59 mmol/L LDL calculated LDL=TC(total cholesterol)-HDL-(TG(triglyceride)/5) TG: 0.51-7.34 mmol/L	TC 2.59 – 10.34 mmol/L HDL 0.65-2.59 mmol/L TG 0.56-6.77 mmol/L
Heamatocrit Range			Cholesterol 30~50%
Memory	200 records	1,000 test results	Store 1000 Cholesterol Data.
Power supply	4 AAA batteries (1.5V) AC Adapter (Mini USB, 5V dc, 50 mA)	Internal rechargeable battery (3.7V, 1000 mAh Lithium polymer battery)	(AAA) 1.5V X 4
Weight	145g (without batteries)	120g	120g
Dimensions	137 mm × 79 mm × 26 mm	Width(130 mm), Depth(68 mm), Height(23 mm)	130 x 65 x 30 mm3

Accutrend Plus (Roche Diagnostics, Switzerland)

Table 5: Table of characteristics, Accutrend Plus

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Barrett, 2014[17], Australia	Analytical Validity, Cohort	Laboratory, Secondary Care	Women in late pregnancy, n=40	Capillary blood	National Association of Testing Authorities, Australia (NATA) accredited to ISO 15189 standard clinical, commercial laboratory (Beckman DXC800), venous blood	Bland-Altman difference: Mean Bias: −0.01 mmol/L (−0.5%) (95% CI −0.93 – 0.91 mmol/L (−28.5% - 27.5%). The reference method was highly correlated with the capillary method (r = 0.89, P <0.0001), and the two distributions were not statistically different (mean difference 0.01 mmol/L (SD 0.47), t = 0.18, P =0.86). Passing-Bablok linear regression analysis: y = − 0.01 +0.98 × (95% CI for the intercept −0.51 – 0.38; 95% CI for the slope 0.85 – 1.15)	The use of this device in clinical studies of pregnancy, outside a diagnostic setting would seem reasonable.	

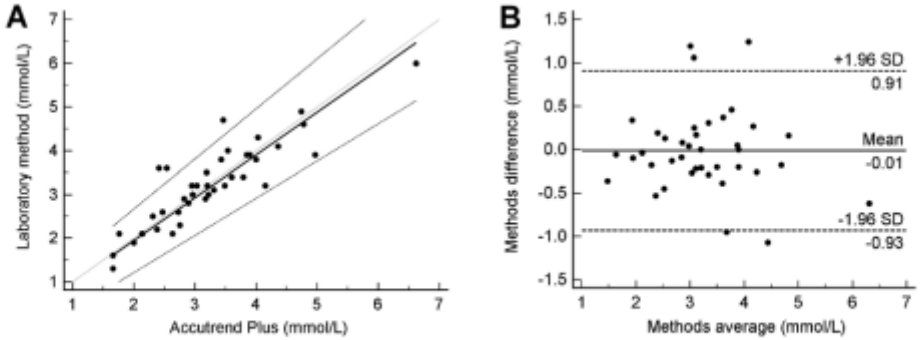


Figure 1 Graphs of comparison between methods. A. Passing Bablok regression plot for triglycerides determined on laboratory method and Accutrend® Plus. **B**. Bland Altman Plot for the difference between methods.

Coquiero, 2014[18], Brazil	Clinical validity, Cohort	Secondary Care	Adults (≥ 18 years), n=53	Capillary blood	Private clinical laboratory Diagnóstica Laboratório de Análises Clínicas Ltda (Labmax 240), venous blood	Cutoff TC 5.17 mmol/L; TG 1.69 mmol/L ; Se (%): TC: 84.4 TG: 90.5 Sp (%) TC: 95.2 TG: 96.9 Lin's concordance coefficient with the laboratory method (r) TC:r=0.944 [0.905, 0.967]; TG: r=0.990 [0.982,0.994] Concordance (%) for subject classification according to the Brazilian Guidelines for Diagnosis and	The Accutrend Plus system showed good reproducibility and a high level of agreement with the laboratory method. Accutrend Plus system detected significantly higher values of triglycerides and lower values of TC than the laboratory methods. Accutrend Plus system showed good reproducibility and high agreement with the laboratory method and high sensitivity and specificity in discriminating between	Low

						Treatment of Metabolic Syndrome: TC: 86.8 TG: 94.3 Kappa statistic (agreement) TC: 0.73 TG: 0.88.	normal and high values of the variables analyzed. Clinicians should apply caution in using these devices to diagnose diseases. If use of a laboratory method is not feasible, we strongly recommend that practitioners use more than one measurement taken across multiple days and correlated with clinical history.	
Kurstjens, 2021 [19], Netherlands	Clinical validity, Cross sectional	Secondary Care	Adults (≥ 18 years), n=61	Fasting capillary blood	Dutch Foundation for Quality Assessment in Medical Laboratories (SKML), chemistry analyser (Advia Chemistry XPT system, Siemens, Germany) at the JBZ clinical chemistry laboratory, JBZ (Siemens, Advia Chemistry XPT system), venous blood	Cutoff = 5.2 mmol/L; Se (%): 92 Sp (%): 89 PPV: 85% NPV: 94% Pearson's r: 0.94 Mean relative difference (MRD): 4 ± 7% Mean absolute relative difference (MARD): 6 ± 5% Passing-Bablok analyses: y = 1.08x–0.21. (intercept –0.21 [95% CI –0.76–0.25], slope 1.08 [95% CI 1.00–1.19]) Pearson's r = 0.94.	Accutrend Plus shows the best performance compared with the routine chemistry analyser. However, the Accutrend Plus is not able to measure the HDL concentration, limiting its practical use as a screening tool.	Low

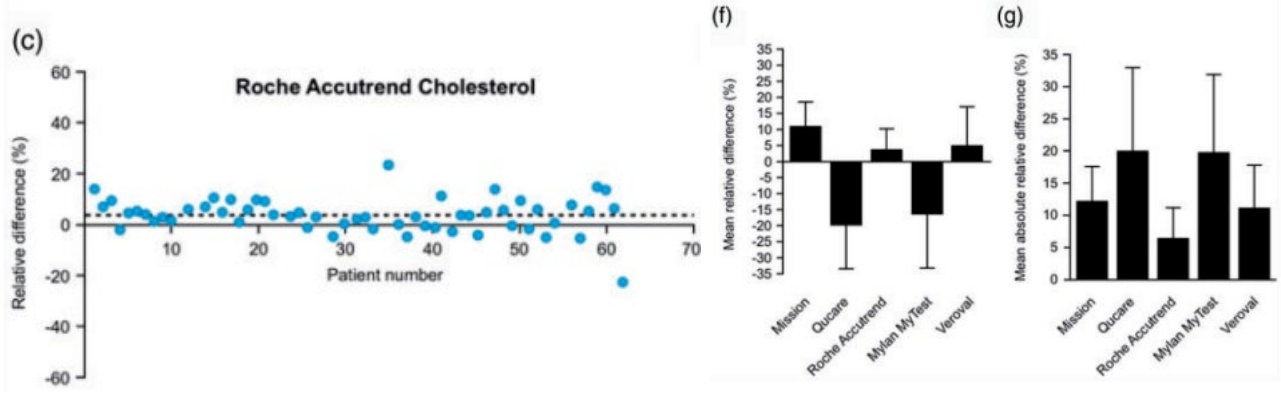


Figure 1. Accuracy analyses. (a–e) The relative difference between the blood cholesterol concentration of each individual patient (blue dot) measured by the self-tests (a) *Mission*, (b) *Qucare*, (c) *Accutrend Plus*, (d) *Mylan MyTest* and (e) *Veroval*, compared with the routine chemistry analyser from Siemens (Advia XPT). The dotted lines indicate the mean relative difference (MRD). (f) The MRD of each self-test, data taken from A-E. (g) The mean absolute relative difference of each self-test.

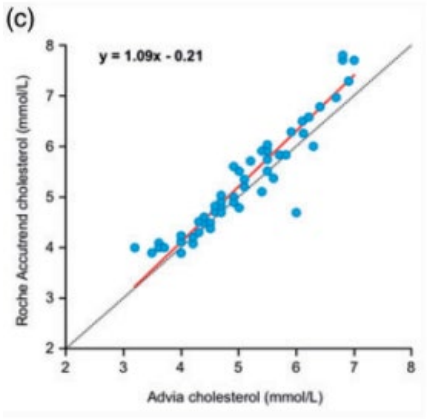


Figure 2. Method comparison analyses. (a–c) Passing Bablok analyses comparing the self-tests to the routine chemistry analyser from Siemens (Advia XPT). (a) *Mission* (intercept –0.15 [95% CI –0.64–0.35], slope 1.15 [95% CI 1.05–1.25]), (b) *Qucare* (intercept –0.90 [95% CI –1.79–0.11], slope 1.00 [95% CI 0.80–1.18]) and (c) *Accutrend Plus* (intercept –0.21 [95% CI –0.76–0.25], slope 1.08 [95% CI 1.00–1.19]).

Scafoglieri, 2012 [20], Belgium	Analytical validity, Prospective Cohort	Laboratory, Secondary Care	Healthy volunteers, n=60	Fasting capillary blood	Vitros® 5.1 FS chemistry system (Ortho-Clinical Diagnostics, Johnson & Johnson, Beerse, Belgium), venous blood	Estimated bias TC: 0.26 mmol/L (−0.95, 1.47) (95% CI 0.10 to 0.42) ICC = 0.85, P < 0.001 TG: −0.16 mmol/L (−1.29, 0.98) (95% CI −0.32 to 0.01) ICC = 0.68, P < 0.001 TC: 95% limits of agreement were (−0.95, 1.47 mmol/L); TG: 95% limits of agreement of (−1.29, 0.98 mmol/L) The concordance for subject classification according to the National Cholesterol Education Program (NCEP) guidelines was significant (P < 0.001), with substantial agreement for TC (K(w) = 0.67), and moderate agreement for TG (K(w) = 0.50).	Although the Accutrend Plus system may provide useful information for the referral of persons at cardiovascular risk, this device should not be used as a substitution for the laboratory methods in the diagnosis of hyperlipidemia. Given its day-to-day reproducibility, the TC was significantly lower when measured with the Accutrend Plus system than when the reference method was used. A strong correlations and substantial variability between the reference method and the Accutrend Plus system for measuring TC and TG was also detected.	

Mendez-Gonzalez, 2010 [21], Spain	Analytical validity, cohort	Laboratory, secondary care	Non-pregnant adults over 18, n=101 (TC), n=102 (TG) samples	Capillary blood	Accutrend GCT, capillary (71) CardioChek PA, venous (109) Hitachi 912 instrument as reference, venous blood	Precision Not reported Accuracy Total error (%) Control TC = 8.5 TG = 10.3 Prediction of bias based on the patient sample (%): TC (5.17 mmol/l) = -7.5 TG (1.69 mmol/l) = 5.4	All the 3 devices correctly classified a high percentage of dyslipemic patients. Total cholesterol was significantly lower when measured with the Accutrend Plus system than when the reference method was used. A strong correlations and substantial variability between the reference method and the Accutrend Plus system for measuring TC and TG was also detected.	
Maciel, 2019 [22], Brazil	Clinical validity, cross-sectional	Community	Adult volunteers, n=30	Fasting capillary blood	Laboratory tests, fasting venous blood	Cutoff TC 5.17 mmol/L ; TG 1.69 mmol/L ; Se (%): TC: 100 TG: 100 Sp (%) TC: 69.23 TG: 80 Lin's coefficient (95%CI) TC: 0.86 (0.74; 0.98), p<0.001 TG: 0.91 (0.84; 0.98), p<0.001 Spearman TC: 0.89, p<0.001 TG:0.4, p<0.001 Bland - Altman	There was substantial agreement between the methods for the measurement of TG concentration and poor agreement for measuring TC. In this study, the point-of-care method did not show a good capacity to measure TG and TC levels compared to the laboratory method in this study population. Caution is advised in the use of the point-of-care methods in population and epidemiological studies.	Low

						(95%CI) TC: 8.70 (-18.64; 36.16) TG: 5.35 (-44.16; 54,86)		

CardioChek PA Analyzer (Polymer Technology Systems, USA)

Table 6: Table of characteristics, CardioChek PA

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator(s)	Results	Key Findings	Study Risk of Bias*
Bolodeoku, 2018 [23], UK	Analytical validity, case study	Laboratory, secondary care	Healthy individual, after fasting, = 1	Capillary fasting blood was taken for 12 days over 2 months.	Elemark, capillary blood 3in1, capillary blood	Precision Coefficient of variation (CV%) TC = 9.4 TG = 23 HDL = 7 LDL = 14 Accuracy Mean ± SD (mmol/l) TC = 4.2±0.4 TG = 0.8±0.2 HDL = 1.5±0.1 LDL = 2.4±0.3	The CardioChek PA produced the lowest biological variation for TG and HDL. Mean estimations for TC and TG using CardioChek PA were lower than Elemark and 3in1.	
Bolodeoku, 2019 [24], UK	Analytical validity, cohort	Laboratory	healthy normal lipidemic subjects, 4 hours after fasting, n= 3	Venous blood replicates for each subject	Elemark, venous blood	Precision Coefficient of variation (CV%) Within-run TC = 5.4-8.3 TG = 4-12.1 HDL = 3.4-5.5 LDL = 9.4-14	Both devices showed reasonable within run imprecision for their TC and HDL but not LDL. The between day imprecision for both devices were consistent with the published	

				Within run (10 samples) Between day (6 samples)		Between-day TC=8 TG=22.4 HDL=8 LDL=9.4 Accuracy Mean conc. (mmol/l) Within-run TC = 4.7-5.3 TG = 0.7-1.2 HDL = 1.7-1.9 LDL = 2.4-3.2 Between-day TC=4.5 TG=0.9 HDL=1.4 LDL=2.6	within person biological variability.	
Dale, 2008 [25], USA	Analytical validity, cross-sectional	Laboratory, secondary care	Healthy staff, 12 hours after fasting, n= 34	Capillary blood	Laboratory Corporation of America, venous blood	Precision Intraclass correlation coefficients (ICCs) were determined for each device vs. the laboratory analysis: TC = 0.53 TG = 0.84 HDL = 0.41 LDL = 0.70 Accuracy Not reported	ICC values > 0.75 were defined as Indicators of excellent reproducibility. The only ICC exceeding 0.75 using CardioChek PA was for TG (p =0.84). The Cholestech LDX system demonstrated greater reproducibility than CardioChek PA when compared with a laboratory gold standard.	
Donato, 2015 [26], USA	Analytical validity, cohort	Laboratory	Adult volunteers, 12 hours after fasting and 2-3	Capillary	Cholestech LDX, capillary blood Cholestech, residual serum	Precision Not reported Accuracy	Minor difference between fasting and postprandial samples.	

			hours after a meal, n= 57		Cobas c501, venous serum	Mean bias between device and comparator, % ± SD: TC = −7.5 ± 11.1 TG= −2.6 ± 36.0 HDL = −3.9 ± 14.5 Non-HDL = −9.5 ± 15.9 LDL = −10.0 ± 21.6	HDL measurements were not affected by TG content on either device. CardioChek was more accurate for HDL than Cholestech. Both CardioChek and Cholestech exhibited significant variability in TG measurement relative to the reference method.	
dos Santos Ferreira, 2015 [27], Brazil	Analytical validity, cross-sectional	Laboratory, secondary care	Patients, 20-85 years, 12 hours after fasting, n = 516	Capillary blood Venous blood	Cobas 6000, venous blood	Mean predicted bias between device and comparator (%): Capillary TC = -3.7 TG = 13.7 HDL = 5.9 Venous TC = -7 TG = 4.5 HDL = 9 Linear regression analyses, average bias, venous v capillary TC = 4 TG = -10.3 HDL = -3.3	Correlation between capillary and venous was high for HDL and TG, and good for TC. Good clinical agreement for TC, HDL and TG compared with the reference analyzer.	
Matteucci, 2014 [28], Itay	Analytical Validity, cohort	Laboratory, secondary care	healthy volunteers, diabetic patients, n= 88	Capillary blood Venous blood Samples from	Cobas 6000, venous blood	Precision Coefficient of variation (CV%) 2011: TC = 7.5–10.3 TG = 6.3–9.2 HDL = 6.8–11.2	The initial evaluation suggested the device underestimated TC (bias 6.5%) and gave within-assay CVs above 6% for all lipid fractions.	

				these patients were assessed over three years. 2010 to 2013 (784 samples) 2011 (88 samples) 2013 (153 samples)		2013: TC = 1.3–2.9 TG = 2.3–4.3 HDL = 2.3–5.6 Accuracy Mean bias between device and comparator, % ± SD: 2011: TC = 6.5±9.9 TG = 0.5±6.3 HDL = –1.0±3.7 2010 to 2013: TC = –0.9±3.0 TG = –0.3±1.2. HDL = –0.5±1.8 2013: TC = 0.2±4.3 TG = 0.3±2.3 HDL = –0.03±2.2	There were sequential improvements to the device in 2013: total error 1.3% for TC and 3.1% for HDL. Device could be used in screening programmes aimed at early identification of lipid disorders since the quality surveillance suggests results are sufficiently valid, reliable, and reproducible.	
Mendez-Gonzalez, 2010 [21], Spain	Analytical validity, cohort	Laboratory, secondary care	Non-pregnant adults over 18, n=109	Venous blood	Accutrend GCT, capillary blood (71) Accutrend Plus, capillary blood (71) Hitachi 912 instrument as reference, venous blood	Precision Not reported Accuracy Total error (%) Control TC = 25.1 TG = 14 HDL = 18.4 Prediction of bias based on the patient sample (%): TC (5.2 mmol/l) = 20 TG (1.7 mmol/l) = -8.5 HDL (1.2 mmol/l) = -3.4	All the 3 devices correctly classified a high percentage of dyslipemic patients. CardioChek overestimated the cut-point by 20%. CardioChek classified 48% of normolipemic patients as hypercholesterolemic. CardioChek could be valid for TG and HDL but overestimates TC and LDL.	

