



# RAPPORT **MED** • **DNA**

**HEALTHY • LAB<sup>®</sup>**

## Access your test results digitally

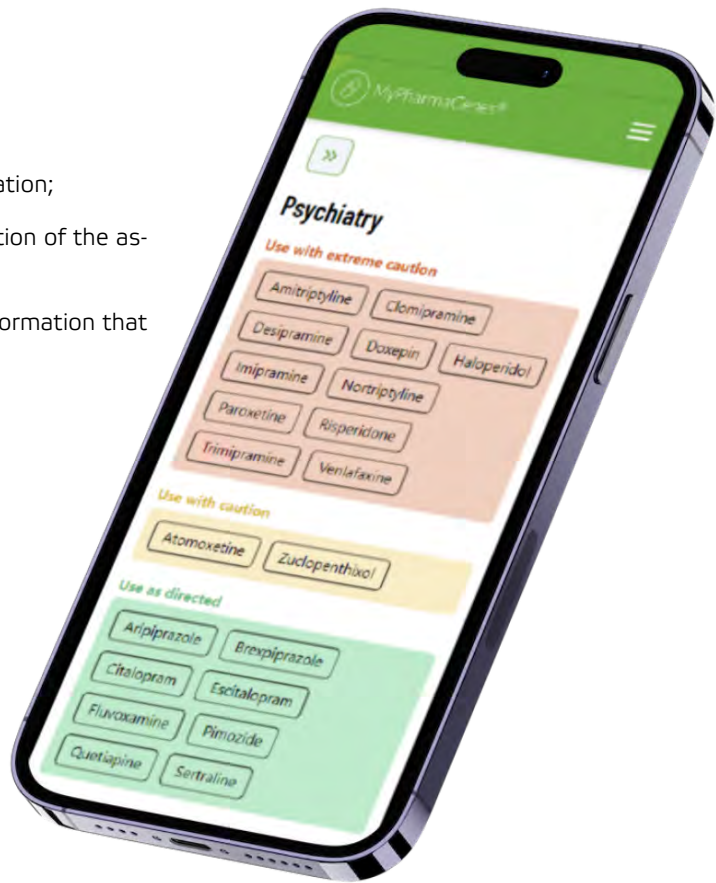
With simple, intuitive and interactive navigation

### WebApp features:

- Manage the personal drug portfolio;
- Signal adverse effects after taking a drug;
- Have quick access to a personalised drug classification;
- Find specific information about the biological function of the assessed genes;
- Access the relevant bibliography with scientific information that supports the results.



[CLICK HERE](#)



### Operation:











- Scan the QR code on this page using the camera on your mobile device (mobile phone or tablet).
- The WebApp will open on your internet browser. It is not necessary to install any application.
- Add a shortcut to your home screen, so you don't need to re-read the QR code to open the WebApp.

## GENETIC STUDY OF PHARMACOGENETICS

CASE INDEX		CUSTOMER INSTITUTION	
Full name:	N.A.	Referring physician:	N.A.
Gender:	Female	Referral number:	N.A.
Date of birth:	2023-06-05	Place of harvest:	Cantanhede
Ethnicity:	Caucasian	Referring facility:	HeartGenetics
Referral reason:	N.A.	Sample collection date:	2023-06-05
Purpose:	Pharmacogenetics	Sample reception date:	2023-06-06
Specimen type:	Epithelium	Report issue date:	2024-02-06

### What is analysed in this genetic test?

This genetic test analyses your DNA in order to assess 85 variants in 28 genes, associated with the response and/or risk of adverse effects of more than 100 drugs with an impact on the 10 therapeutic areas described below. Additionally, it assesses the copy number variation of the *CYP2D6* gene, considering the presence of hybrid alleles with *CYP2D7* gene.

 <b>Psychiatry</b>	 <b>Neurology</b>	 <b>Pain management</b>	 <b>Cardiology</b>	 <b>Oncology</b>
<i>CYP2B6, CYP2C19, CYP2D6, CYP3A4</i>	<i>CYP2C19, CYP2C9, CYP2D6, HLA-A, HLA-B, SCN1A</i>	<i>CYP2B6, CYP2C19, CYP2C9, CYP2D6</i>	<i>ABCG2, ADD1, APOE, CYP2C18, CYP2C19, CYP2C9, CYP2D6, CYP3A4, CYP4F2, F2, F5, KIF6, SLCO1B1, VKORC1</i>	<i>CYP2D6, DPYD, HCP5, NUDT15, TPMT, UGT1A1</i>
 <b>Gastroenterology</b>	 <b>Immunosuppression</b>	 <b>Rheumatology</b>	 <b>Urology</b>	 <b>Infectiology</b>
<i>CYP2C19, CYP2C9, CYP2D6</i>	<i>ATIC, CYP3A4, CYP3A5, NUDT15, TNF, TPMT</i>	<i>CYP2C9</i>	<i>CYP2D6</i>	<i>CYP2B6, CYP2C19, DPYD, HCP5, IFNL3, ITPA, UGT1A1</i>




### Important Disclaimer

This genetic test was developed to be used as a working tool by your doctor or healthcare professional. The results obtained may help to define a personalised treatment, with a constant focus on increasing its effectiveness and on reducing the risk of experiencing adverse effects.




The completion of this test, as well as the results obtained, can not be used as a substitute for professional medical advice and treatment. The genetic results of this test do not depend on the physical or clinical condition, nor on the therapeutic used by the tested individual.

### Icons used in the report

#### Biological impact

-  Risk of reduced efficacy
-  Altered metabolism
-  Risk of adverse effects

#### Evidence level

-  Recommendations from PGx consortia
-  PharmGKB level (1A – 2B)
-  Drug label annotations

## DRUGS SUMMARY

Use with extreme caution  
or change drugs

Use with caution

Use as directed

No PGx recommendations

**Psychiatry**  
see page 6Amitriptyline,  
Clomipramine,  
Desipramine, Doxepin,  
Haloperidol, Imipramine,  
Nortriptyline, Paroxetine,  
Risperidone, Trimipramine,  
Venlafaxine, VortioxetineAtomoxetine,  
Escitalopram, Sertraline,  
ZuclopenthixolAripiprazole,  
Brexipiprazole, Citalopram,  
Fluvoxamine, Pimozide,  
QuetiapineAmoxapine, Amphetamine,  
Bupropion, Clobazam,  
Diazepam, Flibanserin,  
Iloperidone, Perphenazine,  
Protriptyline, Sertindole,  
Thioridazine**Neurology**  
see page 16

Eliglustat

There are no drugs in this  
categoryCarbamazepine,  
Fosphenytoin,  
Lamotrigine,  
Oxcarbazepine, Phenytoin,  
SiponimodBrivaracetam,  
Deutetrabenazine,  
Donepezil, Galantamine,  
Meclizine, Pitolisant,  
Tetrabenazine,  
Tolperisone, Valbenazine**Pain management**  
see page 22

Codeine, Tramadol

There are no drugs in this  
categoryCelecoxib, Flurbiprofen,  
Hydrocodone, Ibuprofen,  
Lornoxicam, Meloxicam,  
Piroxicam, TenoxicamCarisoprodol, Lofexidine,  
Methadone, Oliceridine**Cardiology**  
see page 26There are no drugs in this  
categoryFlecainide, Metoprolol,  
Propafenone, WarfarinAcenocoumarol,  
Atorvastatin, Clopidogrel,  
Fluvastatin, Lovastatin,  
Phenprocoumon,  
Pitavastatin, Pravastatin,  
Rosuvastatin, SimvastatinEthinyl estradiol,  
Hydrochlorothiazide,  
Losartan, Ranolazine,  
Rivaroxaban

