



# MDR MBL (VIM,IMP,NDM) Real-TM

## Handbook

Real Time PCR kit for detection and differentiation of metallo- $\beta$ -lactamases (MBL) drug resistance genes VIM,IMP,NDM in Enterobacteriaceae and Non Fermenting Gram Negative Bacteria (NFGNB)

 **C1-100FRT**

 **100**



## NAME

### MDR MBL (VIM,IMP,NDM) Real-TM

## INTRODUCTION

Nosocomial respiratory tract infections are major cause of excessive morbidity and mortality. Patients with serious underlying diseases have an especially high risk of acquiring these infections and that risk is magnified by exposure to respiratory therapy.

Beta-lactams remain a cornerstone for antimicrobial chemotherapy of a large number of bacterial infections, but their efficacy has been increasingly thwarted by dissemination of acquired resistance determinants among pathogenic bacteria. The exposure of bacterial strains to a multitude of  $\beta$ -lactams has induced a dynamic and continuous production and mutation of  $\beta$ -lactamase in many bacteria, expanding their activity even against later generation cephalosporins 5 and carbapenems by the production of extended-spectrum beta-lactamase (ESBL) and metallo-beta-lactamase (MBL) respectively. Since the genes that code for the production of ESBL are often linked to other resistance genes causing extended spectrum of drug resistance, this will result into fewer therapeutic alternatives.

ESBLs with hydrolytic activity against carbapenems are classified in three groups:

- Class A  $\beta$ -lactamases - *Klebsiella pneumoniae* carbapenemase (KPC)
- Class B - metallo-beta-lactamase (MBL) which includes New Delhi metallo- $\beta$ -lactamase (NDM), Verona integron-encoded-metallo- $\beta$ -lactamase (VIM) and imipenemase-metallo- $\beta$ -lactamase (IMP)
- Class D - OXA-carbapenemases.

Main ESBL-producing pathogens are:

- Enterobacteriaceae
  - E. coli
  - K. Pneumoniae
  - K. Oxytoca
  - P. mirabilis
  - Enterobacter
  - Salmonella
- Non-fermentative Gram-negative
  - A. baumannii
  - P. aeruginosa

Methods of detection of ESBLs:

- Phenotypic methods (antibiotic susceptibility)
  - Used routinely in clinical laboratories
  - The accuracy of semiautomated microbiology systems is not optimal
- Genotypic methods (PCR-based amplification)
  - Used in reference laboratories
  - Discriminate between specific types of ESBLs
  - Need shorter time to detection (culture not required)
  - Have ability to detect low level resistance

## INTENDED USE

**MDR MBL (VIM,IMP,NDM) Real-TM** PCR kit is an *in vitro* nucleic acid amplification test for detection and differentiation of MDR genes using real-time hybridization-fluorescence detection of amplified products.

## PRINCIPLE OF ASSAY

The detection of MDR genes includes DNA isolation from biological materials and real-time PCR amplification of DNA. MDR genes detection by the polymerase chain reaction (PCR) is based on the amplification of genome specific region using specific primers. In real-time PCR, the amplified product is detected using fluorescent dyes. These dyes are linked to oligonucleotide probes which bind specifically to the amplified product. The real-time monitoring of fluorescence intensities during the real-time PCR allows detection of the amplified product without re-opening the reaction tubes after the PCR run. **MDR MBL (VIM,IMP,NDM) Real-TM** PCR kit uses “hot-start”, which greatly reduces the frequency of nonspecifically primed reactions.

- The *MDR MBL VIM group* is detected in the FAM/Green channel.
- The *MDR MBL IMP group* is detected in the JOE/HEX/Yellow channel
- The *Internal Control (IC)* is detected in the Rox/Texas Red/Orange channel.
- The *MDR MBL NDM group* is detected in the Cy5/Red channel

## MATERIALS PROVIDED

<b>Reagent</b>	<b>Volume (ml)</b>	<b>Amount</b>
<b>PCR-mix-1-FRT MBL</b>	1.2	1 tube
<b>PCR-mix-2</b>	0.3	2 tubes
<b>Hot Start TaqF Polymerase</b>	0.03	2 tubes
<b>Pos2 MBL (C+)</b>	0.2	1 tube
<b>DNA-buffer</b>	0.2	1 tube
<b>Negative Control (C-)*</b>	1.2	2 tubes
<b>Internal Control (IC)**</b>	1.0	1 tube

**MDR MBL (VIM,IMP,NDM) Real-TM** PCR kit is intended for 110 amplification reactions including controls.

\* *Must be used in the isolation procedure as Negative Control of Extraction: add 100 µl of C- (Negative Control) to labeled NCE tube;*