						LDL (2.6 mmol/l) = 32.5		
Park, 2016[29], Kenya	Analytical validity, cross-sectional, prospective	Community	Adults screened for non-communicable diseases, n= 246	Venous blood Capillary blood	COBAS INTEGRA 400 plus Biochemistry Analyzers, venous blood	Precision Coefficient of variance using Pitman's test: TC = -0.22 TG = -0.18 HDL = 0.29 LDL = -0.27 Accuracy Mean bias between device and comparator, % [95% CI]: TC = -15.9 [-19.8, -12.1] TG= 0.03 [-8.6, 8.6] HDL = -8.2 [-12.9, -3.6] LDL = -25.9 [-29.7, -22.1]	The CardioChek PA analyzer was substantially inaccurate for LDL, HDL and TC. Patients at higher risk of complications from hyperlipidaemia were most likely to be misclassified into a lower risk category.	
Whitehead, 2013[30], UK	Analytical Validity, cohort	Laboratory, primary care	Individuals screened for diabetes and CVD, n = 167	Capillary blood	Modular P analyser, venous blood Cholestech LDX, capillary blood	Precision Coefficient of variation percent (CV%) Intra-batch (15) TC Level 1 = 3.7 TC Level 2 = 3.6 HDL Level 1 = 6.2 HDL Level 2 = 3.5 Inter-batch (12) Plasma TC Level 1 = 4.9 TC Level 2 = 5.3 HDL Level 1 = 8.7 HDL Level 2 = 10.3	The Cholestech LDX exhibited lower intra- and inter-batch imprecision and external quality assessment (EQA) scheme between-analyser variation for the measurement of TC and HDL when compared to the CardioChek. CardioChek results were influenced by the specimen haematocrit.	

						Whole blood TC Level 1 = 6.4 TC Level 2 = 6.7 HDL Level 1 = 7.8 HDL Level 2 = 6.4 EQA between analyser data [mean %CVs of between-analyser variation (range)]: TC = 15.1 (13-19.3) HDL = 18.9 (17.5-20.3) Accuracy Mean bias between device and comparator, % ± SD (106) TC = -12.7±18.8 HDL = 1.7±15.8	The Cholestech LDX displayed closer agreement with the laboratory methods for the measurement of TC and HDL.	
Whitehead, 2014[31], UK	Clinical validity, cross-sectional	Laboratory, primary care	Non-diabetic and non-overt CVD individuals aged 30-75, n=162	Capillary blood Venous blood (87 subjects)	Cholestech LDX, capillary blood Modular P analyser, venous blood	Mean % bias vs.lab method: Mean TC:HDL ratio [95% limit of agreement] = -3.7 [-48.8-41.4] CVD risk classification comparison for CardioChek v lab method: Agreement (%) JBSII = 73 (96.1) Framingham = 80 (92) QRISK2 = 85 (97.7) Disagreement (%) JBSII = 3 (3.9) Framingham = 7(8)	The CardioChek identified all subjects classed as high risk by QRISK2 but failed to identify 6/31 (19.4%) and 3/19 (15.8%) of subjects classed as high risk by the Framingham and JBSII algorithms, respectively. The CardioChek did not misclassify any moderate risk subjects as high risk.	Medium

						QRISK2 = 2(2.3) Disagreement when lab risk score was high JBSII = 3 (3.9) Framingham = 6 (6.9) QRISK2 = 0		

CardioChek Plus (Polymer Technology Systems, USA)

Table 7: Table of characteristics, CardioChek Plus

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Bastianelli, 2017 [32], USA	Analytical Validity, cross section	Laboratory	n = 30	Capillary blood sample	Venepuncture standard lipid panel, measured using Integra and Cobas analysers, venous blood	Average difference against Integra analyser: TC = 7.8% HDL = 6.2% TG = 5.1% Average difference against Cobas analyser: TC = 4.2% HDL = 0.8% TG = 7.0%	CardioChek Plus operated within industry accuracy standards.	

Cholestech LDX (Abbott, USA)

Table 8: Table of characteristics, Cholestech LDX

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*

Bastianelli, 2017[32], USA	Analytical Validity, cross section	Laboratory	n=30	Capillary blood	Venepuncture standard lipid panel, measured using Integra and Cobas analysers, venous blood	Average difference against Integra analyser: TC 0.5%, HDL 4.5% TG 3.3% Average difference against Cobas analyser: TC = 4.6% HDL = 2.6% TG = 1.6%	Cholestech operated within industry accuracy standards.	
Bubner, 2009[33], Australia	Analytical Validity, cross section	Primary Care	patients with established type 1 or type 2 diabetes, established hyperlipidaemia, or taking anticoagulant therapy, n=4968	Sample not specified in the paper	Usual Pathology Laboratory test	Difference between PoCT and pathology laboratory: TC = 16.8% [90% CI, 12.3% to 21.4%] HDL= −7.7% [90% CI, −12.9% to −2.5%] TG = 3.8% [90% CI, −0.9% to 8.6%]	Results provide evidence that managing patients using PoCT for all tests (except INR and HDL cholesterol) results in the same or better therapeutic control than traditional pathology laboratory testing.	
Carey, 2006[34], Ireland	Analytical Validity, cross section	Laboratory	subjects attending the Cardiac Risk Factor Clinic, or hospital staff volunteers, n=100	Capillary and venous blood	Laboratory test using Hitachi Modular P® analyser, venous blood sample	Average difference: TC = 0.037 (95% -0.03, 0.11) HDL = -0.11 (95% -0.143, -0.078) TG = 0.25 (95% 0.17, 0.24)	Cholestech LDX yields results that correlate highly significantly to those measured independently in a standardized hospital laboratory.	
Cobbaert, 1994[35], Netherlands	Analytical Validity, cohort	Secondary Care	Lipid Clinic in-patients and	Venous blood	Abell-Kendall Method used by Lipid Reference Laboratory,	Maximal overall precisions: TC = 2.9% HDL = 4.3%	From this performance study, it can be concluded that Cholestech has	

			volunteers, n=43		Rotterham, venous blood	TG = 6.0%	produced a portable lipid profile analyser that is both precise and accurate for the measurement of total cholesterol in heparinised venous blood specimens.	
Cummings, 1994[36], US	Analytical Validity, cross section	Secondary Care	diabetic clinic patients, n=40	Venous blood	Technicon DAX in laboratory, venous blood	Average difference: total cholesterol 0.04, high-density lipoprotein cholesterol 0.03, triglycerides 0.02	We conclude that the Cholestech LDX analyser provides accurate and precise measurements of TC, HDL-C and TG concentrations.	
Dale, 2008[25], US	Analytical Validity, cross section	Laboratory, Secondary care	Healthy staff, 12 hours after fasting, n = 34	Capillary blood sample	Laboratory Corporation of America using venous blood sample	Precision Intraclass correlation coefficients (ICCs) were determined for each device vs. the laboratory analysis, with values > 0.75 defined as Indicators of excellent reproducibility: TC = 0.96 HDL = 0.88 LDL= 0.87 TG = 0.99	All ICC results exceeded 0.75 using Cholestech LDX, suggesting an excellent level of reproducibility. The Cholestech LDX system demonstrated greater reproducibility than CardioChek PA when compared with a laboratory gold standard. Cholestech LDX was therefore selected for implementation into their community-based programs to assess global CVD risk.	
Donato, 2015[26], US	Analytical Validity, Cohort	Laboratory	Adult volunteers, 12 hours after fasting and 2-3	Capillary blood sample	CardioChek using capillary blood sample, Laboratory Cobas c501 using serum	Accuracy Mean bias between device and comparator in % ± SD: TC = −7.0 ± 6.3	HDL measurements were not affected by triglyceride content on either device.	

			hours after a meal, n = 57		sample, venous blood	TG= 5.2 ± 38.0 HDL = −12.5 ± 9.8 Non-HDL = −4.4 ± 7.6 LDL = −5.5 ± 10.4	Calculated non-HDL-C was significantly more accurate on the Cholestech compared to the CardioChek. CardioChek was more accurate for HDL than Cholestech. Both CardioChek and Cholestech exhibited significant variability in triglyceride measurement relative to the reference method. The optimal approach to capillary lipid screening may be to use Cholestech non-HDL as it exhibited little bias relative to reference methods.	
Gialamas, 2010[37], Australia	Analytical Validity, Cohort	Primary care and Laboratory	patients established hyperlipidaemia and were currently taking or had been eligible for lipid lowering medication, from 30 general practices, n=765	Capillary blood	Compared against Laboratories' routine method. Roche Diagnostics (6), Olympus (2), OrthoClinical Diagnostics (2) and Siemens Dimension (1), venous blood	Estimated bias: TC = −0.28 mmol/L(95% CI−0.37, −0.20) and 95% limits of agreement were (−1.04, 0.48 mmol/L). HDL = −0.09 mmol/L (95% CI−0.15, −0.04) and the 95% limits of agreement were (−0.55, 0.36 mmol/L).	High levels of concordance between PoCT and laboratory test results were found for all the tests. On average, POCT devices underestimated TC and HDL results but overestimated triglyceride results compared to the laboratory.	

Jain, 2017[38], UK	Analytical Validity, cross section	Community Screening	participants who attended a community CVD Screen (n = 83) and Diabetic Care clinic (n = 149), n=232	Capillary blood sample	Compared against Laboratories' routine method using venous blood sample, Afinion AS100 analyser using capillary blood sample	Deming regression for TC Afinion AS100 vs Cholestech LDX: 0.46 + 0.91x Deming regression for HDL Afinion AS100 vs Cholestech LDX: 0.04 + 1.07x Deming regression TG Afinion AS100 vs Cholestech LDX: 0.05 + 1.02x	The Cholestech LDX and Afinion AS100 analyser results agree well with each other and the established laboratory methods.	
Jain, 2011[39], UK	Clinical Validity, Cohort	Community Screening	South Asian adults aged 30 - 74 years, n=406	Capillary blood sample	Venous blood sample tested at Clinical Biochemistry Laboratory using a Roche Modular P analyser and Roche reagents	Deming regression for TC -0.62 + 1.07x R^2 =0.83 Deming regression for HDL-C (mmol/l) -0.33 + 1.16x R^2 =0.66 Deming regression for TG -0.00 + 1.01x R^2 =0.71 Overall risk agreement JBS2 89.2% QRISK2 94.6% ETHRISK 95.4% Framingham 92.6%	We conclude that POCT technology for initial screening of risk factors is appropriate for The NHS Health Check programme.	Low
O' Donovan, 2011 [40], Ireland	Analytical Validity,	Laboratory	80 University College Cork	Capillary blood	Reflotron Plus analysis, capillary blood	Mean difference: TC = 0.24 (95% CI 0.15, 0.33)	There were statistically significant differences and clinical differences	

	cross section		staff members			HDL = 0.24 (95% CI 0.16, 0.33) TG = 0.10 (95% CI 0.01, 0.19) LDL = 0.05 (95% CI 0.11, 0.23)	between the 2 POCT devices tested when reporting TC, HDL and TG levels	
Parikh, 2009 [41], USA	Clinical Validity, cross section	Laboratory	family members or cohabitants of patients hospitalized with CVD, between 20 and 79 years of age, who did not have established CVD or diabetes, n=250	Capillary blood	Fresh venous blood was analysed by the Columbia University General Clinical Research Center (GCRC) core laboratory by using standard methods for serum lipids, venous blood	The correlations between fingerstick and core laboratory were: TC 0.91 LDL-C 0.88 HDL-C 0.77 TG 0.93 At a clinical cut-point of TC≥2.26 mmol/L, the fingerstick measurement had 79% sensitivity to categorize participants as having abnormal cholesterol and 95% specificity to categorize participants as having normal cholesterol levels. Sensitivity to identify abnormal values was ≥76% for all categories of lipids	Fingerstick screening is accurate and has good clinical utility to identify persons with abnormal blood lipids and hsCRP at the point of care in a diverse population that is eligible for primary prevention of CVD. The sensitivity of finger stick screening to categorize patients as adherent to ATP III lipid cut-points was ≥76% for TC, HDL, LDL and TG	Medium
Shemesh, 2006[42], Australia	Clinical Validity, cross section	Community, Laboratory	76 samples from residents aged 15 years and older	Capillary blood	Lipids were measured on the Hitachi 917 analyser by routine automated colourimetric and	Agreement between PoCT and laboratory: TC (cutoff ≥5.5mmol/L) 91% (95% CI 81, 96)	The Cholestech LDX provided good agreement with laboratory measures for population-based screening for CVD risk	Low

					enzymatic methods, venous blood	HDL (male cutoff <1.03 mmol/L and female cutoff <1.29mmol/L) 98% (95% CI 77, 94) TG (cutoff ≥1.7mmol/L) 93% (95% CI 84, 97)	factors based on conventional cutoff values with the possible exception of HDL at low levels and are an analytically robust alternative to conventional testing for this purpose.	
Rogers, 1993 [43], USA	Analytical Validity, Cohort	Laboratory	volunteers aged 18 to 61, n=18	Heparinized venous whole blood and plasma, venous serum, and heparinized capillary fingerstick whole blood	Abbott VP analyzer with Abbott A-gent enzymatic cholesterol reagent containing cholesterol esterase and cholesterol oxidase, venous blood	Bias of PoTC at 2000mg/L Cholesterol level: Venous whole blood 2.5% Venous plasma 4.1% Venous Serum 6.10% Capillary whole blood 6.06% Bias of PoTC at 2400mg/L Cholesterol level: Venous whole blood 1.3% Venous plasma 2.9% Venous Serum 5.08% Capillary whole blood 5.05%	It appears that Cholestech has produced a portable screening analyzer that is both precise and accurate for the measurement of TC in capillary specimens.	
Rubin, 2003 [44], USA	Clinical Validity, Cross Section	Laboratory	fasting subjects, n=47	Capillary blood sample	A Hitachi model 911 semi-automated spectrophotometer using a venous blood sample, Reflotron using a capillary blood sample, and	Bisa compared to laboratory reference: TC = −1.67 HDL = 7.03 TG = 14.6 Agreement with laboratory reference:	Cholestech met the NCEP III guidelines for accuracy in measurement of TC, but not TG. Results suggest that Cholestech met the current NECP III	Low

					Ektachem DT-60 using a venous blood sample	TC (cutoff ≥2.17 mmol/L) 90% HDL (cutoff <1.55 mmol/L) 77% TG (cutoff ≥1.69 mmol/L) 94%	guidelines for accuracy in measurement of TC	
Shephard, 2009[45], Australia (Design, implementation and results of the quality control program for the Australian government's point of care testing in general practice trial)	Analytical Validity, RCT	Primary Care	n=1101	Capillary blood sample	Local laboratory	TC Imprecision goal 5% Within-practice median CV Lot A Level 1: 3.1% Level 2: 3.0% Lot B Level 1: 2.3% Level 2: 2.9% TG Imprecision goal 7.5% Within-practice median CV Lot A Level 1: 3.9% Level 2: 3.7% Lot B Level 1: 5.0% Level 2: 5.4% HDL Imprecision goal 6% Within-practice median CV Lot A Level 1: 5.5% Level 2: 3.9% Lot B Level 1: 6.7% Level 2: 4.8%	Median within-practice imprecision met the analytical goals for all PoC tests, except for HDL where observed performance was outside the minimum goal for one level and one lot number of QC. Most practices achieved the imprecision goals for all analytes, with the principal exception of HDL.	