**Oncology**

see page 32

Ondansetron, Tropisetron

There are no drugs in this category

Capecitabine, Cisplatin,  
Fluorouracil, Irinotecan,  
Mercaptopurine,  
Tamoxifen, Tegafur,  
ThioguanineErlotinib, Pazopanib,  
SN-38**Gastroenterology**

see page 36

There are no drugs in this category

There are no drugs in this category

Dexlansoprazole,  
Lansoprazole,  
Omeprazole, PantoprazoleDronabinol,  
Metoclopramide,  
Rabeprazole**Immunosuppression**

see page 39

There are no drugs in this category

There are no drugs in this category

Azathioprine, Tacrolimus

Etanercept, Methotrexate

**Rheumatology**

see page 41

There are no drugs in this category

There are no drugs in this category

There are no drugs in this category

Lesinurad

**Urology**

see page 43

There are no drugs in this category

There are no drugs in this category

There are no drugs in this category

Darifenacin, Fesoterodine,  
Mirabegron, Tamsulosin,  
Tolterodine**Infectiology**

see page 45

Voriconazole

Efavirenz

Abacavir, Atazanavir,  
Flucloxacillin, Flucytosine,  
PEG interferon- $\alpha$  +  
ribavirinNevirapine, Ombitasvir +  
paritaprevir + ritonavir



## PSYCHIATRY

### Use with extreme caution or change drugs

Amitriptyline	Clomipramine	Desipramine	Doxepin	Haloperidol	Imipramine
Nortriptyline	Paroxetine	Risperidone	Trimipramine	Venlafaxine	Vortioxetine

### Use with caution

Atomoxetine	Escitalopram	Sertraline	Zuclopenthixol
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### Use as directed

Aripiprazole	Brexiprazole	Citalopram	Fluvoxamine	Pimozide	Quetiapine
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### No PGx recommendations

Amoxapine	Amphetamine	Bupropion	Clobazam	Diazepam	Flibanserin
Iloperidone	Perphenazine	Protriptyline	Sertindole	Thioridazine	

Drugs for which there are only genetic markers associated with reduced efficacy or increased risk of adverse effects are not shown in this detail section if only no-risk genotypes have been identified. This means that some of the drugs classified as "Use as indicated", associated with the green colour, or with "No PGx recommendations", associated with the grey colour, may not be represented below because there is no relevant information to provide. On the contrary, all genetic markers associated with the metabolizer status will be detailed even if a normal metabolizer capacity has been identified.

Unless otherwise stated, the information present in this report should not be used to adjust medication on which a patient is found to be responding favorably and/or stable.

## Atypical antidepressants

## Bupropion



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2B6</i>	*1/*6	Reduced metabolism		2A	

There are no recommendations for changing the standard dose.

## Atypical antipsychotics

## Risperidone



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

Based on the identified *CYP2D6* genotype, the DPWG recommends to use an alternative to risperidone or to titrate the dose according to the maximum dose for the active metabolite (paliperidone). Maximum doses for paliperidone are defined for oral administration as 12 mg/day for adults and children from 15 years of age weighing at least 51 kg and 6 mg/day for children from 15 years of age weighing less than 51 kg.

## Aripiprazole



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

The DPWG indicates that therapy should be started with the standard dose.

## Brexiprazole








Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

The DPWG indicates that no changes to the standard dose are required.


## Quetiapine






 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP3A4</i>	*1/*1	Normal metabolism	  		

There are no recommendations for the identified result.


## Iloperidone






 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

There are no recommendations defined for changing the standard dose.

## Sertindole


 Markers without guideline recommendations






Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

There are no recommendations for changing the standard dose.

## Benzodiazepines


## Clobazam






 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism	  		

There are no recommendations for changing the standard dose.

## Diazepam

 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism	  		

There are no recommendations for changing the standard dose.



## Central Nervous System (CNS) stimulants

## Amphetamine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism					

There are no specific recommendations regarding dose adjustment.

## Selective serotonin reuptake inhibitors (SSRI)

## Paroxetine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism				1A	

CPIC and DPWG recommend avoiding the use of paroxetine, replacing it with drugs not metabolised, or predominantly metabolised, by CYP2D6.

## Escitalopram



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism				1A	

- The CPIC recommends to start therapy with the standard dose.
- The DPWG indicates that there are no recommendations to change the standard dose.

## Sertraline



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2B6</i>	*1/*6	Reduced metabolism				1A	
<i>CYP2C19</i>	*1/*17	Rapid metabolism				1A	

Based on the genotypes of *CYP2C19* and *CYP2B6* the CPIC recommends to initiate therapy with standard starting dose.

## Citalopram



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism		1A	

- The CPIC recommends to start therapy with the standard dose.
- The DPWG indicates that there are no recommendations to change the standard dose.

## Fluvoxamine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

The CPIC makes no recommendations to change the standard dose.

## Serotonin modulators

## Vortioxetine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

The CPIC recommends to avoid the use of vortioxetine and to select alternative drugs not predominantly metabolised by CYP2D6. If this is not possible, it recommends to initiate therapy at standard starting dose and titrate increases in the maintenance dose based on efficacy and side effects.

## Serotonin receptor 1A agonist/serotonin receptor 2A antagonist

## Flibanserin



Markers without guideline recommendations






Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism			

There are no recommendations for changing the standard dose.

## Serotonin-norepinephrine reuptake inhibitors (SNRI)

### Venlafaxine






 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

- The CPIC indicates that there are no recommendations for changes to the standard dose.
- The DPWG recommends monitoring the serum concentrations of venlafaxine and O-desmethylvenlafaxine and, if necessary, adjusting the dose to 150% of the standard. Alternatively, a drug that is not predominantly metabolised by CYP2D6 should be chosen.

### Atomoxetine

 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

The CPIC indicates that:









- Children should start therapy with a daily dose of 0.5 mg/kg and adults with 40 mg and these doses may be increased to 1.2 mg/kg and 80 mg, respectively, after 3 days of treatment.
- In case of therapeutic failure and absence of adverse effects, the peak plasma concentration of atomoxetine must be evaluated in order to guide possible dose increases.

The DPWG indicates that the efficacy of the drug must be monitored or, as a precaution, alternative drugs not metabolised by CYP2D6 must be chosen.

## Tricyclic antidepressants

### Amitriptyline

 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism	  	1A	
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  	1A	

The CPIC indicates that:

- The use of amitriptyline should be avoided.
- If it is crucial to use amitriptyline, therapeutic monitoring should be carried out to guide eventual adjustments of the prescribed dose.

## Clomipramine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism		1A	
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

The CPIC indicates that:

- The use of clomipramine should be avoided.
- If it is crucial to use clomipramine, therapeutic monitoring should be carried out to guide eventual adjustments of the prescribed dose.

## Desipramine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

The CPIC recommends to avoid the use of desipramine and to select alternative drugs not metabolised by CYP2D6. If this is not possible, it recommends an increase of the standard dose under therapeutic monitoring.

## Doxepin



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism			
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

The CPIC indicates that:

- The use of doxepin should be avoided.
- If it is crucial to use doxepin, therapeutic monitoring should be carried out to guide eventual adjustments of the prescribed dose.

