# Multicentre evaluation of a new strip-based blood glucose system (cobas® pulse, Roche Diagnostics) for near-patient testing in critical and non-critical care setting

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## INTRODUCTION

- cobas® pulse (Roche Diagnostics GmbH, Mannheim, Germany) is a new near-patient whole blood (wb) glucose testing system for use in professional healthcare environments.
- No clinically relevant interference has been identified during rigorous evaluations of drugs, endogenous substances, naturally occurring sugars and artificial sweeteners.
- The performance of this system has been evaluated in two separate studies that are the subject of this poster:
  - A multicentre study that used arterial, venous and neonatal heel stick wb samples collected from patients in intensive critical care and non-critical health care settings.
  - A single-centre study that used capillary, wb and finger stick samples collected from adult patients in a non-critical health care setting.

## METHODS

- The performance of the cobas® pulse system and Nova StatStrip® (Nova Biomedical, Waltham, MA, USA) were compared with a plasma-based hexokinase method on the Roche cobas® 6000 system (GLUC3).
- An aliquot from each sample (split sample) was measured on each of the three systems.
- All cobas® pulse measurements were performed by clinical staff who were self-trained on the use of the instrument using only the materials (package insert, quick start guide and operating manual) provided with the system.
- Accuracy was assessed by Clinical and Laboratory Standards Institute (CLSI) POCT12-A3 criteria (Table 1).
- Clinical significance was assessed by plotting pairs of results obtained with the cobas® pulse system and the hexokinase method on a Parkes error grid (Pfützner A. et al. J Diab Sci Technol 2013; 7: 1275-81).

**Table 1. CLSI POCT12-A3 criteria for point-of-care blood glucose testing in acute and chronic care facilities**

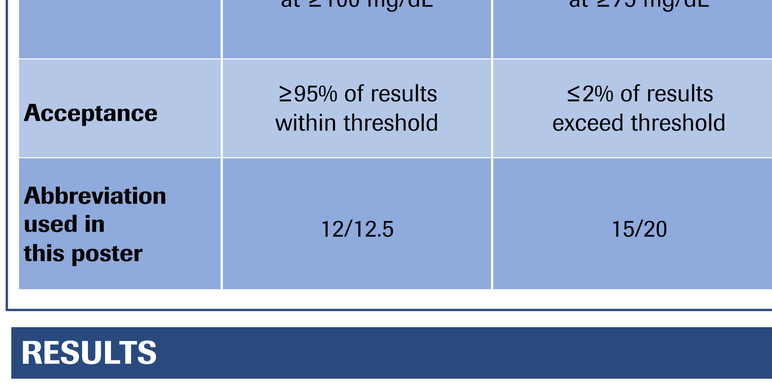
| Breakpoint | 100 mg/dL (5.55 mmol/L) | 75 mg/dL (4.2 mmol/L) |
|---|---|---|
| Threshold | 12 mg/dL of the reference test result at <100 mg/dL, or 12.5% of the reference test result at ≥100 mg/dL | 15 mg/dL of the reference test result at <75 mg/dL, or 20% of the reference test result at ≥75 mg/dL |
| Acceptance | ≥95% of results within threshold | ≤2% of results exceed threshold |
| Abbreviation used in this poster | 12/12.5 | 15/20 |

## RESULTS

**Patients and samples.**

- In the multicentre study, 1290 wb samples were collected, of which 1142 were evaluable (316 arterial, 706 venous and 120 heel stick).
- These samples were collected from 975 patients (711 adult, 66 paediatric and 198 neonatal) ranging in age from <23 hours to >80 years, with and without diabetes in critical and non-critical care settings at 12 US sites (Figure 1A).

**Figure 1. Disposition of patients**




ED, emergency department; GW, general ward; GWN, general ward nursery; ICU, intensive care unit; MICU, medical ICU; OC, outpatient clinic; OR, operating room; SICU, surgical ICU.
Patients may have provided more than one sample. Patients who provided evaluable and non-evaluable samples are considered evaluable patients.

- Characteristics of patients who contributed arterial, venous and heel stick samples are presented in Table 2.