Shephard, 2002[46], Australia	Analytical Validity, cross section	Laboratory	n=51	Capillary and venous blood sample	Hitachi 917 analyser, venous sample	Mean difference between PoCT and laboratory: TC = <2% HDL = <5.5% TG = <2% Mean difference between capillary and venous samples for POCT: TC 0.8% HDL 2.3% TG 0.4%	The Cholestch PoCT lipid analyser demonstrated excellent analytical performance characteristics for TC and TG. There was no significant difference between capillary or venous blood.	
Whitehead, 2013[30], UK	Analytical Validity, cohort	Laboratory, Community	individuals attending community health check clinics, n=167	Capillary blood	Roche laboratory Methods, Roche Modular P analyser, CardioChek, , venous blood	Mean bias between PoCT and Laboratory: TC -0.14 ±0.13 HDL 0.7 ±0.7 TG -0.8 ±0.6	The Cholestech LDX exhibited lower intra- and inter-batch imprecision and external quality assessment (EQA) scheme between-analyser variation for the measurement of TC and HDL when compared to the CardioChek. When compared to the standard laboratory methods, the Cholestch LDX exhibited lower mean percentage biases than the CardioChek for the measurement of TC and HDL.	
Whitehead, 2014[31], UK	Clinical Validity, cross section	Laboratory, Community	patients meeting the criteria for cardiovascul	Capillary blood	Roche laboratory Methods, Roche Modular P analyser,	Overall CVD risk classification agreement:	All subjects classified as high risk (risk score >20%) by the three risk algorithms based on the	Medium

			ar risk assessment with the Framingham and QRISK2 algorithms, n=162		CardioChek, , venous blood	JBSII: 92.8% Framingham: 96.3% QRISK2: 99.4%	laboratory results were correctly identified by the Cholestech LDX. One (2.2%) and four (7.0%) moderate-risk subjects were misclassified by the Cholestech LDX as high risk, using the JBSII and Framingham risk algorithms, respectively.	
Volles, 1998 [47], USA	Clinical Validity, cross section	Primary Care	Healthy volunteers and hypercholesterolemic patients,n=98	Venous and Capillary blood	Cobas-Bio analyzer and reagents, venous blood	Mean % bias (95% CI) Venous: 1.6 (0.33-2.8) Capillary: 2.1 (0.774.8) Mean absolute % bias (95% CI) Venous: 5.0 (4.2-5.8) Capillary: 5.4 (4.5-6.3) The percentage of subjects who had a bias for total cholesterol greater than 8.9% Venous: 12.4% Capillary: 22.4% Misclassification rates: Results that would produce misclassification compared with standardized laboratory results above or below 2.17 mmol/L and above or	In summary, both the LDX and the AccuMeter measured TC with similar accuracy and met the NCEP requirement of * 3% for average accuracy. However, neither met the NCEP 3% requirement for precision, and both produced a significant number of individual results that exceeded the * 8.9% total error criteria for single cholesterol measurements. Due to imprecision, the devices are best suited for screening purposes and not for monitoring in patients being treated for hypercholesterolemia.	Low

						below 6.21 mmol/L TC were counted and divided by the total number of subjects to give a percentage. Venous: 11% Capillary: 8% Results that would produce misclassification were counted only if they exceeded ± 8.9% of the standardized laboratory method results Venous: 2% Capillary: 3%		
Motta, 2015[48], Australia	Analytical Validity, Cohort	Primary Care	Adult community members with type 2 diabetes=61, n=103	Venous blood	Regional accredited pathology laboratory, venous blood	Passing/Bablok Analyses and Bland-Altman Analyses Analyte; Device; No.Patients; Slope; Intercept; Correlation Coefficient; Mean Bias; 95% Limits of Agreement; Mean % Bias TC: Cholestech: 98; 0.86; 0.28; 0.98; −0.32; −0.77; −0.13; −7.4 HDL: Cholestech 94 1.16 −0.31 0.93 −0.10 −0.38–0.18 −8.3 LDL:	This study adds to the evidence that the performance of the Cholestech is not as reliable as past studies have shown. In terms of the concordance data, the Piccolo also outperformed, or was equivalent to, the Cholestech for all lipid fractions.	

						Cholestech 87 0.85 0.09 0.94 −0.25 −0.78–0.28 −10.7 TG: Cholestech 98 1.10 −0.07 0.99 0.12 −0.27–0.52 4.8 Analyte Therapeutic Goal; Device Concordant Results (n %) Discordant Results (Difference in POCT vs Laboratory Results) TC; <4.0 mmol/L; Cholestech 82/98; 84% 12/16 ≤ 0.4 mmol/L HDL >1.0 mmol/L Cholestech 84/94 89% 3/11 ≤ 0.1 mmol/L LDL <2.5 mmol/L Cholestech 77/87 88% 3/8 ≤ 0.25 mmol/L TG <1.5 mmol/L Cholestech 94/98 96% 1/4 ≤ 0.15 mmol/L		

PiccoloXpress (Abbott, USA)

Table 9: Table of characteristics, PiccoloXpress

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Motta, 2015[48], Australia	Analytical Validity, Cohort	Primary Care	Type 2 Diabetes Patients, n = 61 (103 samples)	Venous blood	Regional Accredited Pathology Laboratory, venous blood	Bland-Altman Mean Bias: TC: -0.14[-0.46-0.18], -3.2% (n=101), HDL: 0.04 [-0.11-0.19], 3.3% (n=94); LDL-0.23[-0.59-0.12], -9.9% (n=94), TG 0.16[-0.13-0.45], 6.4% (n=96), mean bias, ≤6.5% for all lipid tests, except LDL cholesterol (mean bias, −9.9%) Passing-Bablok linear regression analysis: TC r=0.99, HDL r=0.98, LDL r=0.94, TG r=0.99	Piccolo was shown to be analytically sound; Piccolo was chosen as the recommended device for the measurement of glucose and lipids owing to its ability to perform tests for multiple analytes using the 1 reagent disc (or cartridge).	
Simpson, 2010[49], Australia	Analytical Validity, Cohort	Tertiary Centre	Patients in Cardiac Care, n=51	Venous blood	Hospital Clinical Laboratory - Roche Diagnostics/ Hitachi Modular, venous blood	TC level ranged from 2.4 to 7.6 mmol/L, HDL cholesterol level ranged from 0.7 to 2.1 mmol/L. Passing-Bablok (A) and Bland-Altman (B) TC (n = 51): y = 1.00x + 0.00 (95% confidence interval [CI] for slope, 0.95Y 1.00; 95% CI for	The imprecision obtained by the Piccolo Xpress for total cholesterol and triglyceride met NCEP recommendations, HDL cholesterol did not (5.4% vs 4.0%). Abaxis Piccolo Xpress is a suitable point-of-care instrument to use in non-laboratory settings	

						intercept, 0.00Y0.15). r = 0.99 (95% CI, 0.99Y1.00 P G 0.0001). HDL (n = 46). y = 0.96x + 0.05 (95% CI for slope, 0.89 to 1.07; 95% CI for intercept, j0.07 to 0.13). r = 0.96 (95% CI, 0.93 to 0.98, P G 0.0001). TG (n = 51). y = 1.08x j 0.08 (95% CI for slope, 1.04 to 1.08; 95% CI for intercept, j0.13 to j0.04). r = 1.00 (95% CI, 0.99Y1.00, P G 0.0001). Coefficient of variations (CV) ranging from 1.18% to 5.39% for the different analytes. There was a high level of correlation between the Piccolo Xpress and the laboratory for all analytes with r values of 0.99, 0.96, and 1.00 for total and HDL cholesterol and triglyceride, respectively.	for lipid analysis, high likelihood (99%) of correct patient classification	

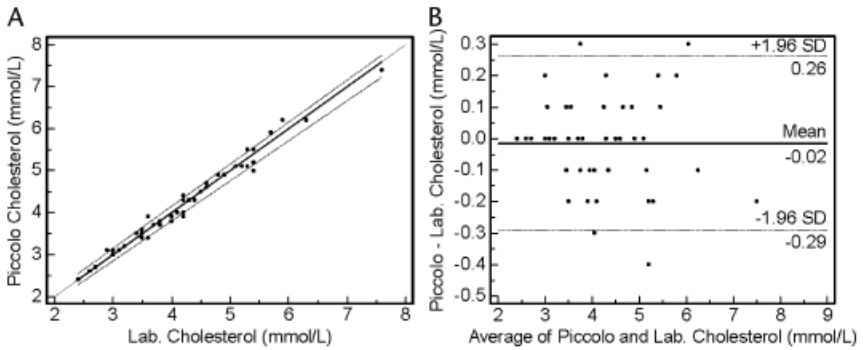


FIGURE 1. Passing-Bablok (A) and Bland-Altman (B) correlation analyses of total cholesterol for the Piccolo Xpress with the Roche Diagnostics/Hitachi Modular (n = 51). $y = 1.00x + 0.00$ (95% confidence interval [CI] for slope, 0.95–1.00; 95% CI for intercept, 0.00–0.15). $r = 0.99$ (95% CI, 0.99–1.00 $P < 0.0001$).

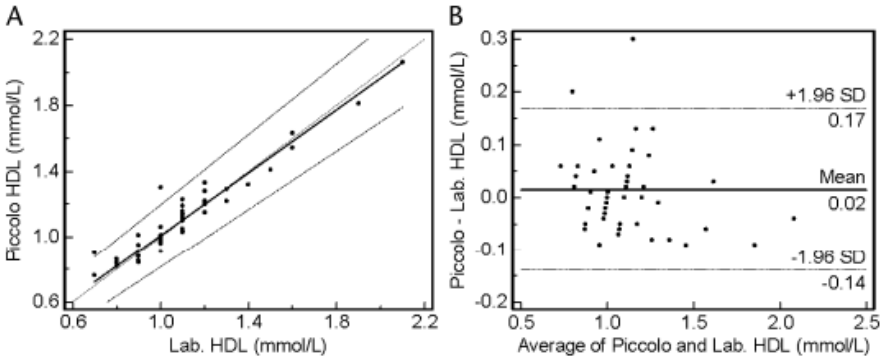


FIGURE 2. Passing-Bablok (A) and Bland-Altman (B) correlation analyses of HDL cholesterol for the Piccolo Xpress with the Roche Diagnostics/Hitachi Modular (n = 46). $y = 0.96x + 0.05$ (95% CI for slope, 0.89 to 1.07; 95% CI for intercept, −0.07 to 0.13). $r = 0.96$ (95% CI, 0.93 to 0.98, $P < 0.0001$).

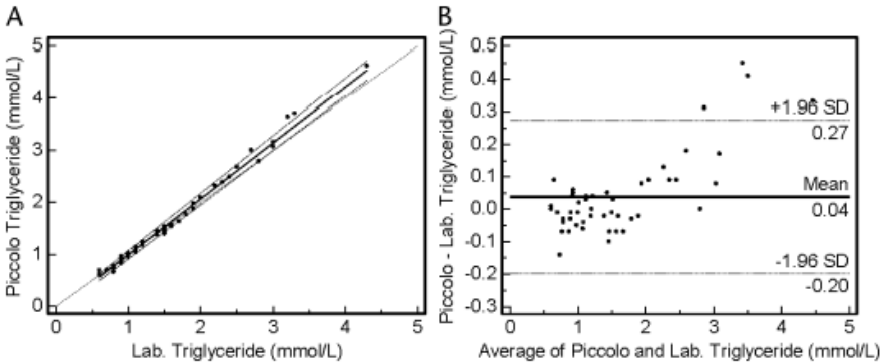


FIGURE 3. Passing-Bablok (A) and Bland-Altman (B) correlation analyses of triglyceride for the Piccolo Xpress with the Roche Diagnostics/Hitachi Modular (n = 51). $y = 1.08x - 0.08$ (95% CI for slope, 1.04 to 1.08; 95% CI for intercept, −0.13 to −0.04). $r = 1.00$ (95% CI, 0.99–1.00, $P < 0.0001$).

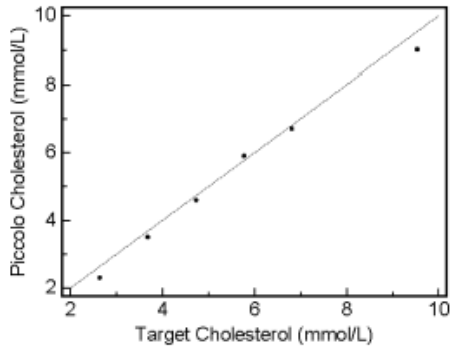


FIGURE 4. Linearity evaluation of total cholesterol for the Piccolo Xpress using samples supplied by the RCPA QAP.

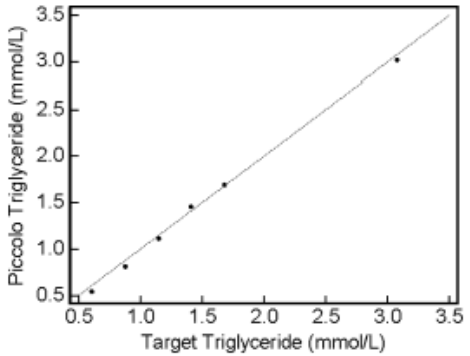


FIGURE 5. Linearity evaluation of triglyceride for the Piccolo Xpress using samples supplied by the RCPA QAP.

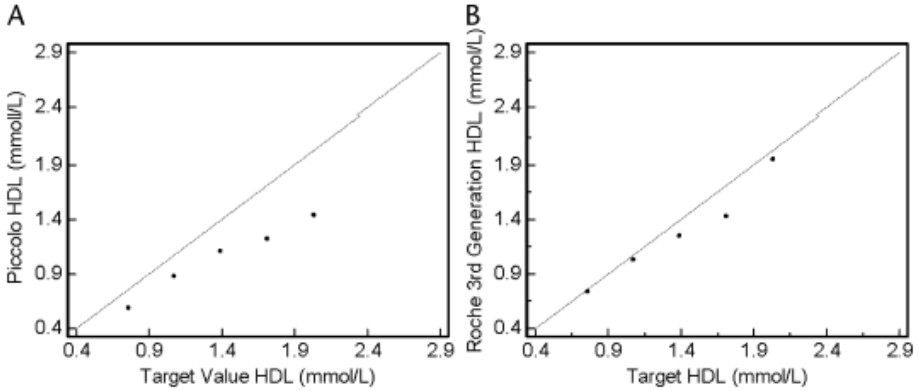


FIGURE 6. Linearity evaluation of HDL cholesterol for the Piccolo Xpress (A) and a laboratory using the HDL-C plus Third-Generation assay on a Roche instrument (B) using samples supplied by the RCPA QAP.

Cobas b101 (Roche Diagnostics, Switzerland)

Table 10: Table of characteristics, Cobas b101

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Roche[50] 2013, Spain and Switzerland	Analytical Validity, Cohort	Clinical Laboratory	Patients, n = 160	Capillary whole blood, Venous EDTA Whole Blood, Venous EDTA Serum	Cobas 6000 + c 501 module using Li-heparin whole blood	Results Lot1 vs Lot2 Lipid ranges: Capillary whole blood - TC: 2.38 to 8.02mmol/l TG: 0.61 to 5.58 mmol/l HDL: 0.46 to 2.38 mmol/l EDTA whole blood - TC: 2.38 to 7.61mmol/l TG: 0.61 to 5.43 mmol/l HDL: 0.47 to 2.44 mmol/l EDTA Serum - TC: 1.92 to 10.81mmol/l TG: 0.54 to 5.77 mmol/l HDLc: 0.47 to 2.39 mmol/l %Mean bias and CV%: Capillary whole blood - TC: 0.61 & 1.57 TG: 1.07 & 3.17 HDL: 1.24 & 2.78. EDTA whole blood - TC: 0.53, 1.57 TG: 0.60, 3.17 HDL: 1.39, 2.78.	The analytical performance of the cobas b 101 analyser was fully suitable for its clinical use. Main advantages of the instrument are ease of use and convenience of handling, small sample volumes, usability of various sample types and calibration free system. Accordingly, the analyser is a useful tool for monitoring the main lipid constituents in POC settings.	

						EDTA plasma - TC: -0.10, 1.67 TG: 0.20, 1.19 HDL :0.90, 2.57. Lot1 vs Lot2 Passing Bablock Regression: Capillary whole blood - TC: y=1.007x + 0.001, r= 0.9970; TG: y= 1.005x + 0.012, r = 0.9984; HDL: y=1.048x -0.045; r = 0.9952; EDTA whole blood - TC: y=1.02x -0.06, r= 0.9970; TG: y=1.00x + 0.01, r = 0.9995; HDL: y=1.07x - 0.07, r= 0.9958. EDTA plasma - TC: y=1.01x -0.05x, r= 0.9988; TG: y=1.00x+0.00, r= 0.9996; HDL: y=1.06x -0.06, r= 0.9973. Results POCT vs Lab Lipid ranges: Capillary whole blood - TC: 2.88 to 7.72mmol/l TG: 0.53 to 4.57 mmol/l HDL: 0.78 to 2.70 mmol/l		

						EDTA whole blood - TC: 2.88 to 7.72mmol/l TG: 0.52 to 4.57mmol/l HDL: 0.78 to 2.42 mmol/l EDTA plasma - TC: 1.90 to 12.63mmol/l TG: 0.52 to 6.77 mmol/l HDL: 0.49 to 2.42 mmol/l %Mean bias and CV%: Capillary whole blood - TC: -0.54, 1.66 TG: 3.88 & 1.39 HDL: 2.06 & 2.30 EDTA whole blood - TC: -1.94, 1.55 TG: 0.13, 1.38 HDL: -0.15, 2.08 EDTA plasma - TC: -2.53, 1.65 TG: -0.17, 1.28 HDL: 0.50, 2.17 POCT vs Lab Passing Bablock Regression: Capillary whole blood - TC: y=1.029x -0.175; r = 0.9906 TG: y= 1.014x +0.018; r = 0.9909 HDL: y= 0.933x +0.115; r = 0.9748		

						EDTA whole blood - TC: y=1.00x-0.10, r=0.9930 TG: y=1.00x +0.00, r = 0.9939 HDL: y=0.92x+0.10, r=0.9806 EDTA plasma - TC: y=1.00x -0.11, r= 0.9942 TG: y=0.99x + 0.01, r= 0.9939 HDL: y=0.98x + 0.01, r= 0.9817 Median bias ranged from: -6.4 to -0.7% for TC, -1.2 to 6.8% for HDL, and -5.4 to 0.9% for TG.		