\*\* *Add 10 µl of Internal Control during the DNA purification procedure directly to the sample/lysis mixture*

## MATERIALS REQUIRED BUT NOT PROVIDED

- Real Time Thermalcycler
- DNA isolation kit
- Desktop microcentrifuge for “eppendorf” type tubes
- Vortex mixer
- Disposable gloves, powderless
- Biohazard waste container
- Refrigerator, Freezer
- Workstation
- Pipettes (adjustable)
- Sterile pipette tips with filters
- Disposable polypropylene PCR tubes or strips
- Tube racks

## STORAGE INSTRUCTIONS

**MDR MBL (VIM,IMP,NDM) Real-TM** must be stored at 2-8°C. **TaqF Polymerase** and **PCR-mix-2** must be stored at -20°C. The kit can be shipped at 2-8°C but should be stored at 2-8°C and -20°C immediately on receipt.

## STABILITY

**MDR MBL (VIM,IMP,NDM) Real-TM** is stable up to the expiration date indicated on the kit label. The product will maintain performance through the control date printed on the label. Exposure to light, heat or humidity may affect the shelf life of some of the kit components and should be avoided. Repeated thawing and freezing of these reagents should be avoided, as this may reduce the sensitivity.

## QUALITY CONTROL

In accordance with Sacace’s ISO 13485-Certified Quality Management System, each lot is tested against predetermined specifications to ensure consistent product quality.

## WARNINGS AND PRECAUTIONS

**IVD**

### ***In Vitro* Diagnostic Medical Device**

For *In Vitro* Diagnostic Use Only

- Wear disposable gloves, laboratory coats and eye protection when handling specimens and reagents. Thoroughly wash hands afterward.
- Use routine laboratory precautions. Do not eat, drink, smoke, apply cosmetics, or handle contact lenses in laboratory work areas. Do not pipette by mouth.
- Do not use a kit after its expiration date.
- Do not mix reagents from different kits.
- Dispose all specimens and unused reagents in accordance with local regulations.
- The use of heparinized specimens is not recommended.
- Avoid repeated thawing and freezing of the reagents, this may reduce the sensitivity of the test.
- Once the reagents have been thawed, vortex and centrifuge briefly the tubes.
- Prepare quickly the Reaction mix.
- Specimens may be infectious. Use Universal Precautions when performing the assay.
- Specimens and controls should be prepared in a laminar flow hood.
- Handle all materials containing specimens or controls according to Good Laboratory Practices in order to prevent cross-contamination of specimens or controls.
- Clean and disinfect all spills of specimens or reagents using a disinfectant such as 0,5% sodium hypochlorite, or other suitable disinfectant. Follow by wiping down the surface with 70% ethanol.
- Avoid contact of specimens and reagents with the skin, eyes and mucous membranes. If these solutions come into contact, rinse immediately with water and seek medical advice immediately.
- Material Safety Data Sheets (MSDS) are available on request.
- Use of this product should be limited to personnel trained in the techniques of amplification.
- Workflow in the laboratory must proceed in a uni-directional manner, beginning in the Extraction Area and moving to the Amplification Area. Do not return samples, equipment and reagents in the area where you performed previous step. Personnel should be using proper anti-contamination safeguards when moving between areas.

## PRODUCT USE LIMITATIONS

All reagents may exclusively be used in in vitro diagnostics. Use of this product should be limited to personnel trained in the techniques of DNA amplification (UNI EN ISO 18113-2:2012). Strict compliance with the user manual is required for optimal PCR results. Attention should be paid to expiration dates printed on the box and labels of all components. Do not use a kit after its expiration date.

## SAMPLE COLLECTION, STORAGE AND TRANSPORT

**Note: Handle all specimens as if they are potentially infectious agents.**

MDR MBL (VIM,IMP,NDM) Real-TM PCR kit is intended for analysis of DNA extracted with DNA purification kits from the clinical/biological materials like haemoculture, bacterial culture, urine, swabs.

- *swabs*: swab area and place in “Eppendorf” tube with 0,5 ml of saline water or PBS sterile (Sacace Transport medium is recommended). Agitate vigorously. Repeat the swab and agitate in the same tube. Centrifuge at 1000g/min for 5 min. Discard the supernatant and leave about 100 µl of solution for DNA extraction.
- *Haemoculture, bacterial culture obtained by inoculation of clinical material in liquid enriched medium*: transfer 0,25 ml of culture in 1,5 ml tube and centrifuge at 10000 g for 10-15 min. Remove and discard the supernatant. Resuspend the pellet in 100 µl of Saline water.
- *urine*: collect 10-20 ml of first-catch urine in a sterile container. Centrifuge for 30 min at 3000 x g, carefully discard the supernatant and leave about 200 µl of solution. Resuspend the sediment. Use the suspension for the DNA extraction.