**Table 2. Baseline characteristics of patients who contributed arterial, venous and heel stick samples in the multicentre study**

| Characteristic | Arterial samples | Venous samples | Heel stick samples | Total[a] (N=975) |
|---|---|---|---|---|
| **Gender** | | | | |
| **Male** | 194 (61.4) | 399 (56.5) | 61 (50.8) | 544 (55.8) |
| **Female** | 122 (38.6) | 307 (43.5) | 59 (49.2) | 431 (44.2) |
| **Age** | | | | |
| **≤28 days** | n=62 | n=16 | n=120 | 198 (20.3) |
| **29 days to <18 years** | n=17 | n=49 | – | 66 (6.8) |
| **≥18 years** | n=237 | n=641 | – | 711[a] (72.9) |

Values are n (%).
[a]Total unique patients (some patients contributed both arterial and venous samples).

- In the single centre study, 702 capillary measurements were performed on samples collected from 117/130 enrolled non-critically ill patients at one US site (Figure 1B, Table 3).

**Table 3. Baseline characteristics of patients who contributed capillary samples in the single-centre study**

| Characteristic | N (%) |
|---|---|
| **Gender** | |
| **Male** | 45 (38.5) |
| **Female** | 72 (61.5) |
| **Age, years** | |
| **22 to 45** | 4 (3.5) |
| **46 to 60** | 29 (24.8) |
| **61 to 80** | 69 (59.0) |
| **≥81** | 15 (12.8) |
| **Diabetes** | |
| **Yes** | 99 (84.6) |
| **No** | 18 (15.4) |

Multicentre study: Arterial, venous and neonatal heel stick wb samples.

- cobas® pulse fulfilled both acceptance criteria (Table 4).
- The cobas® pulse system also fulfilled both criteria in a sub-analysis that included arterial samples collected from neonates.
- NOVA StatStrip® did not meet the criteria for arterial, venous and heel stick samples at the 100 mg/dL breakpoint.
- NOVA StatStrip® also did not fulfil either criteria in the sub-analysis of neonatal samples.

**Table 4. Accuracy of wb glucose measurements according to CLSI POCT12-A3 criteria**

| | Breakpoint and criteria | | | |
|---|---|---|---|---|
| | 5.55 mmol/L (100 mg/dL) Within ! 0.67 mmol/L (! 12 mg/dL)/12.5%, n/N (%) | | 4.2 mmol/L (75 mg/dL) Outside by ! 0.83 mmol/L (! 15 mg/dL)/20%, n/N (%) | |
| **Sample type** | **cobas® pulse vs hexo-kinase** | **NOVA Stat-Strip® vs hexo-kinase** | **cobas® pulse vs hexo-kinase** | **NOVA Stat-Strip® vs hexo-kinase** |
| **Arterial (all)** | 312/316 (98.7) | 277/316 (87.7) | 2/316 (0.6) | 3/316 (0.9) |
| **Arterial (neo-nates)** | 61/62 (98.4) | 45/62 (72.6) | 1/62 (1.6) | 2/62 (3.2) |
| **Venous** | 691/706 (97.9) | 652/705 (92.5) | 8/706 (1.1) | 6/705 (0.9) |
| **Heel stick** | 114/120 (95.0) | 111/120 (92.5) | 0/120 (0) | 2/120 (1.7) |

Results in shaded cells do not meet the acceptance criteria.
n/N, number of samples meeting or not meeting acceptance criteria/total number of samples.

Single-centre study: Capillary wb samples.

- cobas® pulse met both acceptance criteria (Table 5).
- NOVA StatStrip® did not meet the CLSI 12/12.5 criteria.