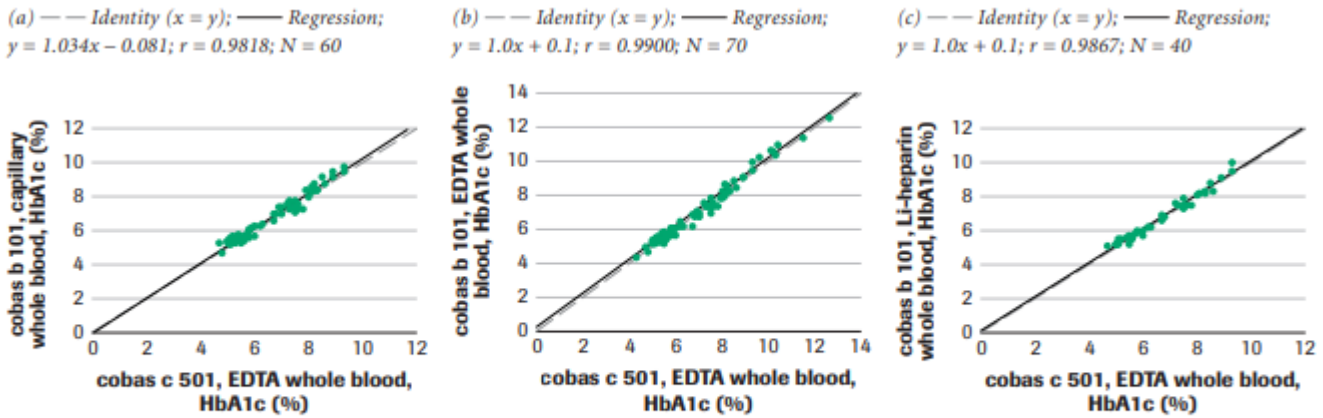


Figure 2 a, b, c: Linear regression analysis of method comparison with HbA1c disc. Passing-Bablok regression analysis was performed for comparison of the cobas b 101 system against the cobas c 501 module as reference with each sample type: capillary whole blood (a), EDTA whole blood (b) and Li-heparin whole blood (c). Only EDTA whole blood was used in the cobas c 501 module for all comparisons.

Barosso, 2018 [51], Spain	Clinical Validity, Crossover RCT	Unknown	Adults aged 35-74 with no CVD, n = 937	Capillary whole blood	Central Laboratory, Pentra autoanalyzer, venous blood	Male: TC ICC (95% CI): 0.86 (0.69–0.92) HDL ICC (95% CI): 0.91 (0.88–0.93) Female: TC ICC (95% CI): 0.90 (0.74–0.95) HDL ICC (95% CI): 0.90 (0.76–0.95) Threshold Cardiovascular risk >5% Male: Sensitivity, % (95% CI): 0.74 (0.63–0.82) Specificity, % (95% CI): 0.97 (0.95–0.99)	The ICCs for TC and HDL were high in both men and women. And the diagnostic accuracy was high, pointing out a marked proportion of correctly classified subjects. The estimates of diagnostic odds ratio, the Youden Index, and the area under the ROC curve showed a satisfactory discriminative power of the self-screening using the 5% cut-off point for cardiovascular risk.	Low

						Accuracy (95% CI): 0.93 (0.90-0.95) Female: Sensitivity, % (95% CI): 0.50 (0.30–0.70) Specificity, % (95% CI): 0.99 (0.98–1.00) Accuracy (95% CI): 0.97 (0.95–0.98)		
ICCnet CHSA, 2013 [52], Australia	Analytical Validity, Cohort	Primary Care	Patients, n= 140	Capillary whole blood	Local Laboratory, venous blood	Quality Control Level 1: TC (CV%): 1.6 TG (CV%): 1.5 HDL (CV%): 2.8 Quality Control Level 2: TC (CV%): 1.6 TG (CV%): 1.2 HDL (CV%): 2.4 Passing Bablock Regression: TC: y = 0.92x - 0.08, r= 0.990 TG: y = 0.82x + 0.06, r= 0.979 HDL: y = 1.77x - 0.44, r= 0.990 %Mean Bias: TC: -9.27 TG: -12.86 HDL: 27.43 POCT vs Lab Passing Bablock Regression: TC: y = 0.96x - 0.05, r= 0.981	The Roche cobas b 101 showed good precision with all analytes meeting the desirable imprecision goals. All lipid analytes showed good correlation when compared to all laboratory methods used. Results of this study suggest that the Roche cobas b 101 is a suitable point of care instrument to use in non-laboratory settings for lipid analysis.	

						TG: y = 0.97x + 0.08, r= 0.959 HDL: y = 1.23x - 0.31, r= 0.955 %Mean Bias: TC: -5.71 TG: 3.50 HDL: -1.43		

Reflotron Plus (Roche Diagnostics, Switzerland)*

Table 11: Table of characteristics, Reflotron Plus

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
O'Donovan, 2011 [40], Ireland	Analytical Validity, Cross-sectional	University	Non-pregnant University Staff aged 18-65, n = 80	Capillary whole blood	Cholestech LDX POCT device	Analyte mmol/L, Mean (+/- SD) TC: 4.78 (0.76) HDL-C: 1.37 (0.37) TG: 1.41 (0.53) LDL-C: 2.75 (0.87) Mean Difference, mmol/L (95% CI): TC: -0.24 (-0.15 - -0.33) HDL-C: -0.24 (-0.16 - -0.33) TG: -0.10 (-0.01 - -0.23) LDL-C: -0.05 (-0.11 - -0.23) There was a statistically significant difference between	Although there was good correlation between the two devices for TC, there was a statistically significant difference between the devices, with Cholestech LDX reporting an average of 0.24 mmol/L higher readings than apparatus two. Similarly for HDL-C and TG, statistically significant differences were observed. In each of these categories, Reflotron Plus reported	

						the devices when reporting TC (P G 0.0005, n = 76), HDL (P G 0.0005, n = 63), and TG (P G 0.05, n = 59). There was no significant difference between the machines when reporting LDL (P 9 0.05, n = 49). A J measure of agreement indicated clinically significant differences between the devices when reporting both TC and LDL.	values lower than Cholestech LDX. Although a patient with a diagnosis of dyslipidemia may use the POCT device to monitor his/her lipid levels, it is advisable that all patients use the same device each time.	
Rubin, 2003[44], USA	Analytical Validity, Cross-Sectional	Laboratory	Fasting Subjects, n = 47 (23 Male, 24 Female)	Capillary Whole Blood	CDC-Certified Hospital, Roche Hitachi model 911 semi-automated spectrophotometer, venous blood	Biases compared to Laboratory Reference Method: TC: -3.35* TG: +10.6* *p<.05 Significance Agreement with laboratory reference: TC (cutoff ≥2.17 mmol/L) 94% TG (cutoff ≥1.69 mmol/L) 98%	The results obtained by the Reflotron appear to be negatively biased. If results are negatively biased, the risk classification could place somebody who might be borderline into the low-risk group.	

*Planned removal from the UK market in May 2022

PixoTest POCT Lipid System (iXensor, Taiwan)

Table 12: Table of characteristics, PixoTest

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator(s)	Results	Key Findings	Study Risk of Bias*
Cheng, 2020 [53], Taiwan	Analytical validity, cross-sectional	Laboratory, three clinical sites	≥ 20 years old Healthy, inpatients and outpatients, n = 120	Capillary Venous	Cobas c111 Analyzer, Capillary Venous	Precision Not reported Accuracy Passing-Bablok regression analysis comparing PixoTest and Cobas c111 across three lots and three sites with Correlation coefficient (R): Venous: TC Slope = 0.99 y = 1x − 0.337 R = 0.995 TG Slope = 0.99 y = 1x + 0.0246 R = 0.998 HDL Slope = 0.99 y = 1x - 0.0297 Correlation coefficient (R) = 0.987 Capillary: TC	The accuracy of PixoTest POCT System is comparable to laboratory methods. These results further indicate that PixoTest System has accuracy consistent across different blood sample sources. PixoTest POCT test results of TC, TG, and HDL, all show linearity with correlation coefficients larger than 0.98 and regression lines of slope approximately equal to 1.0 with absolute intercept no larger than 0.33.	

						Slope = 0.99 y = 1x − 0.105 R = 0.984 TG Slope = 0.99 y = 1x − 0.329 R = 0.998 HDL Slope = 0.99 y = 1x − 0.0403 R = 0.989		

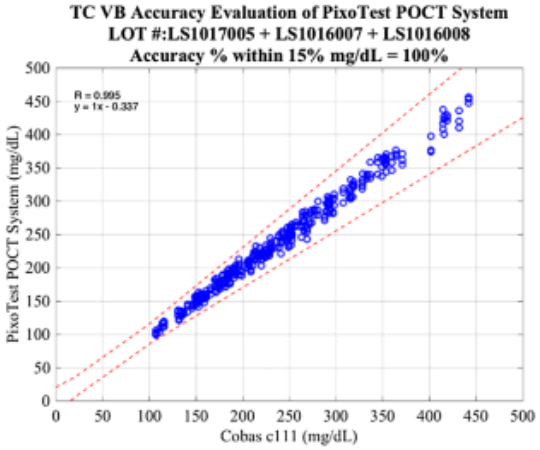


Fig. 3 Venous blood of 3 Lots at 3 sites comparison of TC levels obtained by the PixoTest POCT System (test) and the Roche Cobas c111 (comparative) by CLSI EP09-A3. Scatter plots with ordinary linear fit with the Passing-Bablok regression analysis

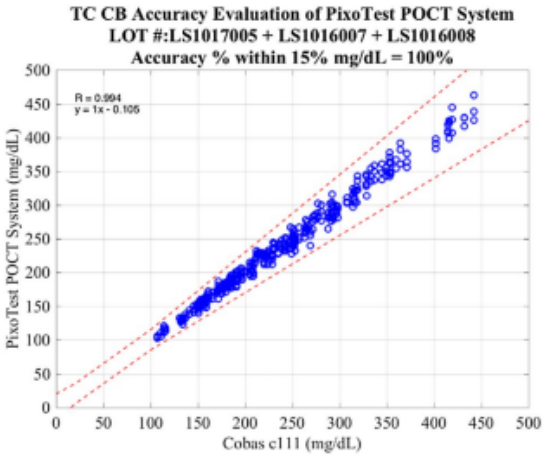


Fig. 4 Capillary blood of 3 Lots at 3 sites comparison of TC levels obtained by the PixoTest POCT System (test) and the Roche Cobas c111 (comparative) by CLSI EP09-A3. Scatter plots with ordinary linear fit with the Passing-Bablok regression analysis

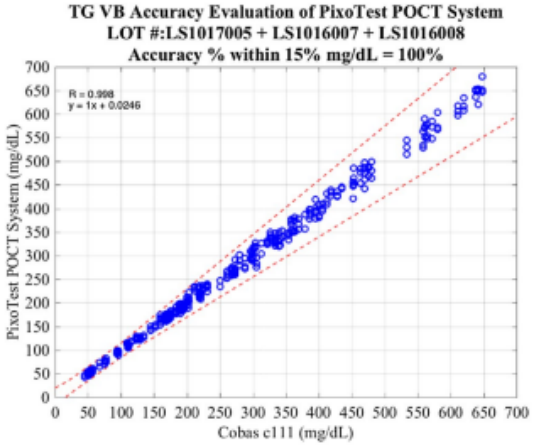


Fig. 5 Venous blood of 3 Lots at 3 sites comparison of TG levels obtained by the PixoTest POCT System (test) and the Roche Cobas c111 (comparative) by CLSI EP09-A3. Scatter plots with ordinary linear fit with the Passing-Bablok regression analysis

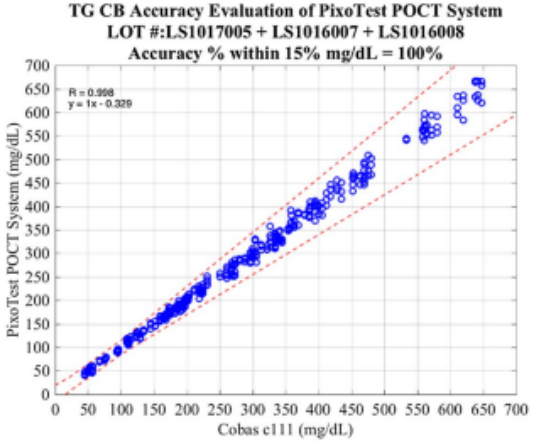


Fig. 6 Capillary blood of 3 Lots at 3 sites comparison of TG levels obtained by the PixoTest POCT System (test) and the Roche Cobas c111 (comparative) by CLSI EP09-A3. Scatter plots with ordinary linear fit with the Passing-Bablok regression analysis

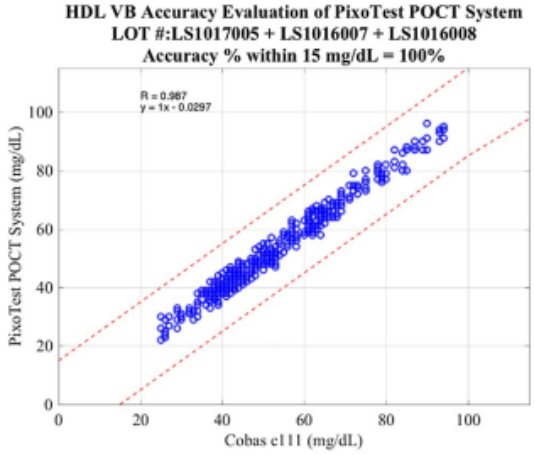


Fig. 7 Venous blood of 3 Lots at 3 sites comparison of HDL levels obtained by the PixoTest POCT System (test) and the Roche Cobas c111 (comparative) by CLSI EP09-A3. Scatter plots with ordinary linear fit with the Passing-Bablok regression analysis

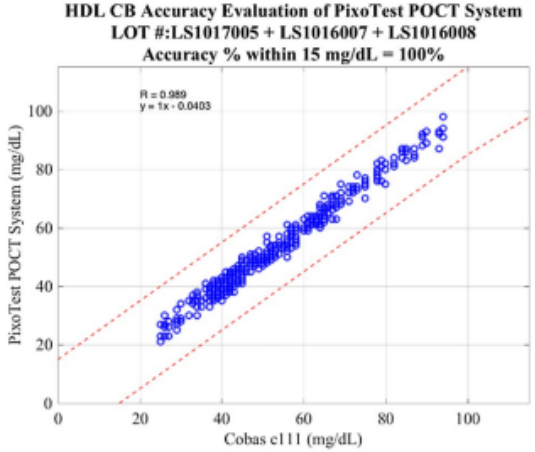


Fig. 8 Capillary blood of 3 Lots at 3 sites comparison of HDL levels obtained by the PixoTest POCT System (test) and the Roche Cobas c111 (comparative) by CLSI EP09-A3. Scatter plots with ordinary linear fit with the Passing-Bablok regression analysis

Mission Cholesterol (ACON Laboratories, USA)

Table 13: Table of characteristics, Mission Cholesterol

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Kurstjens, 2021 [19], Netherlands	Clinical validity, Cross sectional	Secondary Care	Adults (≥ 18 years), n=61 (59 samples)	Capillary Blood	Dutch Foundation for Quality Assessment in Medical Laboratories (SKML), chemistry analyser (Advia Chemistry XPT system, Siemens, Germany) at the JBZ clinical chemistry laboratory, JBZ (Siemens, Advia Chemistry XPT system), venous blood	Cutoff = 5.2 mmol/L; Se (%): 96 Sp (%): 67 PPV: 65% NPV: 96% Pearson's r: 0.96 Mean relative difference (MRD): 11 ± 7% TR: 22±25, HDL: -13±10, LDL_{calc}: 21±14 Mean absolute relative difference (MARD): 12 ± 6% TR: 24±23, HDL: 14±9, LDL_{calc}: 23±11 Passing-Bablok analyses: y = 1.15x–0.15, intercept –0.15 [95% CI –0.64–0.35], slope 1.15 [95% CI 1.05–1.25]). Pearson's r = 0.96 TR: intercept 0.20 [95% CI 0.15–0.38], slope 1.00 [95% CI 0.90–1.06]	Mission perform poorly when calculating the cholesterol:HDL ratio and should not be used for this purpose.	Low

						HDL: intercept −0.20 [95% CI −0.42 to −0.10], slope 1.00 [95% CI 1.00–1.17] LDL: intercept 0.08 (95% CI -0.37 – 0.43), slope 1.2 (95% CI 1.09 – 1.33) cholesterol:HDL ratio (intercept −1.20 [95% CI −1.82 to −0.74], slope 1.62 [95% CI 1.48–1.80]).		