## Imipramine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism		1A	
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

The CPIC indicates that:

- The use of imipramine should be avoided.
- If it is crucial to use imipramine, therapeutic monitoring should be carried out to guide eventual adjustments of the prescribed dose.

## Nortriptyline



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

- The CPIC recommends considering alternative drugs not metabolised by CYP2D6 or, if not possible, an increase in the standard dose and therapeutic monitoring to guide potential adjustments.
- The DPWG recommends considering a dose 1.7x higher than the standard, accompanied by clinical or therapeutic monitoring and, if necessary, choosing an alternative therapy, not metabolised by CYP2D6.

## Trimipramine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism			
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		1A	

The CPIC indicates that:

- The use of trimipramine should be avoided.
- If it is crucial to use trimipramine, therapeutic monitoring should be carried out to guide eventual adjustments of the prescribed dose.

## Amoxapine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
CYP2D6	*1/*1x≥3	Ultrarapid metabolism			

There are no recommendations for changing the standard dose.

## Protriptyline



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
CYP2D6	*1/*1x≥3	Ultrarapid metabolism			

There are no recommendations to change the standard dose.

## Typical antipsychotics

## Haloperidol



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
CYP2D6	*1/*1x≥3	Ultrarapid metabolism		1A	

The DPWG recommends starting therapy with 1.5 times the standard dose or using alternative drugs not metabolised, or extensively metabolised, by CYP2D6.

## Zuclopenthixol



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
CYP2D6	*1/*1x≥3	Ultrarapid metabolism		1A	

The DPWG indicates that there is insufficient information available to make a dosage recommendation. However, dose can be increased, without exceeding 1.5x the standard dose, if effectiveness is insufficient.

## Pimozide



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
CYP2D6	*1/*1x≥3	Ultrarapid metabolism			

The DPWG indicates that no dose adjustment is necessary based on this genotype.

## Perphenazine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism					

There are no recommendations defined for changing the standard dose.

## Thioridazine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism					

There are no recommendations for changing the standard dose.



## NEUROLOGY

### Use with extreme caution or change drugs

Eliglustat

### Use with caution

There are no drugs in this category

### Use as directed

Carbamazepine

Fosphenytoin

Lamotrigine

Oxcarbazepine

Phenytoin

Siponimod

### No PGx recommendations

Brivaracetam

Deutetrabenazine

Donepezil

Galantamine

Meclizine

Pitolisant

Tetrabenazine

Tolperisone

Valbenazine

Drugs for which there are only genetic markers associated with reduced efficacy or increased risk of adverse effects are not shown in this detail section if only no-risk genotypes have been identified. This means that some of the drugs classified as "Use as indicated", associated with the green colour, or with "No PGx recommendations", associated with the grey colour, may not be represented below because there is no relevant information to provide. On the contrary, all genetic markers associated with the metabolizer status will be detailed even if a normal metabolizer capacity has been identified.

Unless otherwise stated, the information present in this report should not be used to adjust medication on which a patient is found to be responding favorably and/or stable.



## Acetylcholinesterase inhibitors

### Donepezil



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism		3	

There are no specific recommendations regarding dose adjustment, despite the significant increase in the metabolising capacity.

### Galantamine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no recommendations for changing the standard dose.

## Anticonvulsants

### Carbamazepine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>HLAA</i>	G (RS41543916)	Normal risk of Stevens-Johnson syndrome or toxic epidermal necrolysis		1A	
<i>HLAB</i>	T (RS144012689)	Normal risk of Stevens-Johnson syndrome or toxic epidermal necrolysis		1A	

Based on the identified *HLA-A* genotype, the CPIC recommends the use of carbamazepine following the standard dosing guidelines.

Based on the identified *HLA-B* genotype, the CPIC recommends the use of carbamazepine following the standard dosing guidelines.

(The variant *HLA-B* rs144012689 is significantly correlated with the presence of *HLA-B*:\*15:02 in multi-ancestry cohorts. While published studies show a sensitivity of 100% there is a lower positive predictive value of approximately 86%, which may lead to the misclassification of some patients and the denial of treatment to individuals that are not at increased risk of hypersensitivity.)

## Fosphenytoin



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism			
<i>HLAB</i>	T (RS144012689)	Normal risk of Stevens-Johnson syndrome or toxic epidermal necrolysis			

Based on the identified *CYP2C9* genotype, the CPIC recommends to start therapy with the recommended initial dose, considering the clinical characteristics of each individual. Subsequent doses should be adjusted according to therapeutic drug monitoring, response and side effects.

Based on the identified *HLA-B* genotype, the CPIC recommends the use of fosphenytoin following the standard dosing guidelines. If an increased dosage is needed, it should be adjusted based on therapeutic drug monitoring, response to treatment, and any potential side effects.

(The variant *HLA-B* rs144012689 is significantly correlated with the presence of *HLA-B*:\*15:02 in multi-ancestry cohorts. While published studies show a sensitivity of 100% there is a lower positive predictive value of approximately 86%, which may lead to the misclassification of some patients and the denial of treatment to individuals that are not at increased risk of hypersensitivity.)

## Oxcarbazepine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>HLAB</i>	T (RS144012689)	Normal risk of Stevens-Johnson syndrome or toxic epidermal necrolysis			

Based on the identified *HLA-B* genotype, the CPIC recommends the use of oxcarbazepine following the standard dosing guidelines.

(The variant *HLA-B* rs144012689 is significantly correlated with the presence of *HLA-B*:\*15:02 in multi-ancestry cohorts. While published studies show a sensitivity of 100% there is a lower positive predictive value of approximately 86%, which may lead to the misclassification of some patients and the denial of treatment to individuals that are not at increased risk of hypersensitivity.)

## Phenytoin



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism		1A	
<i>HLA-B</i>	T (RS144012689)	Normal risk of Stevens-Johnson syndrome or toxic epidermal necrolysis		1A	

Based on the identified *CYP2C9* genotype, the CPIC recommends starting therapy with the recommended initial dose, considering the clinical characteristics of each individual. Subsequent doses should be adjusted according to therapeutic drug monitoring, response and side effects.

Based on the identified *HLA-B* genotype, the CPIC recommends the use of phenytoin following the standard dosing guidelines. If an increased dosage is needed, it should be adjusted based on therapeutic drug monitoring, response to treatment, and any potential side effects.

(The variant *HLA-B* rs144012689 is significantly correlated with the presence of *HLA-B*:\*15:02 in multi-ancestry cohorts. While published studies show a sensitivity of 100% there is a lower positive predictive value of approximately 86%, which may lead to the misclassification of some patients and the denial of treatment to individuals that are not at increased risk of hypersensitivity.)

## Brivaracetam



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism			

There are no recommendations to change the standard dose.

## Antihistamines

## Meclizine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

Because this *CYP2D6* phenotype may affect systemic concentration of meclizine, patients should be monitored for adverse reactions and clinical effect.

## Glucosylceramide synthase inhibitors

## Eliglustat



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

The DPWG recommends to choose an alternative therapy if possible, as eliglustat is contra-indicated in these patients.

## H3 blockers

## Pitolisant



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no recommendations for changing the standard dose.

## Muscle relaxants

## Tolperisone



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no specific recommendations regarding dose adjustment.

## Sphingosine L-phosphate receptor modulators

## Siponimod



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism			

There are no recommendations for the identified result.

## Vesicular monoamine transporter 2 (VMAT2) inhibitors

## Deutetrabenzazine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no recommendations for changing the standard dose. It is possible that this metabolic alteration has no clinical impact.