**Table 5. Accuracy of capillary wb glucose measurements according to CLSI POCT12-A3 criteria**

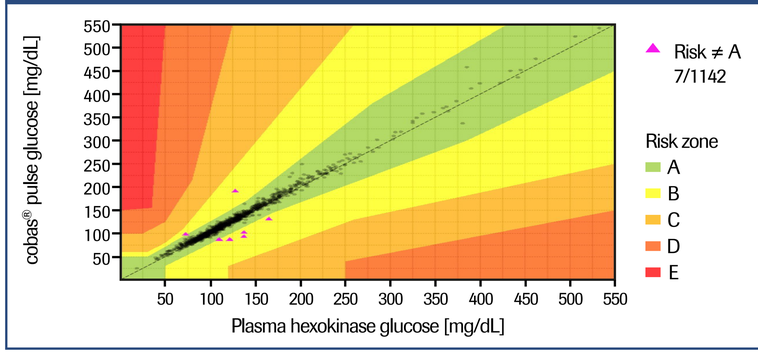
| Breakpoint and criteria | | | |
|---|---|---|---|
| 5.55 mmol/L (100 mg/dL) Within ! 0.67 mmol/L (! 12 mg/dL)/12.5%, n/N (%) | | 4.2 mmol/L (75 mg/dL) Outside by ! 0.83 mmol/L (! 15 mg/dL)/20%, n/N (%) | |
| **cobas® pulse vs hexo-kinase** | **NOVA StatStrip® vs hexo-kinase** | **cobas® pulse vs hexo-kinase** | **NOVA StatStrip® vs hexo-kinase** |
| 698/702 (99.4) | 109/116 (94.0) | 2/702 (0.3) | 1/116 (0.9) |

Results in the shaded cell do not meet the acceptance criteria.
n/N, number of samples meeting or not meeting acceptance criteria/ total number of samples.

Assessment of risk: Parkes error grid.

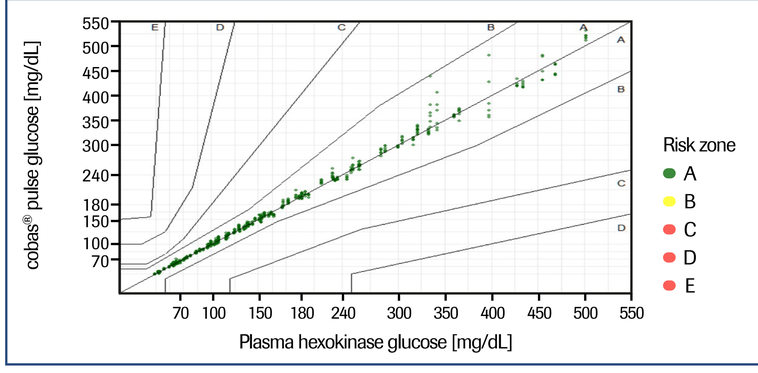
- In the multicentre study (Figure 3), 99.4% (1135/1142) of the arterial, venous and heel stick wb glucose measurements performed on the cobas® pulse were within risk zone A, which corresponds to no effect on clinical action, whereas 0.6% of the results (7/1142) were in risk zone B, which represents altered clinical action of little or no effect on clinical outcome.
- No results were in zones C–E.

**Figure 3. Parkes error grid of cobas® pulse system versus hexokinase test results for all arterial, venous and heel stick blood samples (N=1142) (multicentre study)**




- In the single-centre study (Figure 4), 100% (702/702) of capillary blood glucose values were within risk zone A.

**Figure 4. Parkes error grid of cobas® pulse system versus hexokinase test results for capillary blood samples (N=702) (single-centre study)**




## CONCLUSIONS

- The results of these two studies confirm the accuracy of the cobas® pulse system when used as intended in a diverse patient population by healthcare professionals working in hospital and clinic settings.
- The cobas® pulse system met CLSI POCT12-A3 accuracy criteria for arterial, venous, capillary and heel stick wb samples, and the performance exceeded that of NOVA StatStrip®.
- A clinical risk assessment of the data using Parkes error grids shows that the results obtained with the cobas® pulse system in these studies pose no clinically significant medical risks.

## DISCLOSURES

Dr. Michael Goodman reports participating in a Physician Advisory Board for Terumo BCT. All authors received research support in the form of medical writing assistance from Roche Diagnostics GmbH, Mannheim, Germany. Please see the abstract for all author disclosures. This study was funded by Roche Diagnostics.

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# A New Digital Point-of-Care Tool With Advanced Blood Glucose Measuring Technology