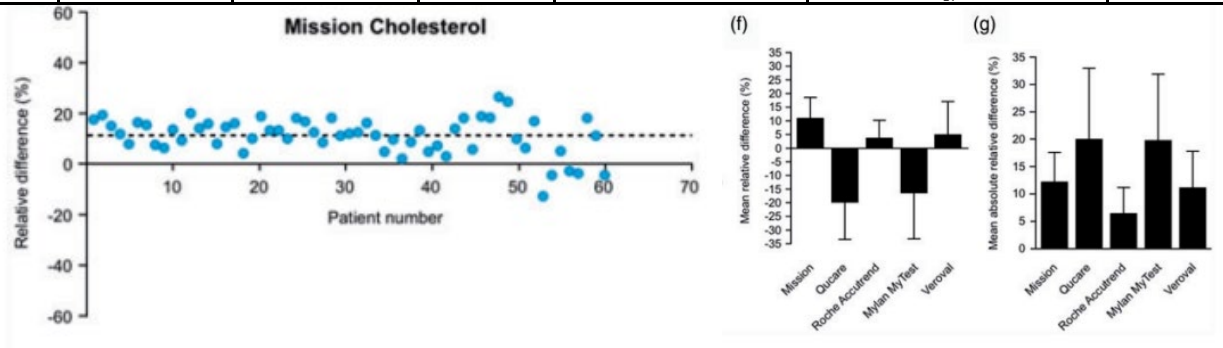


Figure 1. Accuracy analyses. (a–e) The relative difference between the blood cholesterol concentration of each individual patient (blue dot) measured by the self-tests (a) *Mission*, (b) *Qucare*, (c) *Accutrend Plus*, (d) *Mylan MyTest* and (e) *Veroval*, compared with the routine chemistry analyser from Siemens (Advia XPT). The dotted lines indicate the mean relative difference (MRD). (f) The MRD of each self-test, data taken from A-E. (g) The mean absolute relative difference of each self-test.

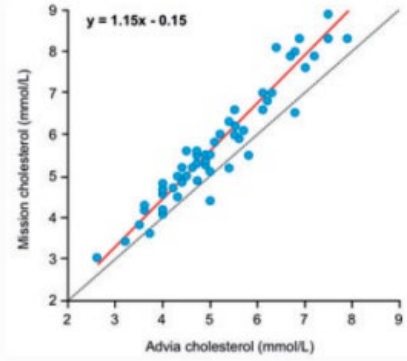


Figure 2. Method comparison analyses. (a–c) Passing Bablok analyses comparing the self-tests to the routine chemistry analyser from Siemens (Advia XPT). (a) *Mission* (intercept –0.15 [95% CI –0.64–0.35], slope 1.15 [95% CI 1.05–1.25]), (b) *Qucare* (intercept –0.90 [95% CI –1.79–0.11], slope 1.00 [95% CI 0.80–1.18]) and (c) *Accutrend Plus* (intercept –0.21 [95% CI –0.76–0.25], slope 1.08 [95% CI 1.00–1.19]).

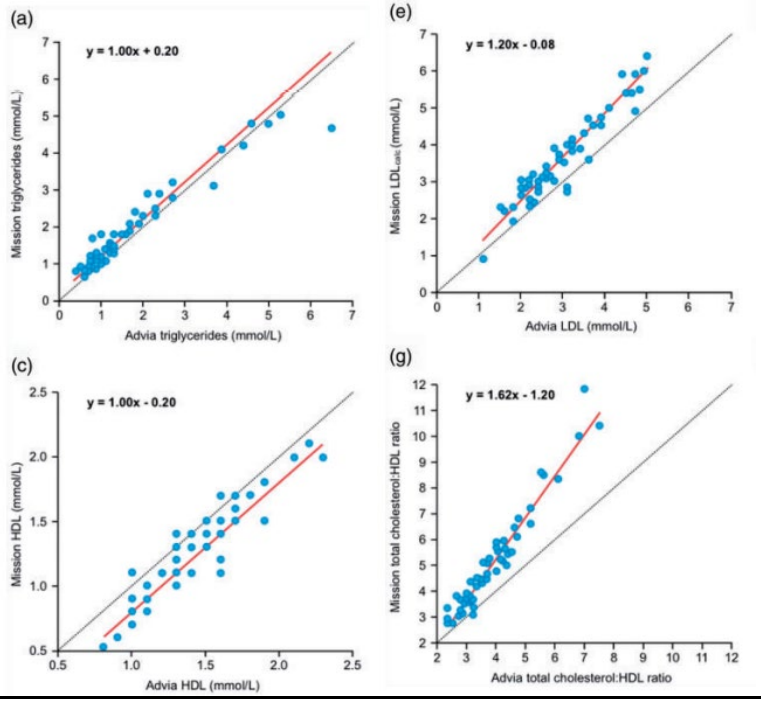


Figure 3. Method comparison for the lipid panel. Passing Bablok (PB) analyses comparing the triglyceride and HDL concentrations, and the calculated LDL and cholesterol:HDL ratio of the self-tests to the values from the routine chemistry analyser from Siemens (Advia XPT). (a) PB *Mission* triglycerides (intercept 0.20 [95% CI 0.15–0.38], slope 1.00 [95% CI 0.90–1.06]) and (b) PB *Qucare* triglycerides (intercept –0.12 [95% CI –0.33–0.13], slope 0.92 [95% CI 0.76–1.12]). (c) PB *Mission* HDL (intercept –0.20 [95% CI –0.42 to –0.10], slope 1.00 [95% CI 1.00–1.17]). (d) PB *Qucare* HDL (intercept 0.46 [95% CI 0.25–0.66], slope 0.40 [95% CI 0.25–0.5]). (e) PB *Mission* calculated LDL (LDL_{calc}) (intercept 0.08 (95% CI -0.37 – 0.43), slope 1.2 (95% CI 1.09 – 1.33)). (f) PB *Qucare* LDL_{calc} (intercept –0.40 [95% CI –1.16–0.29], slope 1.00 [95% CI 0.79–1.23]). (g) PB *Mission* cholesterol:HDL ratio (intercept –1.20 [95% CI –1.82 to –0.74], slope 1.62 [95% CI 1.48–1.80]). (h) PB *Qucare* total cholesterol:HDL ratio (intercept 1.75 [95% CI 1.07–2.25), slope 0.61 [95% CI 0.46–0.82]).

Qucare Multi Meter (DFI Diagnostics, South Korea)

Table 14: Table of characteristics, Qucare

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Kurstjens, 2021 [19], Netherlands	Clinical validity, Cross sectional	Secondary Care	Adults (≥ 18 years), n=61	Capillary Blood	Dutch Foundation for Quality Assessment in Medical Laboratories (SKML), chemistry analyser (Advia Chemistry XPT system, Siemens, Germany) at the JBZ clinical chemistry laboratory, JBZ (Siemens, Advia Chemistry XPT system), venous blood	Cutoff = 5.18 mmol/L; Se (%): 40 Sp (%): 100 PPV: 100% NPV: 71% Pearson's r: 0.69 Mean relative difference (MRD): –19 ± 13% TR: -7±44, HDL: -26±16, LDL_{calc}: -15±22 Mean absolute relative difference (MARD): 12 ± 6% TR: 27±35, HDL: 27±13, LDL_{calc}: 20±18 Passing-Bablok analyses: y = 1.00x–	Both the accuracy and diagnostic performance of the Qucare are poor, and hence, this device led to erroneous interpretations. Qucare perform poorly when calculating the cholesterol:HDL ratio and should not be used for this purpose.	Low

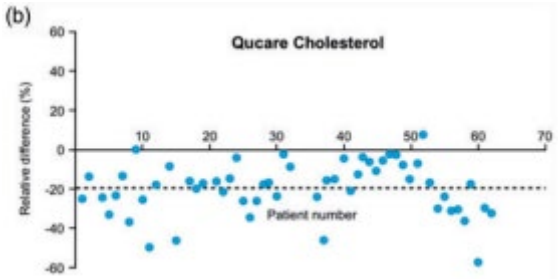
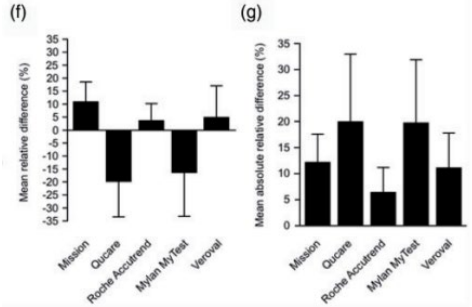
						0.90. Pearson's r = 0.69, intercept –0.90 [95% CI –1.79–0.11], slope 1.00 [95% CI 0.80–1.18] TR: intercept –0.12 [95% CI –0.33–0.13], slope 0.92 [95% CI 0.76–1.12] HDL: intercept 0.46 [95% CI 0.25–0.66], slope 0.40 [95% CI 0.25–0.5] LDL: (intercept –0.40 [95% CI –1.16–0.29], slope 1.00 [95% CI 0.79–1.23]) cholesterol:HDL ratio (intercept 1.75 [95% CI 1.07–2.25), slope 0.61 [95% CI 0.46–0.82])		
								

Figure 1. Accuracy analyses. (a–e) The relative difference between the blood cholesterol concentration of each individual patient (blue dot) measured by the self-tests (a) *Mission*, (b) *Qucare*, (c) *Accutrend Plus*, (d) *Mylan MyTest* and (e) *Veroval*, compared with the routine chemistry analyser from Siemens (Advia XPT). The dotted lines indicate the mean relative difference (MRD). (f) The MRD of each self-test, data taken from A-E. (g) The mean absolute relative difference of each self-test.

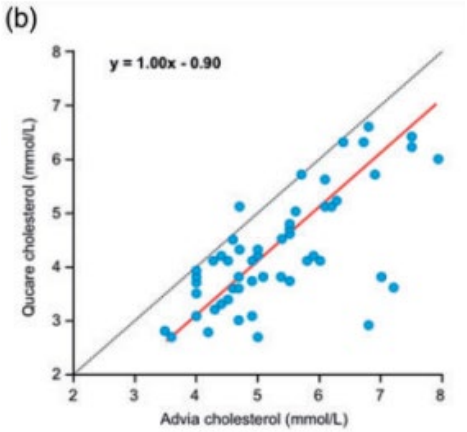


Figure 2. Method comparison analyses. (a–c) Passing Bablok analyses comparing the self-tests to the routine chemistry analyser from Siemens (Advia XPT). (a) *Mission* (intercept –0.15 [95% CI –0.64–0.35], slope 1.15 [95% CI 1.05–1.25]), (b) *Qucare* (intercept –0.90 [95% CI –1.79–0.11], slope 1.00 [95% CI 0.80–1.18]) and (c) *Accutrend Plus* (intercept –0.21 [95% CI –0.76–0.25], slope 1.08 [95% CI 1.00–1.19]).

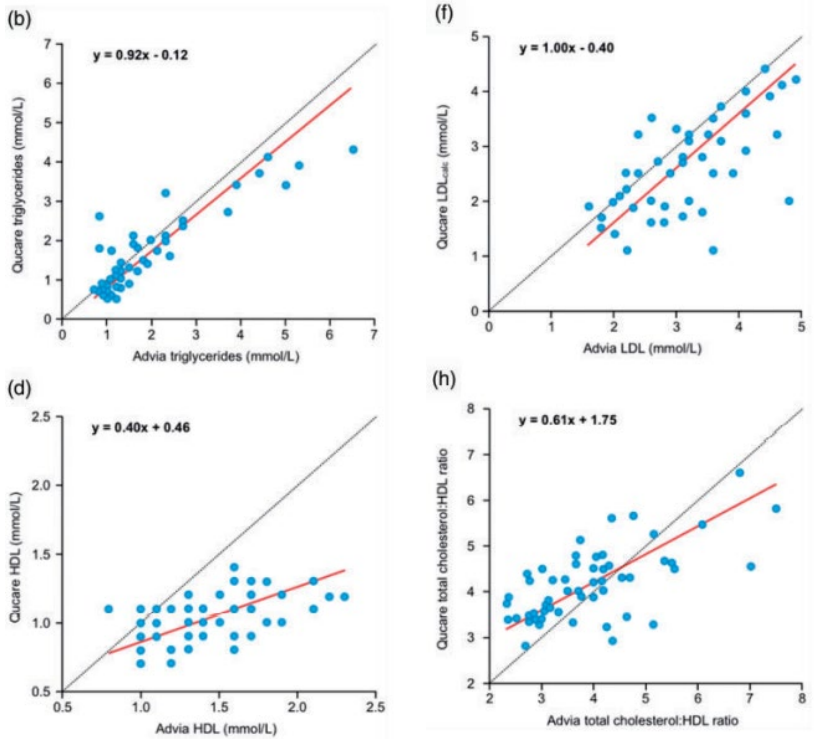


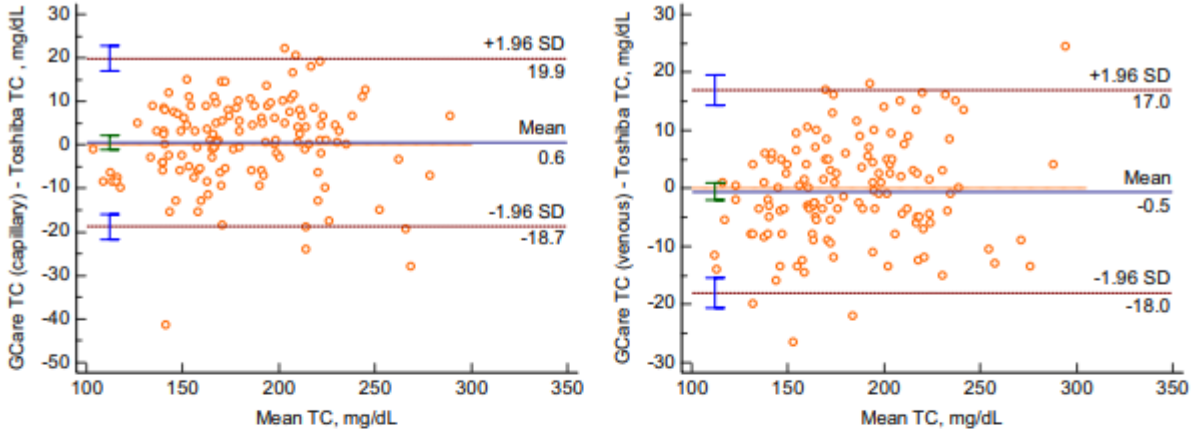
Figure 3. Method comparison for the lipid panel. Passing Bablok (PB) analyses comparing the triglyceride and HDL concentrations, and the calculated LDL and cholesterol:HDL ratio of the self-tests to the values from the routine chemistry analyser from Siemens (Advia XPT). (a) PB *Mission* triglycerides (intercept 0.20 [95% CI 0.15–0.38], slope 1.00 [95% CI 0.90–1.06]) and (b) PB *Qucare* triglycerides (intercept –0.12 [95% CI –0.33–0.13], slope 0.92 [95% CI 0.76–1.12]). (c) PB *Mission* HDL (intercept –0.20 [95% CI –0.42 to –0.10], slope 1.00 [95% CI 1.00–1.17]). (d) PB *Qucare* HDL (intercept 0.46 [95% CI 0.25–0.66], slope 0.40 [95% CI 0.25–0.5]). (e) PB *Mission* calculated LDL (LDL_{calc}) (intercept 0.08 (95% CI -0.37 – 0.43), slope 1.2 (95% CI 1.09 – 1.33)). (f) PB *Qucare* LDL_{calc} (intercept –0.40 [95% CI –1.16–0.29], slope 1.00 [95% CI 0.79–1.23]). (g) PB *Mission* cholesterol:HDL ratio (intercept –1.20 [95% CI –1.82 to –0.74], slope 1.62 [95% CI 1.48–1.80]). (h) PB *Qucare* total cholesterol:HDL ratio (intercept 1.75 [95% CI 1.07–2.25), slope 0.61 [95% CI 0.46–0.82]).