## Tetrabenzazine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no recommendations for changing the standard dose however, there must be monitoring of the response to the drug.

## Valbenzazine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no specific recommendations regarding dose adjustment. It is possible that this metabolic alteration has no clinical impact.



## PAIN MANAGEMENT

### Use with extreme caution or change drugs

Codeine

Tramadol

### Use with caution

There are no drugs in this category

### Use as directed

Celecoxib

Flurbiprofen

Hydrocodone

Ibuprofen

Lornoxicam

Meloxicam

Piroxicam

Tenoxicam

### No PGx recommendations

Carisoprodol

Lofexidine

Methadone

Oliceridine

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## Alpha adrenergic agonists

## Lofexidine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no therapeutic recommendations for this gene-drug association.

## Muscle relaxants

## Carisoprodol



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism			

There are no recommendations for changing the standard dose.

## Non-steroidal anti-inflammatory drugs

## Celecoxib



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism			

The CPIC recommends starting therapy with the standard dose.

## Flurbiprofen







Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism			

The CPIC recommends starting therapy with the standard dose.

## Ibuprofen





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism	  	<b>1A</b>	

The CPIC recommends starting therapy with the standard dose.

## Lornoxicam





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism	  	<b>1A</b>	

The CPIC recommends starting therapy with the standard dose.

## Meloxicam





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism	  	<b>1A</b>	

The CPIC recommends starting therapy with the standard dose.

## Piroxicam





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism	  	<b>1A</b>	

The CPIC recommends starting therapy with the standard dose.

## Tenoxicam

 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism	  	<b>1A</b>	





The CPIC recommends starting therapy with the standard dose.



## Opioid analgesics

## Codeine





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  	1A	

The CPIC, CPNDS and DPWG recommend avoiding the use of codeine, especially in co-medication with CYP3A4 inhibitors and/or in the presence of a decreased kidney function. Alternative therapy not predominantly metabolised by CYP2D6 is recommended.

## Tramadol





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  	1A	

The CPIC recommends avoiding tramadol and using a non-codeine opioid if opioid use is warranted. The DPWG recommends that an alternative drug not metabolised by CYP2D6 be considered or, if this is not possible, a reduction to 40% of the standard dose and the monitoring of adverse effects.


## Hydrocodone





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  	1A	

The CPIC does not recommend therapeutic adjustment based on this result.


## Methadone






 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2B6</i>	*1/*6	Reduced metabolism	  	2A	

There are no therapeutic recommendations for this gene-drug association.

## Oliceridine

 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

There are no recommendations for the identified result.



## CARDIOLOGY

### Use with extreme caution or change drugs

There are no drugs in this category

### Use with caution

Flecainide

Metoprolol

Propafenone

Warfarin

### Use as directed

Acenocoumarol

Atorvastatin

Clopidogrel

Fluvastatin

Lovastatin

Phenprocoumon

Pitavastatin

Pravastatin

Rosuvastatin

Simvastatin

### No PGx recommendations

Ethinyl estradiol

Hydrochlorothiazide

Losartan

Ranolazine


Rivaroxaban






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## Anti-anginals

## Ranolazine

 Markers without guideline recommendations






Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

There are no recommendations for changing the standard dose.

## Antiarrhythmics

## Flecainide






 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

The DPWG recommends monitoring the plasma concentrations of flecainide, performing an electrocardiogram or considering alternative drugs.

## Propafenone

 Markers with guideline recommendations











Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

The DPWG indicates that propafenone plasma concentrations as well as the therapeutic response of the drug should be monitored. It is also recommended that an electrocardiogram be performed or that alternative drugs be chosen.


## Anticoagulants

## Warfarin

 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism	  		
<i>CYP4F2</i>	*1/*1	Normal metabolism	  		

The CPIC, DPWG and CPNDS recommend dose calculation using pharmacogenetic-based algorithms, such as EU-PACT, Gage and IWPC.

 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>VKORC1</i>	A (RS2359612)	Increased risk of hypocoagulation				1B	
<i>VKORC1</i>	C (RS61742245)	Increased risk of hypocoagulation §				2A	
<i>VKORC1</i>	C (RS7294)	Increased risk of hypocoagulation §				1B	

There are no recommendations for the identified result.

§ Conflicting evidence for this association has been reported.

### Acenocoumarol



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism				1B	
<i>CYP4F2</i>	*1/*1	Normal metabolism				2A	
<i>VKORC1</i>	G (RS9934438)	Increased risk of therapeutic failure				2A	

There are no recommendations for the identified result.

## Antihypertensives

### Metoprolol



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism					

- The DPWG recommends that the maximum dose indicated for the symptoms be used as the target dose.
- If the drug's response is still insufficient, an increase of up to 2.5x the recommended standard dose should be considered, or an alternative drug chosen.

### Losartan



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism				3	
<i>CYP3A4</i>	*1/*1	Normal metabolism					

There are no recommendations for the identified result.

## Diuretics

## Hydrochlorothiazide



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>ADD1</i>	G (RS4961)	Increased risk of therapeutic failure §		2B	

There are no recommendations for the identified result.

§ Conflicting evidence for this association has been reported.

## Platelet antiaggregants

## Clopidogrel



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism		1A	

The CPIC and DPWG recommend that the dose indicated on the drug label should be followed.

## Statins

## Atorvastatin



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>SLCO1B1</i>	*1/*1	Normal function		1A	

The CPIC recommends to prescribe the desired dose and adjust following doses of atorvastatin based on disease-specific guidelines.











Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>APOE</i>	C (RS7412)	Increased risk of therapeutic failure		2B	

There are no recommendations for the identified result.

## Fluvastatin





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism	  	1A	
<i>SLCO1B1</i>	*1/*1	Normal function	  	1A	

Based on the genotype of both *CYP2C9* and *SLCO1B1* genes, the CPIC recommends to use the desired starting dose, further adjusted based on disease-specific guidelines.

## Lovastatin





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>SLCO1B1</i>	*1/*1	Normal function	  	1A	

The CPIC recommends to prescribe the desired dose and adjust following doses of lovastatin based on disease-specific guidelines.

## Pitavastatin





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>SLCO1B1</i>	*1/*1	Normal function	  	1A	


The CPIC recommends to prescribe the desired dose and adjust following doses of pitavastatin based on disease-specific guidelines.





## Pravastatin

 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>SLCO1B1</i>	*1/*1	Normal function	  	1A	

The CPIC recommends to prescribe the desired dose and adjust following doses of pravastatin based on disease-specific guidelines.

 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>KIF6</i>	A (RS20455)	Increased risk of therapeutic failure	  	2B	

There are no recommendations for the identified result.

## Rosuvastatin



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>ABCG2</i>	G (RS2231142)	Normal function		1A	
<i>SLCO1B1</i>	*1/*1	Normal function		1A	

Based on the genotype of both *ABCG2* and *SLCO1B1* genes, the CPIC recommends prescribing desired starting dose and further adjusting it based on disease- and population-specific guidelines.

## Simvastatin



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>SLCO1B1</i>	*1/*1	Normal function		1A	

The CPIC recommends to prescribe the desired dose and adjust following doses of simvastatin based on disease-specific guidelines.