Transportation of clinical specimens must comply with country, federal, state and local regulations for the transport of etiologic agents.

## DNA ISOLATION

Any commercial RNA/DNA isolation kit, if IVD-CE validated for the specimen types indicated herein at the “SAMPLE COLLECTION, STORAGE AND TRANSPORT” paragraph, could be used.

Sacace Biotechnologies recommends to use the following kits:

- ⇒ **DNA-Sorb-A** (Sacace, [REF](#) K-1-1/A);
- ⇒ **SaMag Bacterial DNA Extraction kit** (Sacace, [REF](#) SM006).

Please carry out DNA extraction according to the manufacture’s instruction. Add 10 µl of Internal Control during DNA isolation procedure directly to the sample/lysis mixture of all samples and Negative Extraction Control (NCE). If amplification is not performed in the same day of extraction, the processed samples can be stored at 2-8°C for at maximum period of 5 days or frozen at –20°/-80°C.

## PROTOCOL (Reaction volume 25 µL):

### PREPARING TUBES FOR PCR

1. Before starting work, thaw and vortex all reagents of the kit. Make sure that there are no drops on the caps of the tubes.
2. Take the required number of PCR tubes for amplification of clinical and control samples (negative control of extraction, negative and positive controls of amplification).
3. To prepare the reaction mixture, mix in a new sterile tube the reagents per one reaction:
  - **10 µl of PCR-mix-FRT MBL,**
  - **5 µl of RT-PCR-mix-2,**
  - **0.5 µl of Polymerase**

Thoroughly vortex the mixture, make sure that there are no drops on the caps of the tubes.

4. Add **15 µl** of the prepared reaction mixture to each PCR tube.
5. Add **10 µl** of **DNA samples** isolated from the clinical samples to each PCR tube.
6. Run the **control reactions**:
  - C-** - Add **10 µl** of the **DNA sample** extracted from the Negative Control to the tube labeled NCE (Negative Control of Extraction)
  - C+** - Add **10 µl** of **Pos2 MBL (C+)** to the tube labeled C+ (Positive Control of Amplification).
  - NCA** - Add **10 µl** of **DNA-buffer** to the tube labeled NCA (Negative Control of Amplification).

Make sure that there are no drops on the tube walls, otherwise vortex the tubes briefly.

**Table. REACTION MIXTURE PREPARATION**

		Reaction volume (with one extra sample)		
Reagent volume for one reaction, µl		10.00	5.00	0.50
N. samples	N. PCR reactions	PCR-mix-1	PCR-mix-2	Polymerase
4	7	80	40	4.0
6	9	100	50	5.0
8	11	120	60	6.0
10	13	140	70	7.0
12	15	160	80	8.0
14	17	180	90	9.0
16	19	200	100	10.0
18	21	220	110	11.0
20	23	240	120	12.0
22	25	260	130	13.0
34	37	380	190	19.0
46	49	500	250	25.0



## AMPLIFICATION

1. Create a temperature profile on your instrument as follows:

Step	Rotor-type Instruments <sup>1</sup>			Plate- or modular type Instruments <sup>2</sup>		
	Temperature °C	Time	Repeats	Temperature °C	Time	Repeats
1	95	15 min	1	95	15 min	1
2	95	5 s	5	95	5 s	5
	60	20 s		60	20 s	
	72	15 s		72	15 s	
3	95	5 s	40	95	5 s	40
	60	20 s fluorescent signal detection		60	30 s fluorescent signal detection	
	72	15 s		72	15 s	

<sup>1</sup> For example Rotor-Gene™ 6000/Q (Corbett Research, Qiagen)

<sup>2</sup> For example, SaCycler-96™ (Sacace), CFX/iQ5™ (BioRad); Mx3005P™ (Agilent), ABI® 7500 Real Time PCR (Applied Biosystems), SmartCycler® (Cepheid)

Fluorescent signal is detected in the channels for the FAM, JOE, ROX and Cy5 fluorophores.

## INSTRUMENT SETTINGS

**Rotor-type instruments** (RotorGene 6000, RotorGene Q)

Channel	Calibrate / Gain Optimisation	Threshold	More Settings/ Outlier Removal	Slope Correct
FAM/Green	5FI - 10FI	0,1	10%	ON
JOE/Yellow	4FI – 8 FI	0,1	10%	ON
ROX/Orange	4FI – 8 FI	0,1	10%	ON
Cy5/Red	4FI – 8 FI	0,1	10%	ON

**Plate- or modular type instruments** (SaCycler-96™ (Sacace), CFX/iQ5™ (BioRad); Mx3005P™ (Agilent), ABI® 7500 Real Time PCR (Applied Biosystems), SmartCycler® (Cepheid)). For result analysis, set the threshold line at a level where curves of fluorescence are linear.