GreenCare Lipid (Green Cross Medical Science, South Korea)

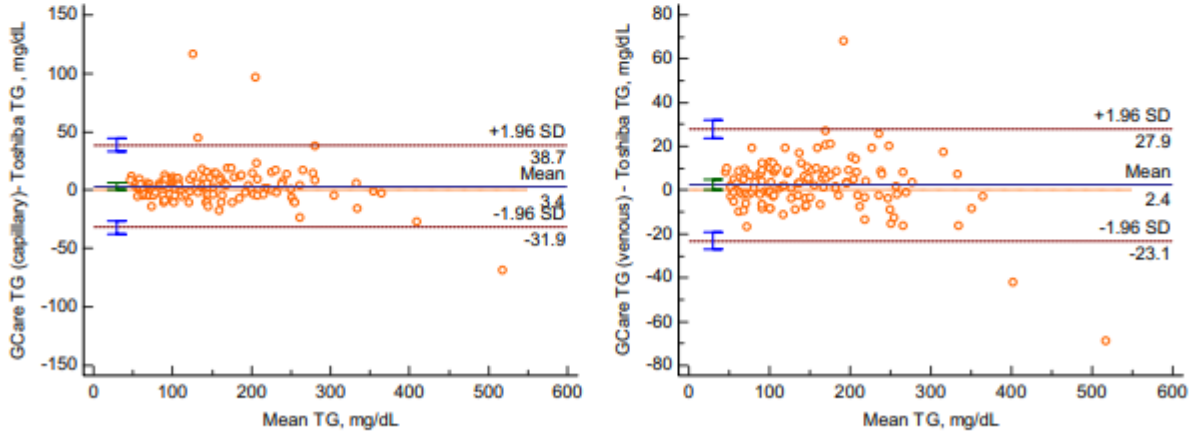
Table 15: Table of characteristics, GreenCare

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Kim and Yoon, 2021[54], Korea	Analytical Validity, Cohort	Secondary Care	Volunteers aged 19-80, n = 136	Capillary Whole Blood, Venous Whole Blood,	TBA2000FR chemistry analyzer, EDTA Whole blood	Precision (CV%): TC: 3.6 TG: 3.8 HDL-C: 5.5 Capillary Blood Agreement (%): TC:: 92.3 <2.17 mmol/L: 92.9 ≥2.17 mmol/L and <6.21 mmol/L: 89.3 ≥6.21 mmol/L: 100 TG: Total: 91.5 <1.69 mmol/L: 94.5 ≥1.69 mmol/L and <2.26 mmol/L: 72.2 ≥2.26 mmol/L: 98.1 HDL: Total: 93.3 <1.03 mmol/L: 73.5 ≥1.03 mmol/L and <1.55 mmol/L: 95.9 ≥1.55 mmol/L: 100 Venous Blood Agreement (%): TC: 91.4 <2.17 mmol/L: 93.6 ≥2.17 mmol/L and <6.21 mmol/L: 83.9 ≥6.21 mmol/L: 100 TG:	The GCare Lipid Analyzer demonstrated good clinical agreement with the reference values for TC, TG, and HDL-C using both capillary and venous blood. The analytical performance based on the NCEP criteria was also acceptable. The GCare Lipid Analyzer is expected to benefit patients by facilitating the convenient monitoring of lipid levels.	

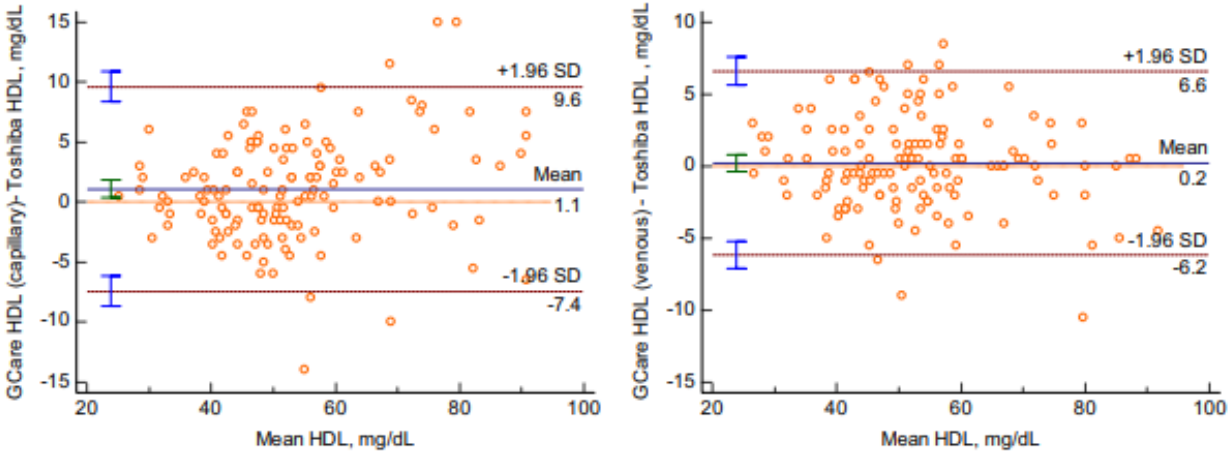
						Total: 95.5 <1.69 mmol/L: 97.3 ≥1.69 mmol/L and <2.26 mmol/L: 83.3 ≥2.26 mmol/L: 100 HDL: Total: 92.9 <1.03 mmol/L: 79.4 ≥1.03 mmol/L and <1.55 mmol/L: 95.3 ≥1.55 mmol/L: 100 Passing–Bablok regression: Capillary Blood: TC: R=0.965, y = -5.338 + 1.038x TG: R=0.968, y = 1.870 + 1.006x HDL-C: R=0.943, y = -2.200 + 1.067x Venous Blood: TC: R=0.969, y = -10.175 + 1.050x TG: R=0.990, y = 3.000 + 1.000x HDL-C: R=0.956, y = 0.000 + 1.000x		


GCare TC (capillary) - Toshiba TC , mg/dL
Mean TC, mg/dL
+1.96 SD
19.9
Mean
0.6
-1.96 SD
-18.7
GCare TC (venous) - Toshiba TC, mg/dL
Mean TC, mg/dL
+1.96 SD
17.0
Mean
-0.5
-1.96 SD
-18.0

(A)

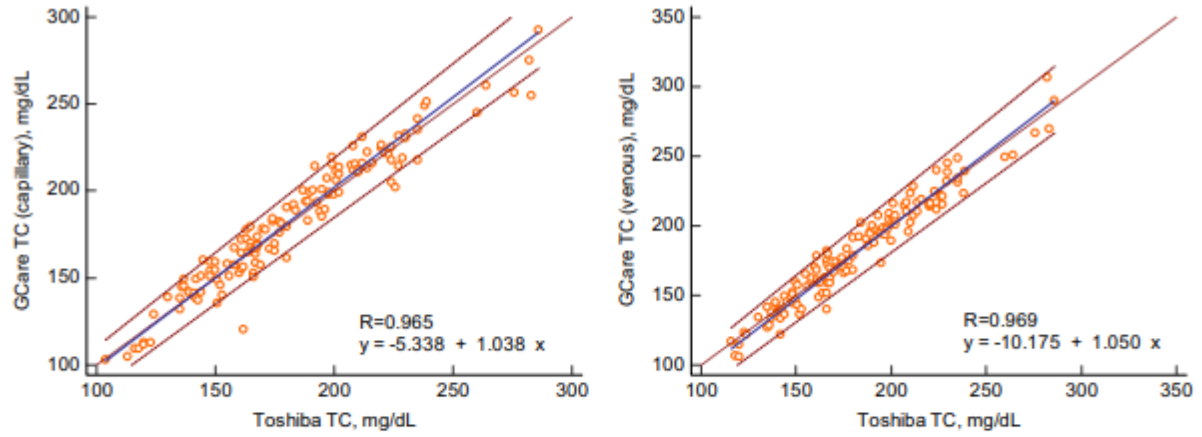

GCare TG (capillary)- Toshiba TG , mg/dL
Mean TG, mg/dL
+1.96 SD
38.7
Mean
3.4
-1.96 SD
-31.9
GCare TG (venous) - Toshiba TG, mg/dL
Mean TG, mg/dL
+1.96 SD
27.9
Mean
2.4
-1.96 SD
-23.1

(B)

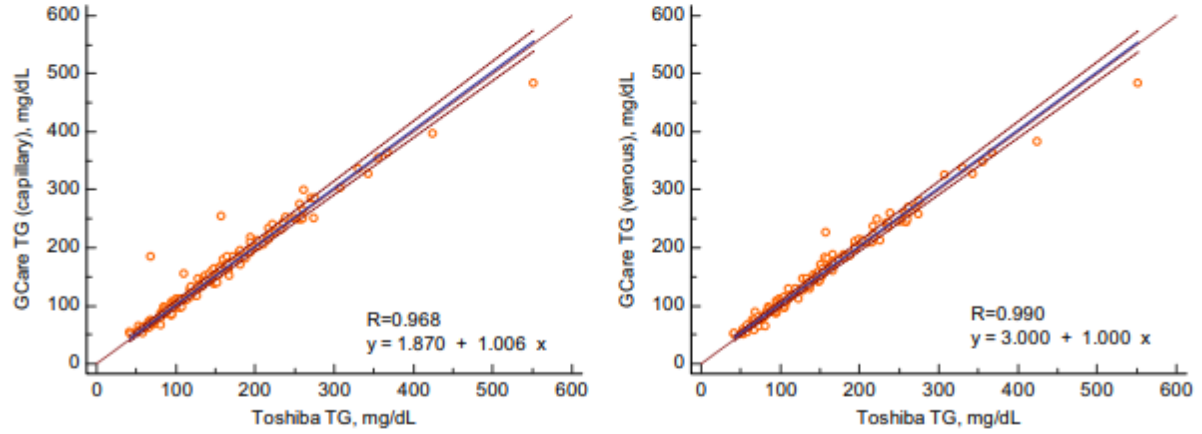


(C)

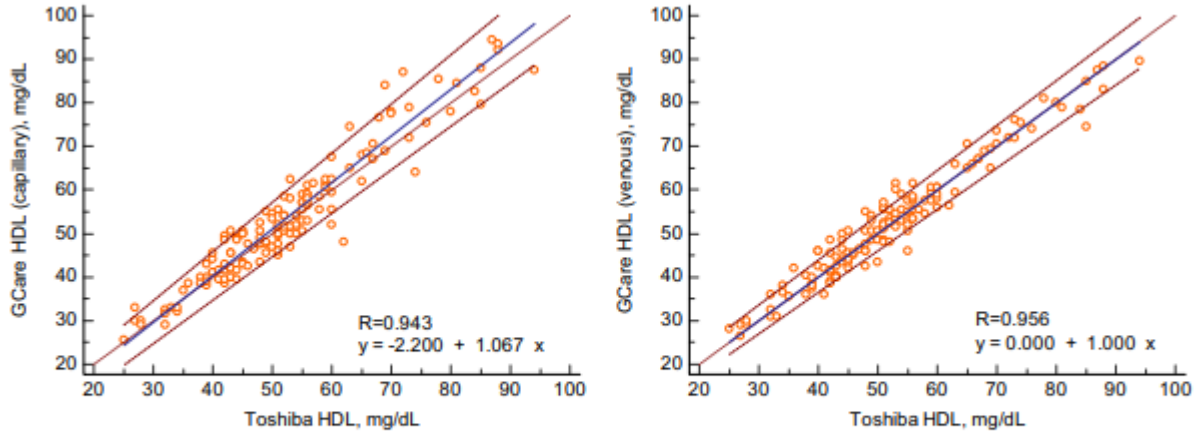
FIGURE 2 Bland–Altman plot of the data obtained using the GCare Lipid Analyzer for: (A) total cholesterol (TC), (B) triglycerides (TG), and (C) high-density lipoprotein cholesterol (HDL-C) in capillary and venous blood samples, compared to the mean TC, TG, and HDL-C using the reference values obtained using the Toshiba TBA TBA2000FR chemistry analyzer


GCare TC (capillary), mg/dL
Toshiba TC, mg/dL
R=0.965
y = -5.338 + 1.038 x
GCare TC (venous), mg/dL
Toshiba TC, mg/dL
R=0.969
y = -10.175 + 1.050 x

(A)


GCare TG (capillary), mg/dL
Toshiba TG, mg/dL
R=0.968
y = 1.870 + 1.006 x
GCare TG (venous), mg/dL
Toshiba TG, mg/dL
R=0.990
y = 3.000 + 1.000 x

(B)



(C)

FIGURE 3 Passing–Bablok regression analysis of the GCare Lipid Analyzer findings for capillary and venous blood samples compared to the reference levels estimated by the Toshiba TBA2000FR chemistry analyzer for (A) total cholesterol (TC), (B) triglyceride (TG), and (C) high-density lipoprotein cholesterol (HDL-C)

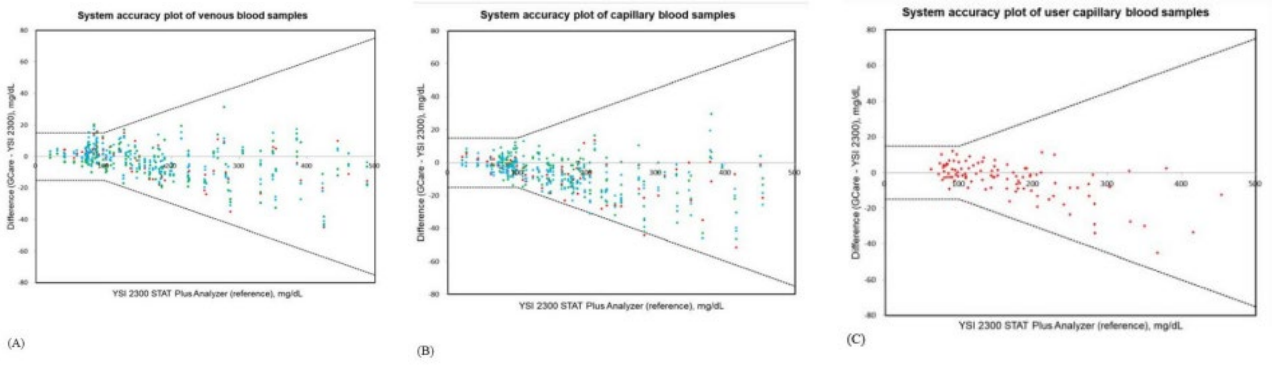


FIGURE 4 System accuracy plot of the measured blood glucose levels using the GCare Lipid Analyzer with a GCare Glucose Test Strip compared with those obtained using the YSI 2300 STAT Plus Analyzer (reference value), obtained from three different lots using (A) venous and (B) capillary blood samples. (C) Plot of user capillary blood glucose results obtained from one lot

Aina Lipids (Jana Care, USA)

Table 16: Table of characteristics, Aina Lipids

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator(s)	Results	Key Findings	Study Risk of Bias*
Akbar[55], 2020, Pakistan	Analytical validity, cross-sectional	Global Health Research Unit	Non-communicable disease (NCD) surveillance program, n = 699	Venous after fasting for 8-14 hours	Cobas c311 analyzer, Venous serum	Precision Not reported Accuracy % bias for TC: Overall = - 46.78 Before cleaning TC level (mmol/l) Mean±SD: Aina = 2.8 ±0.30 Lab = 5.28 ±1.27 R^2 = 0.085 After optical window cleaning TC level (mmol/l) Mean±SD: Aina = 4.67 ±1.5 Lab = 5.45 ±1.89 R^2 = 0.9157	Mean TC level in overall sample by Aina POCT was significantly lower than that of the laboratory method. This trend was also seen in the sub group analysis. After cleaning the optical window, POCT results became comparable with laboratory results. Therefore, Cholesterol POCT requires careful operator training, technical support and strong quality assurance.	

Afinion AS100 (Abbott, USA)

Table 17: Table of characteristics, Afinion AS100

Author, Year, Location[Ref]	**Study Type, Design**	**Clinical Setting**	**Population, Sample Size**	**POCT Sample Type**	**Comparator**	**Results**	**Key Findings**	**Study Risk of Bias***

Abbai, 2018[56], South Africa	Analytical Validity, Cross Sectional	Research Clinic	Adults ≥50 years age, n = 435	EDTA Venous Blood	Central Laboratory, ABX Pentra 400, EDTA Venous Blood	Diagnostic Thresholds (mmol/L): TC: <4.5, TG: <1.70, LDL-C: <2.5, HDL-C (men) 1.0 HDL-C (women) ≥1.2 TC (%): Accuracy: 79.3 Se (%): 100 Sp (%): 63.9 TG (%): Accuracy: 95.4 Se (%): 91.1 Sp (%): 100 LDL-C (%): Accuracy: 76.1 Se (%): 99.1 Sp (%): 63.0 HDLC (men) (%): Accuracy: 90.9 Se (%): 97.5 Sp (%): 63.2 HDLC (women) (%): Accuracy: 89.9 Se (%): 96.3 Specificity: 80.9 Mean Bias (SD) TC: 0.569 (0.377) TG: −0.124 (0.127) LDL-C: 0.528 (0.385) HDL-C: 0.089 (0.095) Concordance correlation: TC: 0.80 TG: 0.99	The results showed very good correlation between the Afinion and the Pentra, with almost perfect correlations noted for HDL-C and triglycerides. This study supports the use of the Afinion as a POC test for the measurement of triglycerides and HDL-C in a South African setting.	

						LDLC: 0.75 HDLC: 0.93		
Jain, 2017[38], UK	Analytical Validity, Cross Sectional	Community Screening	232 participants from a community CVD Screen (n = 83) and Diabetic Care clinic,n = 149	Capillary blood sample	Roche Modular P® analyser (Lab), Venous Blood Sample Cholestech LDX (POCT), capillary blood sample	Measurement Ranges (mmol/L): TC: 2.59–12.95, TG: 0.51– 7.34 HDL-C: 0.39–2.59 Precision Between day: Low controls (%CV): TC: 3.0 TG: 4.5 HDL-C: 3.6 High controls (%CV): TC: 2.2 TG: 3.4 HDL-C: 2.0 Within day: Low controls (%CV): TC: 2.5 TG: 2.1 HDL-C: 2.3 High controls (%CV): TC: 2.3 TG: 3.5 HDL-C: 2.0 Concordance QRISK2 Afinion vs Cholestech LDX: Weighted Kappa: 0.91 QRISK2 Afinion vs Laboratory: Weighted Kappa: 0.94 Deming Regression	This study confirms that POCT using the AfinionAS100 analyser in a community setting yields results that agree well with those of established laboratory methods and the Cholestech LDX (a validated POCT analyser). The Afinion AS100 can be used for initial screening of risk factors in a CVD risk programme, in addition to monitoring patients with the advantage of additional analytes (i.e., HbA1c and UACR)	

						Afinion vs CholestechLDX: TC: 0.46 + 0.91x TG: 0.05 + 1.02x HDL-C: 0.04 + 1.07x Afinion vs Laboratory: TC: 0.46 + 0.85x TG: 0.00 + 1.02x HDL-C: -0.13 + 1.09x		

CR3000 POC system (Callegari Srl, Italy)

Table 18: Table of characteristics, CR3000

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Sblendrio, 2008[57], Italy	Analytical validity, cohort	Laboratory	Unselected healthy adults, n = 21	Capillary	CR3000, venous	Precision Coefficient of variation (CV%) for TC: Capillary = 2.19 Venous = 3.02 Accuracy Analysis of variance (F test) F value = 1.199 Slope (y)= 1.05 ([SE = 0.07; CI (95%) = 1.02-1.08] Intercept (x) = -12.63 ([SE = 12.61; CI (95%) = 4.92]	The values obtained in the capillary blood samples were 2.87% higher than the venous sample measurements. The total variance was statistically similar for venous and capillary measurements (upper critical value of the F distribution is 2.124, $p<0.05$).	