## ONCOLOGY

### Use with extreme caution or change drugs

Ondansetron      Tropisetron

### Use with caution

There are no drugs in this category

### Use as directed

Capecitabine      Cisplatin      Fluorouracil      Irinotecan      Mercaptopurine      Tamoxifen  
Tegafur      Thioguanine

### No PGx recommendations

Erlotinib      Pazopanib      SN-38

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## Antimetabolites

## Capecitabine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>DPYD</i>	WT/WT	Normal metabolism		1A	

The CPIC recommends starting therapy with the standard dose.

## Fluorouracil



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>DPYD</i>	WT/WT	Normal metabolism		1A	

The CPIC recommends starting therapy with the standard dose.

## Mercaptopurine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>NUDT15</i>	C (RS116855232)	Normal metabolism		1A	
<i>TPMT</i>	*1/*1	Normal metabolism		1A	

The CPIC recommends starting therapy with the standard dose.

## Tegafur












Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>DPYD</i>	WT/WT	Normal metabolism		1A	

Therapy should be started with the standard dose.

## Thioguanine

 Markers with guideline recommendations






Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>NUDT15</i>	C (RS116855232)	Normal metabolism	  		
<i>TPMT</i>	*1/*1	Normal metabolism	  	3	

The CPIC recommends starting therapy with the standard dose.

## Selective estrogen receptor modulators

## Tamoxifen

 Markers with guideline recommendations





Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  		

The CPIC and DPWG recommend starting therapy with a standard dose.

## Serotonin receptor antagonists

## Ondansetron





 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  	1A	

The CPIC recommends to select an alternative drug not predominantly metabolized by CYP2D6, such as granisetron. Dolasetron, palonosetron, and ramosetron are also metabolized by CYP2D6, but limited evidence is available to guide the use of these drugs according to this genetic variation.

## Tropisetron

 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	  	1A	

The CPIC recommends to select an alternative drug not predominantly metabolized by CYP2D6, such as granisetron. Dolasetron, palonosetron, and ramosetron are also metabolized by CYP2D6, but limited evidence is available to guide the use of these drugs according to this genetic variation.

## Topoisomerase inhibitors

### Irinotecan



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>UGT1A1</i>	*1/*1	Normal metabolism		1A	

There are no recommendations for the identified result.

### SN-38



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>UGT1A1</i>	*1/*1	Normal metabolism		2A	

There are no recommendations for the identified result.

## Tyrosine kinase inhibitors

### Erlotinib



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>UGT1A1</i>	*1/*1	Normal metabolism			

The identified genotype does not suggest increased caution. For patients with a glucuronidation disorder, the EMA recommends greater caution during treatment.



## GASTROENTEROLOGY

### Use with extreme caution or change drugs

There are no drugs in this category

### Use with caution

There are no drugs in this category

### Use as directed

Dexlansoprazole

Lansoprazole

Omeprazole

Pantoprazole

### No PGx recommendations

Dronabinol

Metoclopramide

Rabeprazole

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## Antiemetics

## Dronabinol



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism			

There are no therapeutic recommendations for this gene-drug association.

## Prokinetic agents

## Metoclopramide



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no therapeutic recommendations for this gene-drug association.

## Proton-pump inhibitors

## Dexlansoprazole



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism			

The CPIC recommends to initiate standard starting daily dose. For the treatment of *H. pylori* infection and erosive esophagitis consider increasing the dose by 50-100%. Daily dose may be given in divided doses. Always monitor for efficacy.

## Lansoprazole



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism		<b>1A</b>	

The CPIC recommends to initiate standard starting daily dose. For the treatment of *H. pylori* infection and erosive esophagitis consider increasing the dose by 50-100%. Daily dose may be given in divided doses. Always monitor for efficacy.

## Omeprazole



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism		1A	

The CPIC recommends to initiate standard starting daily dose. For the treatment of *H. pylori* infection and erosive esophagitis consider increasing the dose by 50-100%. Daily dose may be given in divided doses. Always monitor for efficacy.

## Pantoprazole



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism		1A	

The CPIC recommends to initiate standard starting daily dose. For the treatment of *H. pylori* infection and erosive esophagitis consider increasing the dose by 50-100%. Daily dose may be given in divided doses. Always monitor for efficacy.

## Rabeprazole



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism			

There are no therapeutic recommendations for this gene-drug association.



## IMMUNOSUPPRESSION

### Use with extreme caution or change drugs

There are no drugs in this category

### Use with caution

There are no drugs in this category

### Use as directed

Azathioprine

Tacrolimus

### No PGx recommendations

Etanercept

Methotrexate

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## Antimetabolites

## Azathioprine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>NUDT15</i>	C (RS116855232)	Normal metabolism				1A	
<i>TPMT</i>	*1/*1	Normal metabolism				1A	

The CPIC recommends starting therapy with the standard dose.

## Methotrexate



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>ATIC</i>	T (RS4673993)	Increased risk of therapeutic failure				2B	

There are no recommendations for the identified result.

## Immunomodulating agents

## Tacrolimus



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP3A5</i>	*3/*3	Very reduced metabolism				1A	

The CPIC recommends to initiate therapy with standard recommended dose. Use therapeutic drug monitoring to guide dose adjustments.



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP3A4</i>	*1/*1	Normal metabolism				2A	

There are no therapeutic recommendations for this gene-drug association.





## RHEUMATOLOGY

### Use with extreme caution or change drugs

There are no drugs in this category

### Use with caution

There are no drugs in this category

### Use as directed

There are no drugs in this category

### No PGx recommendations


Lesinurad






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## Selective uric acid reabsorption inhibitors

### Lesinurad

 Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact			Phar- mGKB	Drug label
<i>CYP2C9</i>	*1/*1	Normal metabolism					

There are no therapeutic recommendations for this gene-drug association.



## UROLOGY

### Use with extreme caution or change drugs

There are no drugs in this category

### Use with caution

There are no drugs in this category

### Use as directed

There are no drugs in this category

### No PGx recommendations

Darifenacin

Fesoterodine

Mirabegron

Tamsulosin

Tolterodine

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## Alpha blockers

## Tamsulosin



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no therapeutic recommendations for this gene-drug association.

## Antimuscarinics

## Darifenacin



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no therapeutic recommendations for this gene-drug association.

## Fesoterodine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no therapeutic recommendations for this gene-drug association.

## Tolterodine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no therapeutic recommendations for this gene-drug association.

## Beta-3 adrenergic agonists

## Mirabegron



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism			

There are no therapeutic recommendations for this gene-drug association.



## INFECTIOLOGY

### Use with extreme caution or change drugs

Voriconazole

### Use with caution

Efavirenz

### Use as directed

Abacavir

Atazanavir

Flucloxacillin

Flucytosine

PEG interferon- $\alpha$  +  
ribavirin

### No PGx recommendations

Nevirapine

Ombitasvir +  
paritaprevir +  
ritonavir

Drugs for which there are only genetic markers associated with reduced efficacy or increased risk of adverse effects are not shown in this detail section if only no-risk genotypes have been identified. This means that some of the drugs classified as "Use as indicated", associated with the green colour, or with "No PGx recommendations", associated with the grey colour, may not be represented below because there is no relevant information to provide. On the contrary, all genetic markers associated with the metabolizer status will be detailed even if a normal metabolizer capacity has been identified.

Unless otherwise stated, the information present in this report should not be used to adjust medication on which a patient is found to be responding favorably and/or stable.

## Antifungal antimetabolites

### Flucytosine



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>DPYD</i>	WT/WT	Normal metabolism			

There are no recommendations for the identified result.

