# O.K.N.V.I. RESIST-5

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**IFU-58R11/TB/07**

***In vitro* rapid diagnostic test for the detection of OXA-48, KPC, NDM, VIM and IMP carbapenemases in bacterial culture**

***FOR IN VITRO DIAGNOSTIC USE*** ***EN***
**FOR PROFESSIONAL USE ONLY**
**References: K-15R11, 2x20 cassettes, buffer, 20 tubes and transfer pipets**

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| (EN) For Instructions For Use in your language :<br>(FR) Pour obtenir les notices dans la langue de votre choix :<br>(ES) Para las instrucciones de uso en su idioma :<br>(PT) Para Instruçoes de Uso na sua lingua :<br>(IT) Per le Istruzioni di Uso nella sua lingua :<br>(DE) Für Gebrauchsanleitungen in Ihrer Sprache :<br>(NL) Voor Gebruiksaanwijzing in uw eigen taal :<br>(PL) Instrukcja obsługi w języku użytkownika: | |
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## I. INTRODUCTION

Carbapenemase-producing Organisms (CPO), and more specifically, Carbapenem-resistant Enterobacteriaceae (CRE) represent a major public health concern worldwide due to their broad spectrum of resistance to antibiotics including, besides carbapenems, most classes of antimicrobial agents, and thus leaving very few options for the management of infected patients. Besides CREs, CPOs also include nonfermenting Gram-negative bacilli (NFGNB), such as *Pseudomonas aeruginosa* and *Acinetobacter baumannii* that exhibit resistance not only to beta lactam and other groups of antibiotics, but also to carbapenems. The rapid spread of CPOs and genes encoding these resistances has led to nosocomial outbreaks and endemic situations worldwide.
Development of new rapid diagnostic tests to track antimicrobial resistance patterns is considered as one of the priority core actions by international experts and health authorities. NDM and KPC represent two of the most increasing and prevalent carbapenemases in many countries. On the other hand, class D OXA-48 type carbapenemases are the most challenging resistance mechanisms to be detected by clinical laboratories. VIM is not only present in Enterobacteriaceae but is also highly prevalent in non-fermenting bacteria. IMP should be regarded as a potential problem since they degrade not only C3G but also carbapenem antimicrobial drug like Imipenem. IMP prevalence is the lowest, apart from Japan where it is more prevalent.
Inhibitor-based phenotypic confirmatory tests exist for the confirmation of class A (KPC) and class B (VIM, IMP, NDM) carbapenemases, Nowadays, definitive confirmation of CPO resistance mechanism relies on molecular assays. These tests are expensive and can only be performed in dedicated environment and by skilled personnel, hence limiting their more generalized usage.
O.K.N.V.I. RESIST-5 test is part of Coris BioConcept RESIST range of antimicrobial resistance diagnostic tests.

## II. PRINCIPLE OF THE TESTS

These tests are ready to use and are based on a membrane technology with colloidal gold nanoparticles. Our kit is aimed to detect and identify the carbapenemases from a bacterial colony isolate of Enterobacteriaceae or NFGNB growing on agar plate. Each pouch contains: 2 lateral-flow cassettes for the identification of (i) OXA-48, KPC, NDM and (ii) VIM and IMP.
**Identification of OXA-48, KPC and NDM.** A nitrocellulose membrane is sensitised with:
(1) a monoclonal antibody directed against OXA-48 carbapenemase and variants (except OXA-163-like enzymes) (“O” line)
(2) a monoclonal antibody directed against KPC carbapenemase (“K” line)
(3) a monoclonal antibody directed against NDM carbapenemase (“N” line)
(4) a control capture reagent (upper “C” line).
Four different colloidal gold nanoparticles conjugates are dried on a membrane: a conjugate directed against a second epitope of the OXA-48 carbapenemase, a conjugate directed against a second epitope of the KPC carbapenemase, a third conjugate specific to NDM carbapenemase and a control conjugate to validate the test conditions.
**Identification of VIM and IMP**. A nitrocellulose membrane is sensitised with:
(1) a monoclonal antibody directed against VIM carbapenemase (“V” line),
(2) a monoclonal antibody directed against IMP carbapenemase (“I” line)
(3) a control capture reagent (upper “C” line).
Three different colloidal gold nanoparticles conjugates are dried on a membrane: a conjugate directed against VIM carbapenemase, a conjugate directed against IMP carbapenemase and a control conjugate.
When the provided buffer containing the resuspended bacteria comes into contact with the membrane, the solubilised conjugates migrate with the sample by passive diffusion, while conjugates and sample material come into contact with the immobilised respective antibodies that are adsorbed onto the nitrocellulose strip. If the sample contains an OXA-48, KPC, NDM, VIM or IMP carbapenemase, the respective complexes made of the conjugates and either OXA-48, or KPC, or NDM or VIM or IMP will remain bound to their respective specific lines (OXA-48 : “O” line; KPC : “K” line; NDM : “N” line, VIM : “V” line, IMP : “I” line). The migration continues by passive diffusion and both conjugates and sample material come into contact with the (upper) line control reagent that binds a control conjugate (“C” line), thereby producing a red line.
The result is visible within 15 minutes in the form of red lines on the strip.