Sblendrio, 2008[58], Italy	Analytical Validity, cohort	Laboratory	Unselected adults aged ≥18, 12-14 hours after fasting, n = 375	Venous	VITROS 350, venous serum	Precision Not reported Mean bias between device and comparator, % ± SD: TC = 0.5 ± 7.6 TG = 1 ± 11.1 HDL = -1.6 ± 10.5	The values obtained with the CR3000 falls between the recommended guidelines. The CR3000 lipid panel data correlate well with those from the reference laboratory.	

Elemark lipid device (BBB Tech, South Korea)

Table 19: Table of characteristics, Elemark

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator(s)	Results	Key Findings	Study Risk of Bias*
Bolodeoku, 2018[23], UK	Analytical validity, case study	Laboratory, secondary care	Healthy individuals, after fasting, n = 1	Capillary fasting blood samples were taken for 12 days over 2 months.	CardioChek PA, capillary blood 3in1, capillary blood	Precision Coefficient of variation (CV%) TC = 5 TG = 30 HDL = 13 LDL = 13 Accuracy Mean ± SD (mmol/l) TC = 5.7±0.3 TG = 1.1±0.3 HDL = 1.8±0.2 LDL = 3.5±0.5	Estimated TC, HDL, LDL and TG fell within the intra-individual variation determined in healthy volunteers. Elemark may however have identified the healthy individual as having high cholesterol. The Elemark produced the lowest biological variation for TC and LDL.	
Bolodeoku, 2019[24], UK	Analytical validity, cohort	Laboratory, secondary care	Healthy individuals, 4	Venous	CardioChek PA, venous blood	Precision Coefficient of variation (CV%)	Based on imprecision guidelines, both devices showed reasonable	

			hours after fasting, n = 3	blood for each subject Within run (10 samples) Between day (6 samples)		Within-run TC = 3 - 5.3 TG = 5 - 6.4 HDL = 4.3 - 6.2 LDL = 5.5 - 14.4 Between-day TC = 4 TG = 30.3 HDL = 14 LDL = 15.3 Accuracy Mean conc. (mmol/l) Within-run TC = 4.8-5.8 TG = 0.7-1.5 HDL = 1.6-2.1 LDL = 2.4-3.8 Between-day TC = 5.7 TG = 1.1 HDL = 1.8 LDL = 3.4	within run imprecision for their TC and HDL but not LDL. The between day imprecision for both devices were consistent with the published within person biological variability.	
Yun, 2019[59], South Korea	Analytical validity, cohort	Laboratory, community	Healthy individuals 70.8 ± 10.8 years of age, n= 116 (80 women, 36 men)	Venous, whole blood	AU5800 Analyzer, Venous serum	Precision Correlation co-efficient (R) Co-efficient of determination (R2) TC R = 0.97 R^2 = 0.94 TG R = 0.99 R^2 = 0.98 HDL	95% of the individual blood-testing parameter results fell within ±0.26 mmol/L of the appropriate reference result at HDL concentration <2.59 mmol/L and within ±15% of the reference result at TC and TG concentrations ≥1.13 mmol/L.	

						R =0.97 R^2 = 0.93 Accuracy 99.1% of the TC concentration values at 2.59 mmol/L or above were within ±15% of the reference results 96.7% of the TG concentration values at 1.13 mmol/L or above were within ±15% of the reference results 100% of the HDL concentration values less than 2.59 mmol/L were within ±0.26 mmol/L of the reference results.	Future studies showing actual use cases should use capillary whole blood. Authors also aware that the recruited participants were mainly from the elderly population.	

HealthCube (HealthCubed, India)

Table 20: Table of characteristics, HealthCube

Author, Year, Location[Ref]	Study Type, Design	Clinical Setting	Population, Sample Size	POCT Sample Type	Comparator	Results	Key Findings	Study Risk of Bias*
Giriraja, 2020 [60], India	Clinical Validity, cross section	Tertiary Care	Healthy volunteers (excluded those with known diagnosis of	Capillary Blood	BeneCheck Multimonitoring System (BK6-12M), Capillary Blood	TC cutoff for diagnosis at 3.88 mmol/L, tolerance limits ± 20% (minimum tolerance 0.52 mmol/L)	The cholesterol testdata, although borderline in the range analysis, had an excellent correlation to the reference device.	Low

			acute or critical illness, participation in any other clinical study and history of blood disorders such as lymphoma, leukaemia, myeloma, polycythaemia, Von Willebrand disease, haemophilia and thrombocythemia), n = 150			Percentage within tolerance range: Below cut-off 100% Above cut-off 94.7%		

*QUADAS – 2

Bolodeoku, 2018 [23] and Bolodeoku, 2018 [24], UK included less than 10 participants.

POCTs Manufacturer Stated Performance Specification

In total 37 devices where reviewed, 23 (62.2 % of all devices) of which had user manuals or IFUs available. Of these 23 devices, 19 (51.4% of all devices) stated either Total Cholesterol Accuracy or Total Cholesterol Precision. 4 out of 23 devices (17.4%) met the NCEP standard of evidence for bias and precision. See Appendix 5 for the full list of devices.

Table 21 Manufacturer stated performance

Device	IFU Available?	Measurement Range (mmol/L)	Stated Total Cholesterol Accuracy (TC Bias)	Stated Total Cholesterol Precision (%CV)	Meets NCEP standard of evidence for bias and precision?
Accutrend Plus	Yes	TC: 3.88 - 7.76	5.17 mmol/L: -4.4% 6.21 mmol/L: -1.8%	2.9-5.5	No
Afinion 2 Analyzer	Yes	TC: 2.59 - 12.95 TG: 0.51 - 7.35 HDL: 0.39 - 2.59	Not Reported	2.3-4.4	No
Afinion AS100*	Yes	TC: 2.59 - 12.95 TG: 0.51 - 7.35 HDL: 0.39 - 2.60	Not Reported	2.3-4.4	No
Aina Lipids	Yes	TC: 2.59-7.76 TG: 0.56-5.08 HDL: 0.65-2.20	Not Reported	3.4-4.3	No
BeneCheck Plus	Yes	TC: 2.59-10.35	Not Reported	20	No
CardioChek PA	Yes	TC: 2.59-10.36 TG: 0.57-5.65 HDL: 0.39-2.59	Unknown Concentration: -2.3%	0.0	Yes*
CardioChek Plus	Yes	TC: 2.59-10.36 TG: 0.57-5.65 HDL: 0.39-2.59	Unknown Concentration: -1.7%	0.2	Yes*
Cholestech LDX	Yes	TC: 2.59 - 12.95 TG: 0.51 - 7.35 HDL: 0.39 - 2.59	5.17 mmol/L: -1%	2.4-3.5	No
Cobas b101	Yes	TC: 1.28 - 12.95 TG: 0.51 - 7.35 HDL: 0.39 - 2.59	5.17 mmol/L: -2.1% 6.21 mmol/L: -1.8%	1.6-2.2	Yes

Element Multi	Yes	TC: 2.59-10.36 TG: 0.80-6.86 HDL: 0.65-2.08	Not Reported	3.8-4.7	No
GreenCare Lipid	Yes	TC: 2.59-10.36 TG: 0.57-6.86 HDL: 0.65-2.59	Not Reported	3.6-3.9	No
LipidoCare	Yes	TC: 2.59-11.64 TG: 0.51-7.34 HDL: 0.65-2.46	Not Reported	3.3-3.5	No
LipidPlus	Yes	TC: 2.59-10.36	Not Reported	1.1-1.6	Partial
LipidPro	Yes	TC: 2.59-10.36 TG: 0.80-6.86 HDL: 0.65-2.08	Not Reported	3.8-4.7	No
PiccoloXpress	Yes	TC: 0.52-13.5 TG: 023-5.65 HDL: 0.39-2.59	Unknown Concentration: -0.5%	2.2-2.6	Yes
SimplexTAS 101	Yes	TC: 0.52-12.95 TG: 0.11-5.65 HDL: 0.26-3.88	Not Reported	<5%	No
Skyla HB1	Yes	TC: 1.3-14 TG: 0.4-6.8 HDL: 0.5-1.9	Not Reported	1.3-2.1	Partial
Spotchem EZ/EL	Yes	TC: 1.3-10.36	Not Reported	1.9-4.8	No
VERI-Q MULTI	Yes	TC: 2.59-10.36 TG: 0.57-6.86 HDL: 0.52-2.08	Not Reported	<4%	Partial

*Cholesterol Reference Method Laboratory Network (CRMLN) Certified. NCEP standard of evidence for bias and precision: Bias ≤ 3%, %CV ≤ 3%

Discussion

Our objectives with this report were to systematically identify the currently available POCTs for measuring cholesterol and their associated, published, peer-reviewed clinical evidence. In the results, we extracted and presented the key test, study and accuracy characteristics of the identified POCTs, as derived from the analytical and clinical validity evidence.

There was an approximate 6-fold increase in the POCTs identified for measuring cholesterol since the CEP buyers review in 2009, from 6 to 37 POCTs. However, we have not identified any appropriate evidence for 21/37 identified POCTs. The evidence is unevenly distributed across POCTs, with most of the included evidence (84.1%) focused on three POCTs (Cholestech LDX, CardioChek PA, Accutrend Plus), leaving the other POCTs with no more than three published studies reporting on their performance. The majority of the studies evaluated POCTs developed by multinational corporations (Roche, Abbot, PTS Diagnostics), whereas POCTs without or much less evidence was typically associated with SMEs.

We identified 44 studies associated with the 16 POCTs, which met the inclusion criteria and were extracted in this report, 12 of which were diagnostic accuracy studies, and 32 analytical validity studies. The majority of studies had a low risk of bias, with only two assigned a medium risk of bias, and zero of high risk. Our search also identified two RCTs, 21 cross-sectional study designs, 20 cohort study designs and one case-study.

Analytical validity studies helped us assess the accuracy of a POCTs to measure the analyte of interest (cholesterol/lipids). They were carried out in a laboratory using selected samples (fasting or non-fasting capillary or venous blood). Analytical validity studies extraction tables usually report bias and precision. Diagnostic accuracy studies compare results from a POCT device (index test) to those from a laboratory method (reference standard). They should be conducted in conditions similar to those in which

the test is intended to be used. Clinical validity studies did not often supply sensitivity/specificity.

In general, they are comparing capillary blood used with POCT with venous blood from laboratory testing, but they have also compared venous blood for POCT and venous blood for laboratory testing or capillary blood for both POCT and laboratory testing. Furthermore, the identified studies typically compared POCT vs laboratory reference, but some compared POCT vs POCT.

The reviews show a wide range in device performance, as stated by both the manufacturer and from the literature. 4 devices identified met the requirements of the NCEP standard of evidence for bias and precision. Manufacturer performance data, user manuals and IFUs were unable to be sourced for 14 out of 37 devices (37.8%).

Furthermore, as the UK is currently reviewing the UK MDD 2002, and transitioning from CE marking, the level of evidence required for devices made available on the UK market may change, resulting in removal of some devices from the market where companies find it no longer economically viable (e.g. Reflotron Plus, Roche Diagnostics)

Trends from extracted evidence

Some trends can be observed over the extracted evidence. These are preliminary only, because this study was a mostly descriptive exercise, so does not allow for strong or causal inferences. These trends are listed below:

- Some manufacturers are moving away from measuring lipid profiles to developing devices for other medical conditions. We believe that the market for lipid POCT may not be too viable (unlike blood glucose testing which has survived for a long time), so companies are moving to other avenues (uric acid, CRP, SARS-CoV-2).
- Unlike on other POCT markets, hand-held and desktop POCT have grown at the same rate (18 Desktop vs 19 Handheld. In 2009 this was 3 desktop and 3 handheld)

- Only some studies compared their results against national guidelines like the NCEP guidelines to show concordance of classification between the POCT and laboratory (20, 44, 47, 49, 54).

Limitations of the review

There are several limitations to this work:

(1) This review was limited to analytical and clinical validity/diagnostic accuracy evidence. and as such analytical validity and diagnostic accuracy measures do not provide any information about the impact different testing strategies have on patient outcomes and the health care system [61]. Other types of evidence, such as clinical utility and health economics, were not considered, but may have a role to play in policy making.

(2) The evidence has been presented in a descriptive form (only) and has not been fully synthesised through a meta-analysis of each POCT. Both (1-2) were products of the scope of the current work.

(3) The search strategy was a complex multi-step process and is likely not easily repeatable. In performing the searches as specified we have not considered technologies on the horizon, that do not have published evidence, or those devices that are already in use but have discontinued.

(4) We did not identify an appropriate tool for the critical assessment of analytical validity studies, so the quality of the studies included is uncertain.

(5) To a lesser extent, we have not followed any specific definition for POCT. If a device was used as a POCT and defined as such by the authors of the study, it was included in the review. This has implications for use in primary care practice as POCTs need to meet the same standards as clinical laboratories[62]. However, this was partially mitigated in some instances, where approved guidelines such as the NCEP were used to measure concordance of the classification of disease risk between apparatus.

(6) Comparators tests were performed according to the standard of care (regional/local hospital laboratories) which would all have their own methods for testing (sample storage, sample preparation etc). Whilst method verification data was not included in this report it was assumed that they all followed manufacturer's instructions for the comparator test.

(7) Lastly, there was a range of different instruments used as the laboratory reference standards whose accuracies could be further explored in a meta-analysis.

Conclusions

There was an approximate 6-fold increase in the POCTs identified for measuring cholesterol since the CEP buyers review in 2009. The evidence was unevenly distributed across POCTs, with most of the included evidence (84.1%) focused on three POCTs (Cholestech LDX, CardioChek PA, Accutrend Plus). Older devices from big multinationals tended to have more evidence. In addition, devices from multinational companies, with a greater level of evidence, were more likely to meet the NCEP evidence requirements with regards to precision and accuracy compared to devices from SMEs.

This multi-step systematic review identified 44 studies associated with the 16 POCTs, which met the inclusion criteria; 12 of which were diagnostic accuracy studies with low risk of bias. Studies were mainly comparing capillary blood used with POCT and venous blood for laboratory testing, but also other comparisons were reported. Generally, the identified studies would compare POCT vs laboratory reference and a few compared POCT vs POCT.

Future recommendations

It may also be useful to broaden the scope of these searches to include clinical utility and health economic studies. Future work in the NIHR Newcastle MIC will look to find ways to simplify and formularise this type of multi-step searching, so that searches can be subjected to simpler updates and validation. A simpler, formulaic approach to

searching for current POCTs and other devices may have broader value to clinicians, researchers, industry developers and policy makers.

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Declarations of interest

The authors declare no conflict of interest. The funders had no role in the conception of this study or in the writing of the report.