## Interferons and nucleoside analogues

### PEG interferon- $\alpha$ + ribavirin



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>IFNL3</i>	C (RS12979860)	Favorable response		<b>1A</b>	

The CPIC indicates that:

- For a combination of a protease inhibitor with PEG-IFN- $\alpha$  and RBV therapy: the identified result weighs in favor of using PEG-IFN- $\alpha$  and RBV containing regimens. There is approximately 90% chance for sustained virologic response after 24-48 weeks of treatment. Approximately 80-90% of patients are eligible for shortened therapy (24-28 weeks vs. 48 weeks). Patients receiving boceprevir and telaprevir are eligible if HCV RNA is undetectable by week eight and week four, respectively.
- For PEG-IFN- $\alpha$  and RBV therapy (when a protease inhibitor is not available): one should consider the implications before initiating PEG-IFN- $\alpha$  and RBV containing regimens. There is approximately 70% chance for sustained virologic response after 48 weeks of treatment.



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>ITPA</i>	C (RS1127354)	Increased risk of anemia §		<b>2B</b>	
<i>ITPA</i>	A (RS7270101)	Increased risk of anemia §		<b>2B</b>	

There are no recommendations for the identified result.

§ Conflicting evidence for this association has been reported.

## Non-nucleoside reverse transcriptase inhibitors (NNRTI)

### Efavirenz



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
<i>CYP2B6</i>	*1/*6	Reduced metabolism		1A	

- The CPIC recommends starting therapy using a reduced initial dose of 400 mg/day and, if possible, monitoring steady-state plasma efavirenz concentrations to ensure they are in the suggested therapeutic range (1 to 4 µg/mL). In a multidrug regimen, the potential benefit of dose reduction must be weighed against the potential negative impact of the increased number of pills.
- The DPWG recommends evaluating efavirenz plasma concentrations in the presence of side effects and, if needed, reducing the dose (therapeutic range: 1000-4000 ng/ml). In patients with this type of metabolism, a 400 mg/day dose was shown to be effective.

### Nevirapine



Markers without guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
<i>CYP2B6</i>	*1/*6	Reduced metabolism		2A	

There are no recommendations for changing the standard dose.

## Nucleoside reverse transcriptase inhibitors (NRTI)

### Abacavir



Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar-mGKB	Drug label
<i>HCP5</i>	T (RS2395029)	Low or reduced risk of abacavir hypersensitivity.		1A	





The CPIC recommends starting therapy with the standard dose.

(The variant *HCP5* rs2395029 is significantly correlated with the presence of *HLA-B*:\*57:01 in Caucasians and Hispanics. While published studies show a sensitivity of 100% there is a lower positive predictive value of approximately 94%, which may lead to the misclassification of some patients and the denial of treatment to individuals that are not at increased risk of hypersensitivity. There is no established evidence for the use of this SNP as a surrogate marker for Africans or Asians.)

## Protease inhibitors

### Atazanavir

 Markers with guideline recommendations





Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>UGT1A1</i>	*1/*1	Normal metabolism	  	<b>1A</b>	

The CPIC indicates that there is no need to avoid the use of atazanavir based on this result.

## Triazoles

### Voriconazole

 Markers with guideline recommendations

Gene	Genotype	Phenotype	Biological impact	Phar- mGKB	Drug label
<i>CYP2C19</i>	*1/*17	Rapid metabolism	  	<b>1A</b>	

- The CPIC recommends the use of an alternative drug, not metabolised by CYP2C19, such as isavuconazole, liposomal amphotericin B, and posaconazole. Other clinical factors, such as drug interactions, hepatic function, renal function, fungal species, site of infection, therapeutic drug monitoring, and comorbidities should also be taken into account.
- The DPWG recommends using an initial voriconazole dose 1.5x higher and monitoring plasma levels.



## TECHNICAL INFORMATION

### Methodology

- When applicable a commercial kit is used to perform DNA extraction and purification. DNA concentration and quality are evaluated with a spectrophotometer (HG\_SOP.03).
- Genotyping was performed by studying 85 variants in 28 genes, associated with the response and/or the risk of adverse effects of more than 100 drugs with an impact in several therapeutic areas. Additionally, genotyping was used to evaluate the copy number variation of the *CYP2D6* gene, considering the presence of hybrid alleles with the *CYP2D7* gene.
- Genotyping is achieved using a high-throughput DNA Microchip platform, the iPLEX® MassARRAY® system (Agena Bioscience, Inc.). This array platform allows an optimal genetic analysis by combining the benefits of accurate primer extension chemistry with MALDI-TOF mass spectrometry. The different masses of each generated PCR product are then converted into genotype information (HG\_SOP.06, HG\_SOP.08, HG\_SOP.09, HG\_SOP.18).
- In accordance with Agena Bioscience's iPLEX® chemistry flyer, the MassARRAY® system performs SNP genotyping with a high level of accuracy and reproducibility (more than 99% accuracy on validated assays).

### Genetic panel

<i>ABCG2</i>	ATP binding cassette subfamily G member 2 (Junior blood group)   NC_000004.12	<i>F5</i>	coagulation factor V   NC_000001.11
<i>ADD1</i>	Adducin 1 (alpha)   ENSG00000087274	<i>HCP5</i>	HLA complex P5   NC_000006.12
<i>APOE</i>	Apolipoprotein E   ENSG00000130203	<i>HLAA</i>	major histocompatibility complex, class I, A   NC_000006.12
<i>ATIC</i>	5-aminoimidazole-4-carboxamide ribonucleotide formyltransferase/IMP cyclohydrolase   NC_000002.12	<i>HLAB</i>	major histocompatibility complex, class I, B   NC_000006.12
<i>CYP2B6</i>	cytochrome P450 family 2 subfamily B member 6   NM_000767.5	<i>IFNL3</i>	interferon lambda 3   NC_000019.10
<i>CYP2C18</i>	cytochrome P450 family 2 subfamily C member 18   NC_000010.11	<i>ITPA</i>	inosine triphosphatase   NC_000020.11
<i>CYP2C19</i>	cytochrome P450 family 2 subfamily C member 19   NC_000010.11	<i>KIF6</i>	kinesin family member 6   NC_000006.12
<i>CYP2C9</i>	cytochrome P450 family 2 subfamily C member 9   NM_000771.3	<i>NUDT15</i>	nudix hydrolase 15   NM_018283.1
<i>CYP2D6</i>	cytochrome P450 family 2 subfamily D member 6   NC_000022.11	<i>SCN1A</i>	sodium voltage-gated channel alpha subunit 1   NC_000002.12
<i>CYP3A4</i>	cytochrome P450 family 3 subfamily A member 4   NC_000007.14	<i>SLCO1B1</i>	solute carrier organic anion transporter family member 1B1   NC_000012.12
<i>CYP3A5</i>	cytochrome P450 family 3 subfamily A member 5   NC_000007.14	<i>TNF</i>	tumor necrosis factor   NC_000006.12
<i>CYP4F2</i>	cytochrome P450 family 4 subfamily F member 2   NC_000019.10	<i>TPMT</i>	thiopurine S-methyltransferase   NC_000006.12
<i>DPYD</i>	dihydropyrimidine dehydrogenase   NC_000001.11	<i>UGT1A1</i>	UDP glucuronosyltransferase family 1 member A1   NC_000002.12
<i>F2</i>	coagulation factor II, thrombin   NM_000506.3	<i>VKORC1</i>	vitamin K epoxide reductase complex subunit 1   NC_000016.10