## DATA ANALYSIS

Channel	FAM	HEX	ROX	Cy5
MDR MBL (VIM,IMP,NDM) Real-TM PCR kit	gene MBL group <b>VIM</b>	gene MBL group <b>IMP</b>	<b>IC</b>	gene MBL group <b>NDM</b>

The results are interpreted by the real-time PCR instrument software by the crossing or not crossing of the threshold line by the fluorescence curve (in the middle of the linear section of the fluorescence curve for the positive control (C+) in logarithmic coordinates).

The result of amplification is considered **positive** if the fluorescence curve is characteristic of real-time PCR (S-shaped) and crosses the threshold line once in the significant fluorescence increase

section and if the Ct value detected in the channel is below the threshold value specified in the below table.

The result of amplification is considered **negative** if the fluorescence curve is not S-shaped and if it does not cross the threshold line (the Ct value is absent).

## RESULTS INTERPRETATION

The results are interpreted by the real-time PCR instrument software by the crossing or not crossing of the threshold line by the fluorescence curve.

Sample	Channels			
	FAM/ Green	JOE/ Yellow	ROX/ Orange	Cy5/Red
	VIM	IMP	IC	NDM
NCA	-	-	-	-
NCE	-	-	<30	-
Pos C+	<30	<30	-	<30
Clinical samples	<38	<38	<38	<38

**Sample contains genes MBL group VIM** if the Ct value detected in the FAM channel is less than 38.

**Sample contains genes MBL group IMP** if the Ct value detected in the JOE/HEX channel is less than 38.

**Sample contains genes MBL group NDM** if the Ct value detected in the Cy5 channel is less than 38.

The result is **invalid** if Ct value is not determined (absent) in the channel for FAM, JOE, Cy5 fluorophores, whereas the Ct value in the channel for the ROX fluorophore is not determined (absent) or greater than the specified boundary Ct value. In such cases, PCR analysis should be repeated starting from DNA extraction stage. If the same result is obtained in the second run, re-sampling of material is recommended

Results are accepted as significant only if both positive and negative controls of PCR and the negative control of DNA extraction passed correctly (see above the table for controls).

## TROUBLESHOOTING

- The absence of positive signal in C+ in channels FAM/Green, JOE/HEX/Yellow, Cy5/Red, may indicate incorrect amplification program or other errors made during PCR amplification. In this case, PCR should be carried out once again.
- Detection of any Ct value in NCA suggests contamination of reagents or samples. In this case, it is necessary to repeat the analysis of all tests starting from the isolation stage and to take measures for detecting and eliminating the source of contamination.

## TROUBLESHOOTING

### Sensitivity

Biological material	Transport medium	Sensitivity
Blood cultures, a mixture of bacterial cultures obtained by primary seeding clinical material to solid or liquid medium		$1 \times 10^5$ copies/ml
Urine	-	$5 \times 10^2$ copies/ml
Oropharyngeal and rectal swabs	Transport Medium for Swabs or Transport Medium with Mucolytic Agent	$2 \times 10^3$ copies/ml

The genes of MBL of corresponding types were identified by using this reagents kit then the DNA samples of control strains, carrying the genes of known MBL of VIM-1, VIM-2, VIM-4, VIM-10, IMP-1, IMP-2, IMP -12, IMP-13 types, were analysed.

### Specificity

The analytical specificity of **Sacace MDR MBL (VIM,IMP,NDM) Real-TM** PCR was confirmed in clinical studies and was checked against the following strains: *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, *Klebsiella oxytoca*, *Serratia marcescens*, *Acinetobacter baumannii*, *Proteus mirabilis*, *Enterococcus faecalis*, *Staphylococcus* spp., *Streptococcus* spp., *Candida* spp.

The clinical specificity of **Sacace MDR MBL (VIM,IMP,NDM) Real-TM** PCR kit was confirmed in laboratory clinical trials.

## KEY TO SYMBOLS USED



List Number



Caution!



Lot Number



Contains sufficient  
for <n> tests



For *in Vitro* Diagnostic  
Use



Version



Store at

**NCA**

Negative Control of  
Amplification



Manufacturer

**NCE**

Negative control of  
Extraction



Consult instructions for  
use

**C+**

Positive Control of  
Amplification



Expiration Date

**IC**

Internal Control

\* SaCycler™ is a registered trademark of Sacace Biotechnologies

\* CFX™ and iQ5™ are trademarks of Bio-Rad Laboratories

\* Rotor-Gene™ Technology is a registered trademark of Corbett Research

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