## III. REAGENTS AND MATERIALS

**1. O.K.N.V.I. RESIST-5 (2x20 cassettes)**
20 sealed pouches containing two lateral-flow cassettes and one desiccant.
Each cassette contains one sensitised strip.
**2. LY-D buffer vial (7 mL)**
Tris-EDTA solution containing $NaN_3$ (<0.1%) and a detergent.
**3. Instruction for use (1)**
**4. Disposable collection tubes (20)**
**5. Disposable transfer pipettes (20)**
Materials to be ordered separately:
- RESIST-BC (S-1001): reagents kit for use with blood culture
- ReSCape (S-1002): reagents kits for use with rectal swab

## IV. SPECIAL PRECAUTIONS

- All operations linked to the use of the test must be performed in accordance with good laboratory practices.
- All reagents are for *in vitro* diagnostic use only.
- Pouch must be opened with care.
- Avoid touching nitrocellulose with your fingers.
- Wear gloves when handling samples.
- Never use reagents from another kit.
- Green or blue lines indicate immunoreagents adsorption sites. Green or blue colour disappears during the test.
- The quality of the reagents cannot be guaranteed beyond their shelf-life dates or if reagents are not stored under required conditions as indicated in the insert.

## V. WASTE DISPOSAL

- Dispose of gloves, swabs, test tubes and used devices in accordance with GLP.
- Each user is responsible for the management of any waste produced, and must ensure that it is disposed of in accordance with the applicable legislation.

## VI. STORAGE

- An unopened pouch may be kept at between 4 and 30°C and used until the shelf-life date indicated on the packaging. Once the pouch is opened, run the test immediately.
- Avoid freezing devices and buffer.

## VII. SPECIMEN HANDLING AND COLLECTION

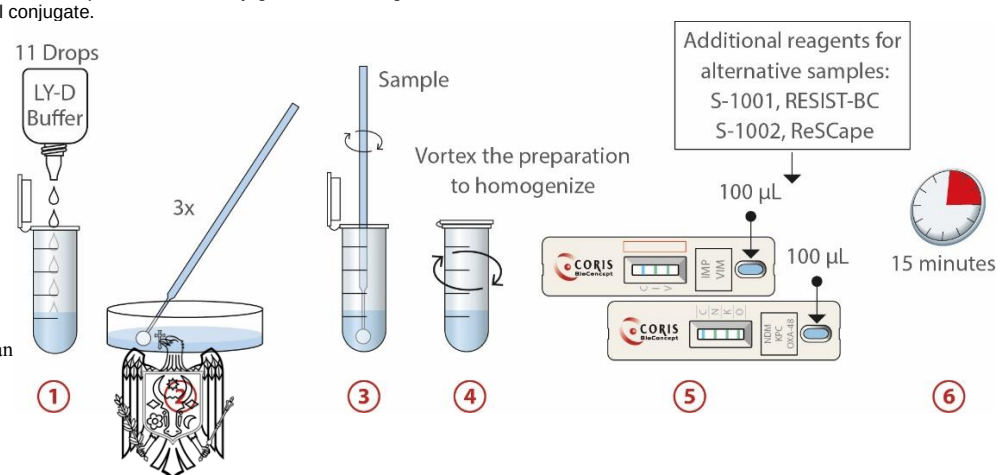
Specimens to be tested should be obtained and handled by standard microbiological methods. Make sure that the specimens are not treated with solutions containing formaldehyde or its derivatives.
The performance of was established with colonies from Mueller Hinton agar, Columbia agar + 5% sheep blood, CLED agar, UriSelectTM 4; Mac Conkey agar, Drigalski agar, CHROMagarTM mSuperCarba®, ChromID® ESBL agar, ChromID®Carba Smart, ChromID® OXA-48, ChromID® CPS® Elite agar, CHROMagarTM KPC, BrillianceTM CRE agar, BrillianceTM ESBL agar, CHOCOLATE PolyViteX™ agar, TSA+5% sheep blood.