Gene	Interrogated haplotype(s)
<i>CYP2B6</i>	*1, *6, *18
<i>CYP2C19</i>	*1, *2, *3, *4A, *4B, *5, *6, *7, *8, *17
<i>CYP2C9</i>	*1, *2, *3, *4, *5, *6, *8, *11, *12, *13, *15, *25, *27
<i>CYP2D6</i>	*1, *2, *3, *4, *6, *7, *8, *9, *10, *11, *12, *14, *15, *17, *18, *19, *20, *29, *41, *69, *114
<i>CYP3A4</i>	*1, *2, *17, *22
<i>CYP3A5</i>	*1, *3, *6, *7
<i>CYP4F2</i>	*1, *3
<i>DPYD</i>	WT, *2A, *13, HapB3, c.2846A>T
<i>HLA-A</i>	*31:01
<i>HLA-B</i>	*15:02, *57:01
<i>NUDT15</i>	*1, *3
<i>SLCO1B1</i>	*1, *5, *15, *37
<i>TPMT</i>	*1, *2, *3A, *3B, *3C, *4
<i>UGT1A1</i>	*1, *6, *80 (*28)
<i>VKORC1</i>	*1, *2

### Risks and limitations

HeartGenetics, Genetics and Biotechnology SA applies a rigorous quality control which may not exclude the possibility of error that might influence the test results. The reliability of the results is always guaranteed as HeartGenetics, Genetics and Biotechnology SA standard quality recommendations have been followed for the execution of this genetic test. The results presented in this report are limited to the available scientific knowledge at the time this test was developed (April 2023). The company guarantees the accuracy of the scientific knowledge presented in the report. It has been assumed as truthful all the above declarations about the individual and healthcare professional identity, the purpose of the study, index case and nature of analysed biological products.

If a gene follows the star allele (\*) nomenclature, the \*1 (wild-type) allele will be assigned in the absence of a positive test result for all variants interrogated for that gene. This result does not exclude the presence of other variants, not tested, either unknown or known but with lesser clinical significance. In the event that a combination of tested genetic variants defines multiple \*(start allele), the most frequent diplotype is reported.

As certain regions of the genome are inherently difficult to genotype, in some cases the assessment of the genetic variation at these locations was made using a proxy variant in place of the known phenotype-associated variant. The prescriber of the test should thus be aware that the genotype-phenotype associations may not be described in the scientific literature for the proxy variant. Nevertheless, these proxies are chosen based on the observation of a very high linkage disequilibrium with the target variant, and as such there is a high statistical likelihood that both variants segregate together in the population. The proxies and their associated target variants used in this test are the following: *HLA-A* rs41543916 as proxy for

HLA-A:\*31:01, HLA-B rs144012689 as proxy for HLA-B:\*15:02, HCP5 rs2395029 as proxy for HLA-B:\*57:01, and UGT1A1 rs887829 as proxy for UGT1A1\*80.

The response to different drugs can be influenced by non-genetic factors, such as drug interactions, age, weight, comorbidities and diet.

## Quality assurance

HeartGenetics, Genetics and Biotechnology SA is an ISO 9001 certified company for Quality Management System and applies External Quality Assessment programs from INSTAND, Reference Institute and IBBL. The laboratory that performs this genetic test complies, at all times, with all the applicable certifications and Law in its territory.

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## Genetic information

The genetic variants considered in the preparation of this report are identified in the table below. The results are described according to HGVS nomenclature (<http://www.hgvs.org>) consulted on 1 May 2020.

Gene	Genetic variant references		Nucleotidic change <sup>1</sup>	Aminoacidic change <sup>1</sup>	Result
	HGMD	rsID			
ABCG2	CM057428	rs2231142	g.88131171G>T	p.Gln141Lys	G
ADD1	CM021240	rs4961	g.2904980G>T	p.Gly460Trp	G
APOE	CM860003	rs7412	c.526C>T	p.Arg176Cys	C
ATIC	-	rs4673993	g.215347616T>C	-	T
CYP2B6	CM066043	rs28399499	c.983T>C	p.Ile328Thr	T
CYP2B6	CM130453	rs3745274	c.516G>T	p.Gln172His	G
CYP2C18	-	rs12777823	g.94645745G>A	-	G
CYP2C19	CR067132	rs12248560	g.94761900C>T	-	C
CYP2C19	CM983291	rs28399504	g.94762706A>G	p.Met1Val	A
CYP2C19	CM992158	rs41291556	g.94775416T>C	p.Trp120Arg	T
CYP2C19	CS941458	rs4244285	g.94781859G>A	p.Pro227=	G
CYP2C19	CM942096	rs4986893	g.94780653G>A	p.Trp212Ter	G
CYP2C19	CM983295	rs56337013	g.94852738C>T	p.Arg433Trp	C
CYP2C19	CM983293	rs72552267	g.94775453G>A	p.Arg132Gln	G
CYP2C19	CS992237	rs72558186	g.94781999T>A	-	T
CYP2C9	CM960481	rs1057910	c.1075A>C	p.Ile359Leu	A
CYP2C9	-	rs1304490498	c.353_362delAGAAATGGAA	p.Lys118fs	A
CYP2C9	CM994193	rs1799853	c.430C>T	p.Arg144Cys	C
CYP2C9	CM056574	rs28371685	c.1003C>T	p.Arg335Trp	C
CYP2C9	CM014176	rs28371686	c.1080C>G	p.Asp360Glu	C
CYP2C9	CM005482	rs56165452	c.1076T>C	p.Ile359Thr	T
CYP2C9	CM045973	rs72558187	c.269T>C	p.Leu90Pro	T
CYP2C9	CM057839	rs72558190	c.485C>A	p.Ser162Ter	C
CYP2C9	CM1213133	rs7900194	c.449G>A	p.Arg150His	G
CYP2C9	-	rs9332131	c.818delA	p.Lys273fs	A
CYP2C9	CM046138	rs9332239	c.1465C>T	p.Pro489Ser	C
CYP2D6	CI962673	-	g.42126666_42126667insAGTGGGCAC	-	WT
CYP2D6	CM900081	rs1065852	g.42130692G>A	p.Pro34Ser	G
CYP2D6	CM931123	rs1135840	g.42126611C>G	p.Ser486Thr	G