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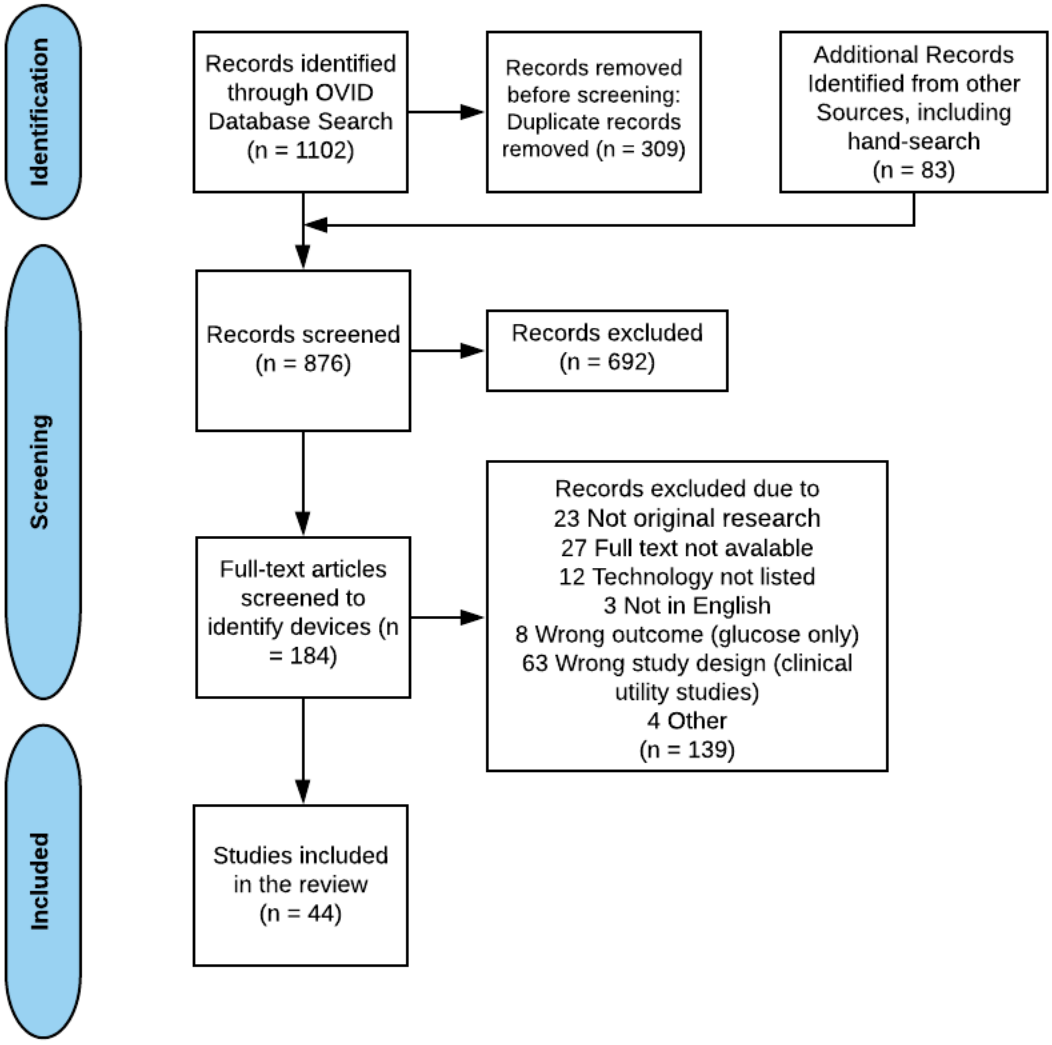
Appendices

Appendix 1: Search Strategy

Figure 1 Flow chart of the selection of studies



The searches used with EMBASE via OVID are reported below:

The first search was a *verbatim* repeat of that used in the 2009 CEP buyers guide (conceptualised as A: [POCT] and B [lipid/cholesterol]), but restricted by year from 2009 onwards.

1 point-of-care test*.mp.

2 POCT.mp.

3 near-patient test*.mp.

4 NPT.mp.

5 or/1-4

6 Laboratory.mp.

7 Cholesterol.mp.

8 HDL*.mp.

9 LDL*.mp.

10 lipid*.mp.

11 or/7-10

12 5 and 6 and 11

13 limit 12 to english language

14 limit 13 to yr="2009 -Current"

The second search was a modified version of the first search, which leveraged validated search filters for the key terms (conceptualised as A: [POCT] and B [lipid/cholesterol] and C [primary care]), but not restricted by year.

1 point-of-care.mp

2 POCT.mp

3 rapid testing.mp

4 laboratory independent.mp

5 near patient testing.mp

6 NPT.mp

7 bedside testing.mp

8 or/1-7

9 diag*.mp

10 CVD prevention.mp

11 Primary Care.mp

12 General Pract*.mp

13 GP.mp

14 Primary Health.mp

15 or/10-14

16 cholesterol*.mp

17 HDL*.mp

18 LDL*.mp

19 VLDL*.mp

20 lipid*.mp

21 dyslipid*.mp

22 hyperlipid*.mp

23 hypolipid*.mp

24 lipoprotein*.mp

25 triglyceride*.mp

26 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25

27 8 and 9 and 15 and 26

28 limit 27 to english language

The final search was for the POCT's names elicited in the initial searches, this was run on the 11 October 2021. This time the searches were not limited (all searchable fields).

1 Piccolo Xpress.af.

2 Jant Pharmacal.af.

3 Accutrend Plus.af.

4 Jana Care.af.

5 Afinion.af.

6 (Allegro and Nova Biomedical).af.

7 Spotchem Arkray.af.

8 BeneCheck.af.

9 CardioChek.af.

10 Cholestech.af.

11 ((CR3000 or Clini5) and Callegari).af.

12 Cobas b101.af.

13 BBB Technologies.af.

14 HealthCube.af.

15 HumaSens.af.

16 Osang.af.

17 (Mission).af.

18 Mission Ultra.af.

19 (MS* and "MedicalSystem").af.

20 Multicare-In.af.

21 PixoTest.af.

22 MNCHIP.af.

23 Qucare.af.

24 Quikread.af.

25 Tascom.af.

26 Skyla.af.

27 Swasthya Sahayak.af.

28 VERI-Q.af.

29 LipidoCare.af.

30 Reflotron Plus.af.

31 (GCcare or GreenCare).af.

32 or/1 -31

33 limit 32 to humans

In both occasions (August and October 2021) we searched:

- Ovid, MEDLINE(R) and In-Process, In-Data-Review & Other Non-Indexed Citations <1946 to *present*>
- Ovid, MEDLINE(R) Daily Update <1946 to *present*> and
- Ovid, Embase <1974 to *present*>

Appendix 2: Inclusion and exclusion criteria

Studies were included if they

- evaluated a POCT for cholesterol (lipid panel) compared to a laboratory test or another POCT
- Study type: clinical validity/diagnostic accuracy studies, analytical validity
- Study design: SR (only to identify primary studies), Cross-sectional, Cohort (prospective, retrospective), RCT

Articles were excluded if they evaluated:

- Technology not listed
- Not original research (except SR)
- Study type: clinical utility, economic evaluation, qualitative studies
- Wrong outcome (evaluated only other parameters i.e. glucose, coagulation testing)
- Wrong setting (laboratory-based test, home testing kits)
- Papers not in English
- In animal studies.

These were coded as:

- Technology not listed
- Not original research
- Wrong study design
- Wrong outcome
- Wrong setting
- Not in English
- In animal studies
- Full text not available
- Other.

Appendix 3: Summary of results

Table 22: Summary table of characteristics

	Design	n	POCT sample	Comparator sample	Comparator
Abbai, 2018, South Africa	cross-sectional	435	venous	venous	lab
Akbar, 2020, Pakistan	cross-sectional	699	venous	venous	lab
Barosso, 2018, Spain	RCT	937	capillary	venous	lab
Barrett, 2014, Australia	cohort	40	capillary	venous	lab
Bastianelli et al, 2017, USA	cross-sectional	30	capillary	venous	lab
Bolodeoku, 2018, UK	case study	1	capillary	capillary	CardioChek vs Elemark
Bolodeoku, 2019, UK	cohort	3	venous	venous	CardioChek vs Elemark
Bubner et al, 2009, Australia	cross-sectional	4968	capillary	venous	lab
Carey et al, 2006, Ireland	cross-sectional	100	capillary and venous	venous	lab
Cheng, 2020, Taiwan	cross-sectional	120	capillary and venous	capillary and venous	lab
Cobbaert et al, 1994, Netherlands	cohort	43	venous	venous	lab
Coquiero, 2013, Brazil	cohort	53	capillary	venous	lab
Cummings et al, 1994, US	cross-sectional	40	venous	venous	lab
Dale, 2008, USA	cross-sectional	34	capillary	venous	lab
Donato, 2015, USA	cohort	57	capillary	venous	lab
Donato, 2015, USA	cohort	57	capillary	capillary	Cholestech LDX vs CardioChek
dos Santos Ferreira, 2015, Brazil	cross-sectional	516	capillary and venous	venous	lab
Gialamas et al, 2010, Australia	cohort	765	capillary	capillary	lab
Giriraja et al, 2020, India	cross-sectional	150	capillary	capillary	lab
ICCnet CHSA, 2013, Australia	cohort	140	capillary	venous	lab
Jain et al, 2011, UK	cohort	406	capillary	venous	lab
Jain et al, 2017, UK	cross-sectional	232	capillary	capillary	Cholestech LDX and Afinion AS100
Jain et al, 2017, UK	cross-sectional	232	capillary	venous	lab
Kim and Yoon, 2021, Korea	cohort	136	capillary and venous	venous	lab
Kurstjens, 2021, Netherlands	cross-sectional	61	capillary	venous	lab

Maciel, 2019, Brazil	cross-sectional	30	capillary	venous	lab
Matteucci, 2014, Itay	cohort	88	capillary and venous	venous	lab
Mendez-Gonzalez, 2010, Spain	cohort	109	venous	capillary	CardioChek PA vs Accutrend Plus
Mendez-Gonzalez, 2010, Spain	cohort	109	capillary	venous	lab
Motta, 2015, Australia	cohort	61	venous	venous	lab
O'Donovan,2011, Ireland	cross-sectional	80	capillary	capillary	Cholestech LDX vs Reflotron Plus
Ordonez-Llanos, 2013, Spain and Switzerland	cohort	160	capillary and venous	venous	lab
Parikh et al, 2009	cross-sectional	250	capillary	venous	lab
Park, 2015, Kenya	cross-sectional	246	capillary and venous	venous	lab
Rogers et al, 1993, US	cohort	18	capillary and venous	venous	lab
Rubin et al, 2003, US	cross-sectional	47	capillary	venous	lab
Sblendrio, 2008, Italy	cohort	21	capillary	venous	lab
Sblendrio, 2008b, Italy	cohort	375	venous	venous	lab
Scafoglieri, 2012, Belgium	cohort	60	capillary	venous	lab
Shemesh et al, 2006, Australia	cross-sectional	76	capillary	venous	lab
Shephard et al, 2002	cross-sectional	51	capillary and venous	venous	lab
Shephard et al, 2009 Design	RCT	1101	capillary	venous	lab
Simpson, 2010, Australia	cohort	51	venous	venous	lab
Volles et al, 1998	cross-sectional	98	capillary and venous	venous	lab
Whitehead, 2013, UK	cohort	167	capillary	venous	lab
Whitehead, 2013, UK	cohort	167	capillary	capillary	CardioChek PA vs Cholestech LDX
Whitehead, 2014, UK	cross-sectional	162	capillary	venous	lab
Yun, 2019, South Korea	cohort	116	venous	venous	lab

Diagnostic accuracy studies, Repeated entry due to several comparisons

Appendix 4: Risk of Bias

	Coquiero, 2013	Kurstjens, 2021	Maciel, 2019	Parikh, 2009	Shemesh, 2006	Rubin, 2003
Consecutive or random sample	Yes	Yes	Yes	Yes	Yes	Yes
Case controlled design avoided	Yes	Yes	Yes	Yes	Yes	Yes
Avoid inappropriate exclusions	Yes	Yes	Yes	Yes	Unclear	Yes
Selection of patients have introduced bias	Low	Low	Low	Low	Low	Low
Is there concern that the included patients do not match the review question?	Low	Low	Low	Low	Low	Low
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear	Yes	Unclear	Unclear	Yes	Yes
If a threshold was used, was it pre-specified?	Yes	Yes	Yes	Yes	Yes	Yes
Could the conduct or interpretation of the index test have introduced bias?	Unclear	No	No	No	No	No
Is there concern that the index test, its conduct, or interpretation differ from the review question?	Low	Low	Low	Low	Low	Low
Is the reference standard likely to correctly classify the target condition?	Yes	Yes	Yes	Yes	Yes	Yes
Were the reference standard results interpreted without knowledge of the results of the index test?	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Could the reference standard, its conduct, or	Low	Low	Low	Low	Low	Low

its interpretation have introduced bias?						
Is there concern that the target condition as defined by the reference standard does not match the review question?	Low	Low	Low	Low	Low	Low
Was there an appropriate interval between index test(s) and reference standard?	Yes	Unclear	Unclear	Unclear	Yes	Yes
Did all patients receive a reference standard?	Yes	Yes	Yes	Yes	Yes	Yes
Did patients receive the same reference standard?	Yes	Yes	Yes	Yes	Yes	Yes
Were all patients included in the analysis?	Yes	No	Yes	No	No	Yes
Could the patient flow have introduced bias?	No	No	No	No	No	No
Prospective study design	Yes	Yes	Yes	Yes	Yes	Unclear
Funding by manufacturer	No	No	No	Yes	No	No
Risk Score	17	17	17	15	17	18
Assessed Risk Level	**Low**	**Low**	**Low**	**Medium**	**Low**	**Low**

...continuing	Whitehead, 2014	Volles, 1998	Giriraja, 2020	Jain, 2011	Jain, 2017	Abbai, 2018	Barosso, 2018
Consecutive or random sample	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes
Case controlled design avoided	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Avoid inappropriate exclusions	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Selection of patients have introduced bias	Medium	Low	Low	Low	Low	Low	Low

Is there concern that the included patients do not match the review question?	Low	Low	Low	Low	Low	Low	Low
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes	Yes	Yes	Yes	Unclear	Yes	Unclear
If a threshold was used, was it pre-specified?	Yes	Yes	Yes	Yes	Unclear	Yes	Yes
Could the conduct or interpretation of the index test have introduced bias?	Yes	No	No	No	No	No	No
Is there concern that the index test, its conduct, or interpretation differ from the review question?	Low	Low	Low	Low	Low	Low	Low
Is the reference standard likely to correctly classify the target condition?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the reference standard results interpreted without knowledge of the results of the index test?	Unclear	Unclear	Yes	Unclear	Unclear	Unclear	Unclear
Could the reference standard, its conduct, or its interpretation have introduced bias?	Low	Low	Low	Low	Low	Low	Low
Is there concern that the target condition as defined by the reference standard does not match the review question?	Low	Low	Low	Low	Low	Low	Low
Was there an appropriate interval between index test(s)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

and reference standard?							
Did all patients receive a reference standard?	Unclear	Yes	Yes	Yes	Yes	Yes	Yes
Did patients receive the same reference standard?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were all patients included in the analysis?	No	Yes	Yes	Yes	Yes	Yes	Yes
Could the patient flow have introduced bias?	No	No	No	No	No	No	No
Prospective study design	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes
Funding by manufacturer	No	Unclear	Yes	Yes	No	No	No
Risk Score	15	18	18	17	15	18	18
Assessed Risk Level	**Medium**	**Low**	**Low**	**Low**	**Medium**	**Low**	**Low**

Appendix 5: Full list of device manuals and IFUs

Device	IFU Available?	Stated Total Cholesterol Accuracy (TC Bias)	Stated Total Cholesterol Precision (%CV)	Meets NCEP level of evidence?
Accutrend Plus	Yes	5.17 mmol/L: -4.4% 6.21 mmol/L: -1.8%	2.9-5.5	No
Afinion 2 Analyzer*	Yes	Not Reported	2.3-4.4	No
Afinion AS100*	Yes	Not Reported	2.3-4.4	No
Aina Lipids	Yes	Not Reported	3.4-4.3	No
BeneCheck Plus	Yes	Not Reported	20	No
CardioChek PA	Yes	Unknown Concentration: -2.3	0.0	Yes*
CardioChek Plus	Yes	Unknown Concentration: -1.7%	0.2	Yes*
Cholestech LDX	Yes	5.17 mmol/L: -1%	2.4-3.5	No
Cobas b101	Yes	5.17 mmol/L: -2.1% 6.21 mmol/L: -1.8%	1.6-2.2	Yes
Element Multi*	Yes	Not Reported	3.8-4.7	No
GreenCare Lipid	Yes	Not Reported	3.6-3.9	No
LipidoCare	Yes	Not Reported	3.3-3.5	No
LipidPlus	Yes	Not Reported	1.1-1.6	Partial
LipidPro	Yes	Not Reported	3.8-4.7	No
PiccoloXpress	Yes	Unknown Concentration: -0.5%	2.2-2.6	Yes
PixoTest	Yes	Information not available	Information not available	No
Qucare Multi	Yes	Information not available	Information not available	No
Quikread Go	Yes	Information not available	Information not available	No
Reflotron Plus	Yes	Information not available	Information not available	No**
SimplexTAS 101	Yes	Information not available	<5%	No
Skyla HB1	Yes	Information not available	1.3-2.1	Partial
Spotchem EZ/EL	Yes	Information not available	1.9-4.8	No
VERI-Q MULTI	Yes	Information not available	<4%	Partial
Allegro	No	IFU not available	IFU not available	Yes*
Clini5	No	IFU not available	IFU not available	Unknown
CR3000	No	IFU not available	IFU not available	Unknown
Elemark	No	IFU not available	IFU not available	Unknown
HealthCube	No	IFU not available	IFU not available	Unknown
HumaSens 2.0 Plus	No	IFU not available	IFU not available	Unknown
Mission Cholesterol	No	IFU not available	IFU not available	Yes*
Mission Ultra	No	IFU not available	IFU not available	Yes*
MS-S200	No	IFU not available	IFU not available	Unknown
MS-S300	No	IFU not available	IFU not available	Unknown
Multicare-In	No	IFU not available	IFU not available	Unknown
Pointcare M3i	No	IFU not available	IFU not available	Unknown
Skyla Hi	No	IFU not available	IFU not available	Unknown
Swasthya Sahayak Pro	No	IFU not available	IFU not available	Unknown