## VIII. PROCEDURE

PREPARATIONS OF THE TEST:
Allow kit components, in unopened packaging, and specimens (in the event that the plate containing colony to be tested was kept at 4°C) to equilibrate at room temperature (15-30°C) before performing a test.
Open the pouch and remove the device. Once opened, run the test immediately. Indicate the patient’s name or specimen number on the device (one device per sample).

SPECIMEN PREPARATION PROCEDURE:
Performance claims with regard to sample types other than bacterial colonies have been established for rectal swabs and blood cultures.
With rectal swabs and blood cultures, the preparation procedure has to be followed as described in the respective kits (S-1002, ReSCape and S-1001, RESIST-BC)
With bacterial colonies, we recommend the use of fresh agar cultures for optimal test performance and as followed:

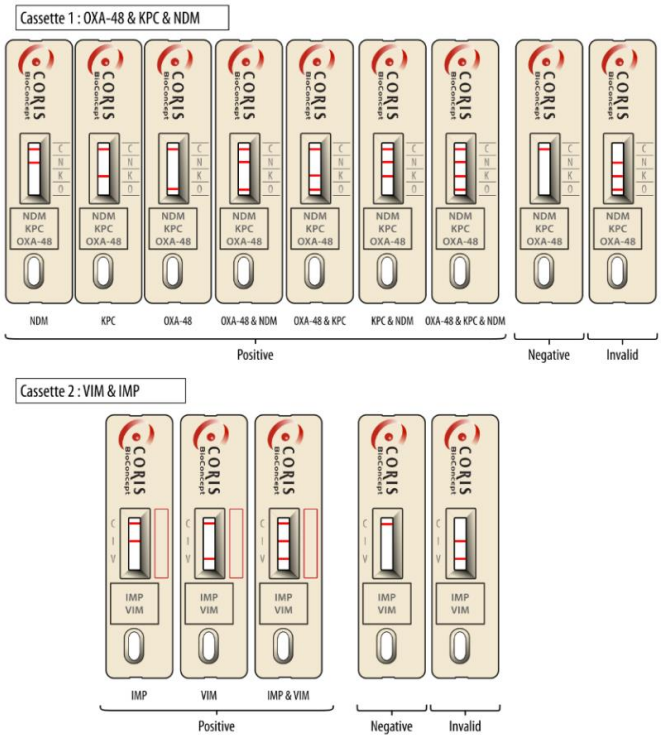
1. Prepare one collection tube and add **11 drops** of LY-D buffer in the tube
2. Harvest bacteria by taking **3 colonies** with a disposable bacteriological loop and dip the loop in the bottom of the tube containing the buffer. The same bacteriological loop can be used to collect the 3 colonies.
3. Stir thoroughly before removing the loop.
4. Close de tube and vortex the preparation to homogenize.
5. Use the transfer pipette provided in the kit and add 100 µL of diluted sample into the sample well of each of the two cassettes labelled (i) NDM, KPC and OXA-48 and (ii) IMP and VIM (**diluted sample must reach the black line indicated on the transfer pipette to accurately aspirate 100 µL**).
6. Allow to react for 15 minutes and read the result