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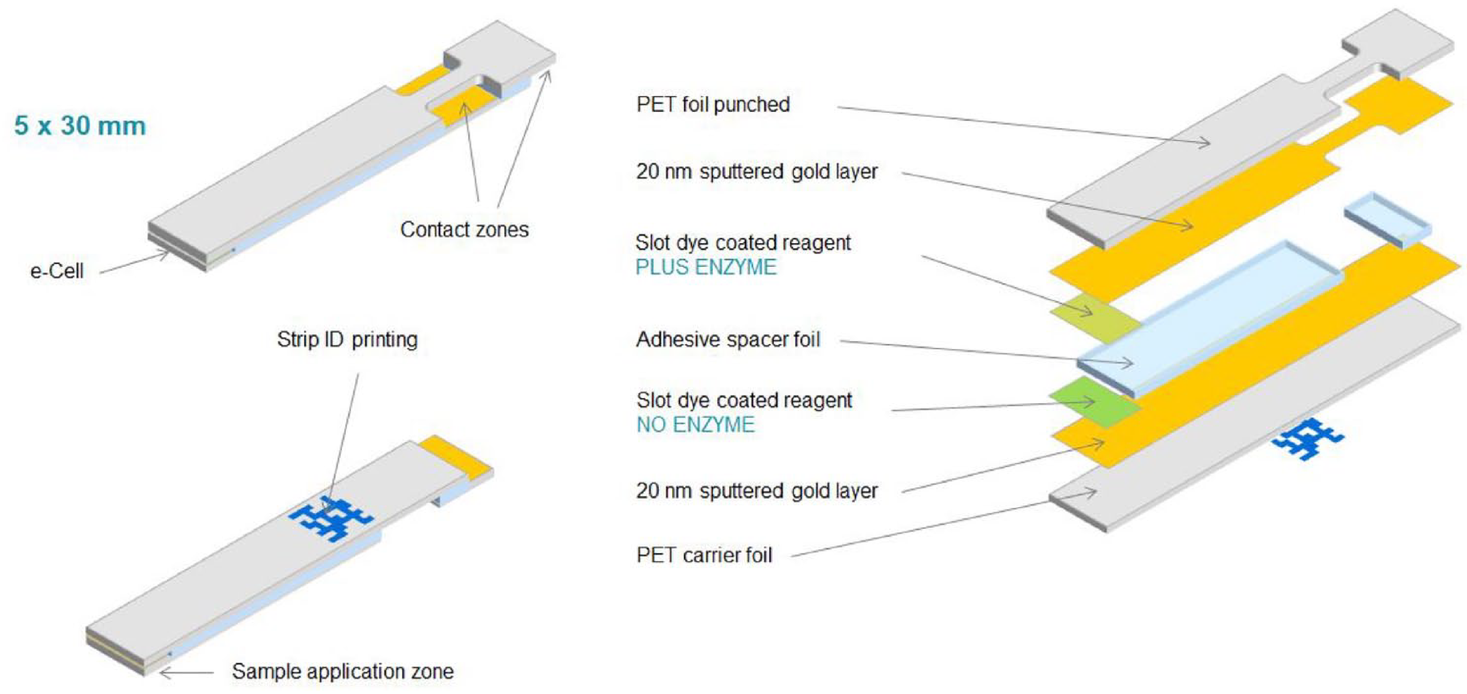
## ABSTRACT