<i>CYP2D6</i>	CM930187	rs16947	g.42127941G>A	p.Arg296Cys	G
<i>CYP2D6</i>	-	rs201377835	g.42129910C>G	-	C
<i>CYP2D6</i>	CM960483	rs28371706	g.42129770G>A	p.Thr107Ile	G
<i>CYP2D6</i>	-	rs28371725	g.42127803C>T	-	C
<i>CYP2D6</i>	CD900279	rs35742686	g.42128242del	p.Arg259fs	T
<i>CYP2D6</i>	CS900241	rs3892097	g.42128945C>T	-	C
<i>CYP2D6</i>	CD941660	rs5030655	g.42129084del	p.Trp152fs	A
<i>CYP2D6</i>	-	rs5030656	g.42128176_42128178del	p.Lys281del	AGA
<i>CYP2D6</i>	CM960482	rs5030862	g.42130668C>T	p.Gly42Arg	C
<i>CYP2D6</i>	-	rs5030865	g.42129033C>A	p.Gly169Ter	C
<i>CYP2D6</i>	CM973337	rs5030867	g.42127856T>G	p.His324Pro	T
<i>CYP2D6</i>	-	rs59421388	g.42127608C>T	p.Val338Met	C
<i>CYP2D6</i>	-	rs72549353	g.42128251_42128254del	p.Thr256fs	CTAA
<i>CYP2D6</i>	-	rs72549354	g.42128817dup	p.Leu213fs	C
<i>CYP2D6</i>	-	rs774671100	g.42130655dup	p.Leu47fs	A
<i>CYP3A4</i>	CR119345	rs35599367	g.99768693G>A	-	G
<i>CYP3A4</i>	CM014347	rs4987161	g.99768458A>G	p.Phe189Ser	A
<i>CYP3A4</i>	-	rs55785340	g.99768360A>G	p.Ser222Pro	A
<i>CYP3A5</i>	CS015291	rs10264272	g.99665212C>T	p.Lys208=	C
<i>CYP3A5</i>	-	rs28365083	g.99652613G>T	p.Thr398Asn	G
<i>CYP3A5</i>	-	rs41303343	g.99652771dup	p.Thr346fs	A
<i>CYP3A5</i>	CS015290	rs776746	g.99672916T>C	-	T
<i>CYP4F2</i>	CM074767	rs2108622	g.15879621C>T	p.Val433Met	C
<i>DPYD</i>	CS961553	rs3918290	g.97450058C>T	-	C
<i>DPYD</i>	CM001977	rs55886062	g.97515787A>C	p.Ile560Ser	A
<i>DPYD</i>	CM003590	rs67376798	g.97082391T>A	p.Asp949Val	T
<i>DPYD</i>	CS107830	rs75017182	g.97579893G>C	-	G
<i>F2</i>	CR961726	rs1799963	c.*97G>A	-	G
<i>F5</i>	CM940389	rs6025	g.169549811C>T	p.Arg534Gln	C
<i>HCP5</i>	-	rs2395029	g.31464003T>G	-	T
<i>HLAA</i>	-	rs41543916	g.29943089G>A	-	G
<i>HLAB</i>	-	rs144012689	g.31355003T>A	-	T
<i>IFNL3</i>	-	rs11881222	g.39244283A>G	-	A
<i>IFNL3</i>	-	rs12979860	g.39248147C>T	-	C
<i>IFNL3</i>	-	rs8099917	g.39252525T>G	-	T
<i>ITPA</i>	CM022413	rs1127354	g.3213196C>A	p.Pro32Thr	C
<i>ITPA</i>	CS022498	rs7270101	g.3213247A>C	-	A
<i>KIF6</i>	CM074911	rs20455	g.39357302A>G	p.Trp719Arg	A
<i>NUDT15</i>	CM148698	rs116855232	c.415C>T	p.Arg139Cys	C
<i>SCN1A</i>	CS084633	rs3812718	g.166053034C>T	-	C
<i>SLCO1B1</i>	CM043776	rs2306283	g.21176804A>G	p.Asn130Asp	A
<i>SLCO1B1</i>	CM043777	rs4149056	g.21178615T>C	p.Val174Ala	T
<i>TNF</i>	CR941560	rs1800629	g.31575254G>A	-	G
<i>TPMT</i>	CM961383	rs1142345	g.18130687T>C	p.Tyr240Cys	T
<i>TPMT</i>	CM961382	rs1800460	g.18138997C>T	p.Ala154Thr	C
<i>TPMT</i>	CM951239	rs1800462	g.18143724C>G	p.Ala80Pro	C
<i>TPMT</i>	CS982385	rs1800584	g.18130781C>T	-	C
<i>UGT1A1</i>	CM930722	rs4148323	g.233760498G>A	p.Gly71Arg	G
<i>UGT1A1</i>	-	rs887829	g.233759924C>T	-	C
<i>VKORC1</i>	CS064465	rs2359612	g.31092475A>G	-	A
<i>VKORC1</i>	-	rs2884737	g.31094233A>C	-	A
<i>VKORC1</i>	CM071142	rs61742245	g.31094624C>A	p.Asp36Tyr	C
<i>VKORC1</i>	CR058398	rs7294	g.31091000C>T	-	C
<i>VKORC1</i>	CS064464	rs8050894	g.31093188C>G	-	C
<i>VKORC1</i>	CR052440	rs9923231	g.31096368C>T	-	C
<i>VKORC1</i>	CS050012	rs9934438	g.31093557G>A	-	G

**Number of non-hybrid copies of *CYP2D6*: 4N+**

(0N: zero copies, 1N: one copy, 2N: two copies, 3N: three copies, 4N+: four or more copies.)

## Overview of the identified metaboliser status

Gene	Genotype	Phenotype	Associated drugs
<i>CYP2B6</i>	*1/*6	Reduced metabolism	Bupropion, Efavirenz, Methadone, Nevirapine, Sertraline
<i>CYP2C19</i>	*1/*17	Rapid metabolism	Amitriptyline, Brivaracetam, Carisoprodol, Citalopram, Clobazam, Clomipramine, Clopidogrel, Dexlansoprazole, Diazepam, Doxepin, Escitalopram, Flibanserin, Imipramine, Lansoprazole, Omeprazole, Pantoprazole, Rabeprazole, Sertraline, Trimipramine, Voriconazole
<i>CYP2C9</i>	*1/*1	Normal metabolism	Acenocoumarol, Celecoxib, Dronabinol, Flurbiprofen, Fluvastatin, Fosphenytoin, Ibuprofen, Lesinurad, Lornoxicam, Losartan, Meloxicam, Phenytoin, Piroxicam, Siponimod, Tenoxicam, Warfarin
<i>CYP2D6</i>	*1/*1x≥3	Ultrarapid metabolism	Amitriptyline, Amoxapine, Amphetamine, Aripiprazole, Atomoxetine, Brexpiprazole, Clomipramine, Codeine, Darifenacin, Desipramine, Deutetrabenazine, Donepezil, Doxepin, Eliglustat, Fesoterodine, Flecainide, Fluvoxamine, Galantamine, Haloperidol, Hydrocodone, Iloperidone, Imipramine, Lofexidine, Meclizine, Metoclopramide, Metoprolol, Mirabegron, Nortriptyline, Oliceridine, Ondansetron, Paroxetine, Perphenazine, Pimozide, Pitolisant, Propafenone, Protriptyline, Ranolazine, Risperidone, Sertindole, Tamoxifen, Tamsulosin, Tetrabenazine, Thioridazine, Tolperisone, Tolterodine, Tramadol, Trimipramine, Tropicsetron, Valbenazine, Venlafaxine, Vortioxetine, Zuclopenthixol
<i>CYP3A4</i>	*1/*1	Normal metabolism	Losartan, Quetiapine, Tacrolimus
<i>CYP3A5</i>	*3/*3	Very reduced metabolism	Tacrolimus
<i>CYP4F2</i>	*1/*1	Normal metabolism	Acenocoumarol, Warfarin
<i>DPYD</i>	WT/WT	Normal metabolism	Capecitabine, Flucytosine, Fluorouracil, Tegafur
<i>TPMT</i>	*1/*1	Normal metabolism	Azathioprine, Mercaptopurine, Thioguanine



### Technical direction

HeartGenetics, Genetics and Biotechnology SA  
Cantanhede, Portugal, 2024-02-06

**Lúcia Gonçalves**  
Technical Laboratory Coordinator  
Molecular Biologist, MSc

**Daniel Luís**  
Scientific director  
Molecular Biologist, MSc

## REFERENCES

The bibliographic references are made available through the WebApp. See the first page of this report to find out how to access them.

## WARNINGS

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