Positive results may be reported as soon as the test and control lines become visible.
**Do not take the appearance of new lines into account after the reaction time has passed.**
**The result must be read on still wet strip.**

## IX. INTERPRETING RESULTS

The results are to be interpreted as follows for each of the two cassettes:
**Negative test result**: a reddish-purple line appears across the central reading window at the Control line (C) position. No other line is present.
**Positive test result**: in addition to a reddish-purple line at the Control line (C), a visible reddish-purple line appears at one of the Test lines position ("N" or "K" or "O") on cassette labelled (i) NDM, KPC, OXA-48 or at one of the Test lines position ("I" or "V") on cassette labelled (ii) IMP and VIM. Intensity of the test line may vary according to the quantity of antigens as well as of the variant type present in the sample. Any reddish-purple test line (OXA-48, KPC, NDM, VIM and IMP), even weak, should be considered as a positive result.
If a positive test line appears beside of the "O" mark, the sample contains OXA-48 or OXA-48-like variants. If it appears beside the "K" mark, the sample contains KPC variants; beside the "N" mark, the sample contains NDM; the "V" mark, the sample contains VIM; and beside of the "I" mark, IMP is present in the sample. Combinations of positive test lines can occur.
In this case the sample contains several carbapenemases.
**Invalid test result**: The absence of a Control line indicates a failure in the test procedure. Repeat invalid tests with a new test device.
Note: during the drying process, a very faint shadow may appear at the Test line positions. It should not be regarded as a positive result.




## X. PERFORMANCE

### A. Detection Limit

The detection limit determined with purified recombinant proteins of OXA-48, KPC, NDM, VIM and IMP have been evaluated at 0.25 ng/mL, 0.5 ng/mL, 0.0625 ng/mL, 0.23 ng/mL and 0.781 ng/mL, respectively.

### B. Retrospective study

The test cassettes were validated by comparison with reference molecular method (validated in house multiplex PCR including sequencing) in a retrospective study performed on 180 non duplicated, consecutive suspected CPE clinical isolates collected between 2012 and 2021 from Belgian hospitals.

| Molecular method / OXA-48 test | Positive | Negative | Total |
|---|---|---|---|
| **Positive** | 41 | 0 | 41 |
| **Negative** | 0 | 139 | 139 |
| **Total** | 41 | 139 | 180 |

95 % Confidence Interval [1]

| | | |
|---|---|---|
| **Sensitivity**: | 100 % | (89.3 to 100 %) |
| **Specificity**: | 100 % | (96.6 to 100 %) |
| Positive Predictive value: | 100 % | (89.3 to 100 %) |
| Negative predictive value: | 100 % | (96.7 to 100 %) |
| Agreement: | 100 % | (180/180) |

| Molecular method / KPC test | Positive | Negative | Total |
|---|---|---|---|
| **Positive** | 24 | 0 | 24 |
| **Negative** | 0 | 156 | 156 |
| **Total** | 24 | 156 | 180 |

95 % Confidence Interval [1]

| | | |
|---|---|---|
| **Sensitivity**: | 100 % | (82.8 to 100 %) |
| **Specificity**: | 100 % | (97.0 to 100 %) |
| Positive Predictive value: | 100 % | (82.8 to 100 %) |
| Negative predictive value: | 100 % | (97.0 to 100 %) |
| Agreement: | 100 % | (180/180) |

[1] Newcombe, Robert G. "Two-Sided Confidence Intervals for the Single Proportion: Comparison of Seven Methods," *Statistics in Medicine*, **17**, 857-872 (1998).

| Molecular method / NDM test | Positive | Negative | Total |
|---|---|---|---|
| **Positive** | 40 | 0 | 40 |
| **Negative** | 0 | 140 | 140 |
| **Total** | 40 | 140 | 180 |