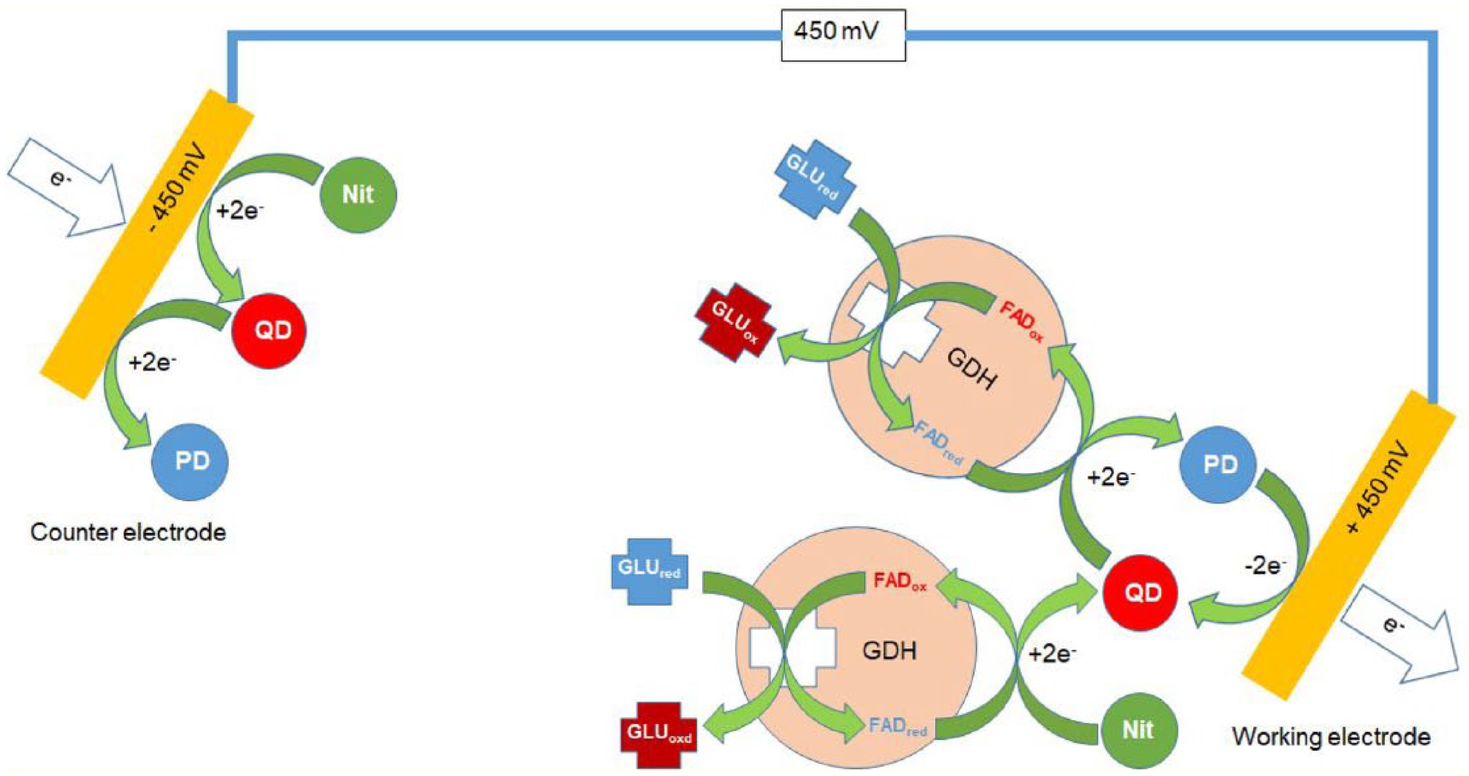
cobas® pulse is a point-of-care blood glucose (BG) measuring system for multiple-patient use in professional healthcare settings. The system provides advances in connectivity and BG measuring technology, and has multiple fail-safes to improve accuracy and reduce the risk of user error. Flavin adenine dinucleotide-dependent glucose dehydrogenase on the working electrode catalyzes oxidation of β-D-glucose in the blood sample. A redox mediator/electron acceptor, on both the working and the counter electrode, facilitates diffusion of electrons in proportion to the glucose concentration and compensates for the effects of potential interfering agents. During development, >1 million test strip measurements were performed using >8000 test scenarios to refine the algorithm model. No clinically relevant interference was identified with extreme variations in blood properties and drugs in whole blood samples.

## TEST STRIP ARCHITECTURE




The picture shows an exploded view technical drawing of the system test strip architecture. The matrix or reagent film - swollen by the application of the blood sample - provides a defined reaction space for the diffusion-controlled electrochemical detection reaction. Homogeneity of the matrix eliminates the need for lot-specific adaptation of the glucose calculation algorithm.

## ELECTROCHEMISTRY OF GLUCOSE DETECTION IN THE SYSTEM




Glucose detection occurs on gold electrodes in the reagent-coated slot dye. The working electrode is covered by a reagent layer (FADGDH) that catalyzes oxidation of β-D-glucose in the blood sample. On both, the working and the counter electrode, a redox mediator/electron acceptor facilitates diffusion of electrons from the co-factor to the electrode surface proportional to the concentration of glucose in the blood sample.

The FADGDH enzyme system is specific for glucose, and does not react with other saccharides in blood, which greatly reduces the risk for false positives.

## COMPENSATION FOR ELECTRO-ACTIVE SUBSTANCES

A key goal during the development of the system was absence of clinically relevant interferences. This was achieved by having the counter electrode generate a response current that closes the measurement circuit and by a change in polarity during the measurement sequence.

This process compensates for the effects of electro-active substances in blood samples.

* PET: Polyethylenterephthalat; FADGH: flavin adenine dinucleotide-dependent glucose dehydrogenase.