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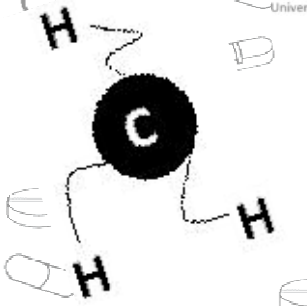
PRINCÍPIOS & FUNDAMENTOS da Química Medicinal

PARTE 4

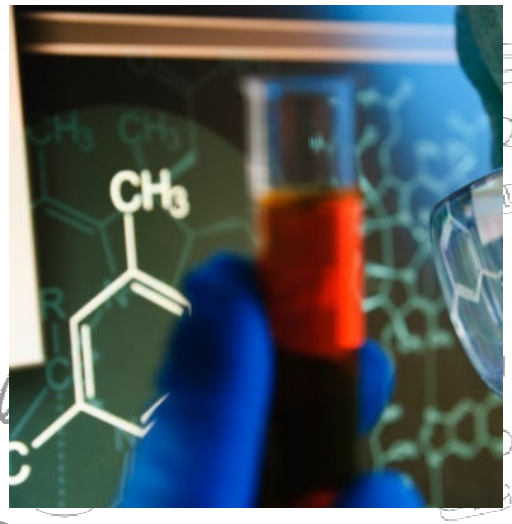


Eliezer J. Barreiro

Professor Titular

Universidade Federal do Rio de Janeiro

LASSBio® Laboratório de Avaliação e Síntese de Substâncias Bioativas 20 anos



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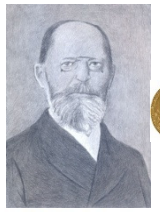
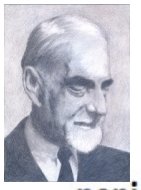
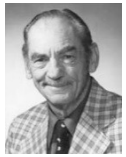
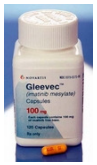
Linha do tempo...