95 % Confidence Interval [1]

| | | |
|---|---|---|
| **Sensitivity:** | 100 % | (89.1 to 100 %) |
| **Specificity:** | 100 % | (96.7 to 100 %) |
| Positive Predictive value: | 100 % | (89.1 to 100 %) |
| Negative predictive value: | 100 % | (96.7 to 100 %) |
| Agreement: | 100 % | (180/180) |

| Molecular method / VIM test | Positive | Negative | Total |
|---|---|---|---|
| **Positive** | 43 | 0 | 43 |
| **Negative** | 3 | 134 | 137 |
| **Total** | 46 | 134 | 180 |

95 % Confidence Interval [1]

| | | |
|---|---|---|
| **Sensitivity:** | 93.5 % | (81.1 to 98.3 %) |
| **Specificity:** | 100 % | (96.5 to 100 %) |
| Positive Predictive value: | 100 % | (89.8 to 100 %) |
| Negative predictive value: | 97.8 % | (93.2 to 99.4 %) |
| Agreement: | 98.3 % | (177/180) |

| Molecular method / IMP test | Positive | Negative | Total |
|---|---|---|---|
| **Positive** | 19 | 0 | 19 |
| **Negative** | 0 | 161 | 161 |
| **Total** | 19 | 161 | 180 |

95 % Confidence Interval [1]

| | | |
|---|---|---|
| **Sensitivity:** | 100 % | (79.1 to 100 %) |
| **Specificity:** | 100 % | (97.1 to 100 %) |
| Positive Predictive value: | 100 % | (79.1 to 100 %) |
| Negative predictive value: | 100 % | (97.1 to 100 %) |
| Agreement: | 100 % | (180/180) |

The O.K.N.V.I. RESIST-5 kit was also validated with rectal swabs and blood cultures.

### C. Repeatability and reproducibility

To check intra-batch accuracy (repeatability), the same positive samples and a buffer solution were processed 15 times on kits of the same production batch in the same experimental conditions. All observed results were confirmed as expected.
To check inter-batch accuracy (reproducibility), some samples (positive and buffer) were processed on kits from three different production batches. All results were confirmed as expected.

## XI. LIMITS OF THE KIT

The test is qualitative and cannot predict the quantity of antigens present in the sample. Clinical presentation and other test results must be taken into consideration to establish diagnosis. A positive test does not rule out the possibility that other antibiotic resistance mechanisms may be present.

## XII. TECHNICAL PROBLEMS / COMPLAINTS

If you face a technical problem or if performances do not correspond with those indicated in this package insert:

1. Record the lot number of the kit concerned.
2. If possible, keep the sample in the appropriate storage condition during the complaint management.
3. Contact Coris BioConcept (client.care@corisbio.com) or your local distributor.

Any serious incident that has occurred in relation to the device shall be reported to the manufacturer and the competent authority of the Member State in which the user and/or the patient is established.

## XIII. BIBLIOGRAPHIC REFERENCES


**A.** **J. Wesley MacDonald and V. Chibabhai Evaluation of the RESIST-4 O.K.N.V immunochromatographic lateral flow assay for the rapid detection of OXA-48, KPC, NDM and VIM carbapenemases from cultured isolates** Access Microbiology 2019;1
**B.** T. Pilate, S. Desmet Detection of carbapenemase production in pseudomonas aeruginosa in a tertiary care centre Annual Meeting of the Royal Belgian Society of Laboratory Medicine November 15th, 2019 Belgium
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**H.** **Glupczynski Y, Evrard S, Huang TD, Bogaerts P.** Evaluation of the RESIST-4 K-SeT assay, a multiplex immunochromatographic assay for the rapid detection of OXA-48-like, KPC, VIM and NDM carbapenemases. **J Antimicrob Chemother. 2019 Feb 6. doi: 10.1093**


**Last update** 18 APRIL 2025

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|---|---|---|---|
| REF | Catalogue number | | Manufacturer |
| IVD | In vitro diagnostic medical device | | Temperature limits |
| Σ | Contains sufficient for <n> tests | LOT | Batch code |
| | Consult instructions for use | | Do not reuse |
| | Keep dry | | Use by |
| DIL SPE | Diluent specimen | CONT $NaN_3$ | Contains Sodium azide |
| UDI | Unique device identifier | | |