Química Medicinal









Galeno

Fischer

Salvarsan^{R}

Fourneau

penicilina

Fleming

Bovet

indometacina

cimetidina

lovastatina

aciclovir

Elion

Hitchings

Black

imatinibe

estatina

indinavir

150	1902	1907	1911	1941	1945	1957	1962	1975	1980	1981	1987	1988	1996	2001

500aC	1889	1908	1935	1943	1948	1959	1964	1982	1985	1991	2013

Hipocrates

Paracelso

AAS

Ehrlich

Domagk

estreptomicina

Ahlquist

Kornberg

propranolol

Hodgkin

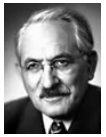
Vane

Goldstein

Brown

atorvastatina

ponatinibe



The Magic Bullet Theory

Inovação

Mecanismo molecular de Asp-protease

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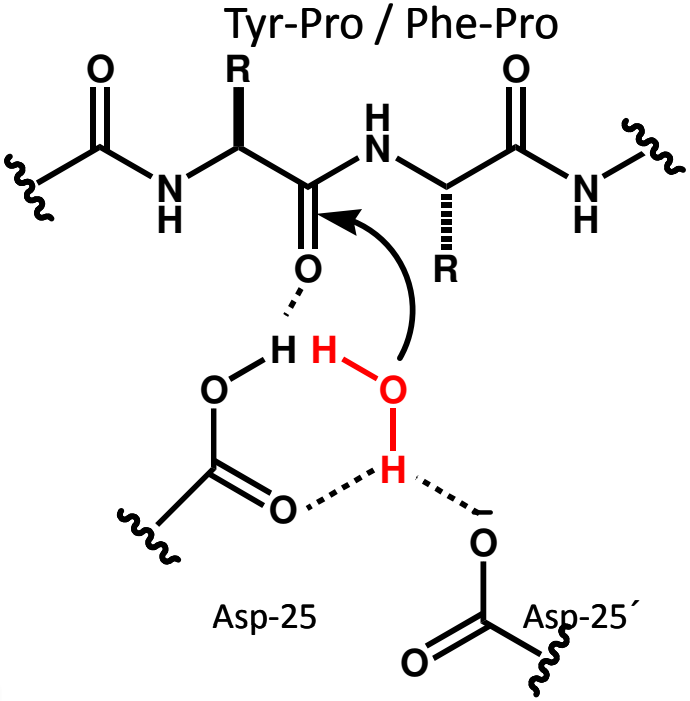
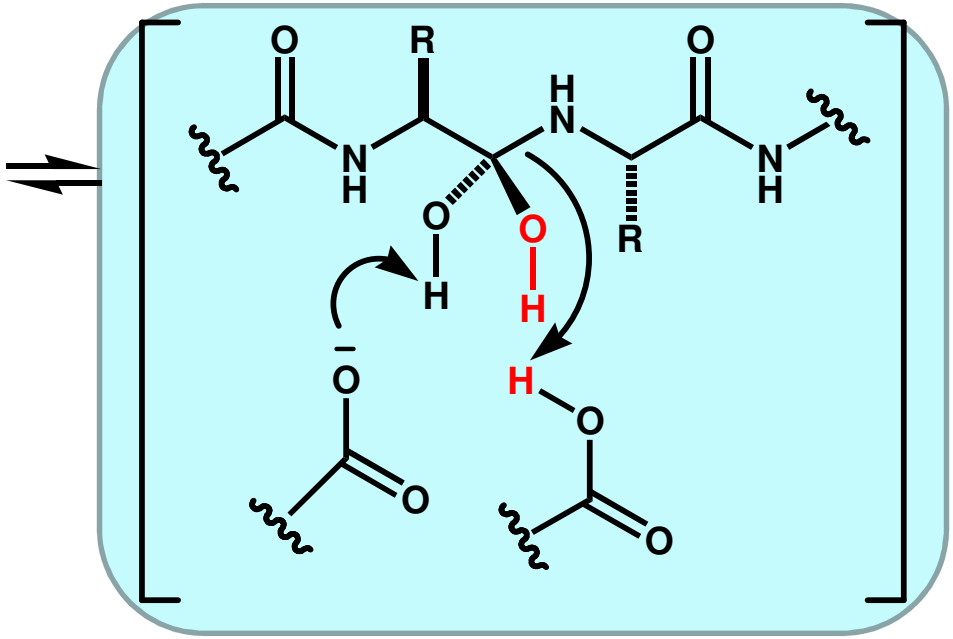
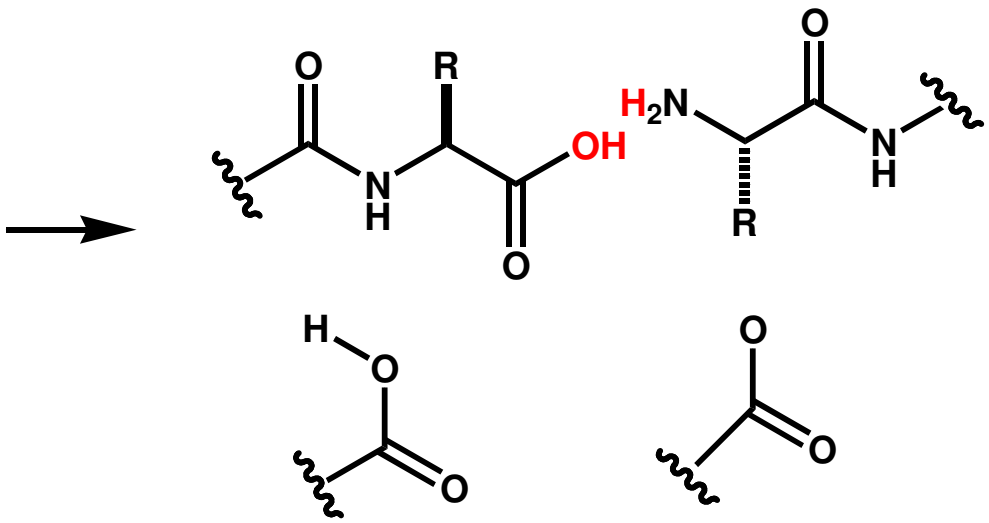
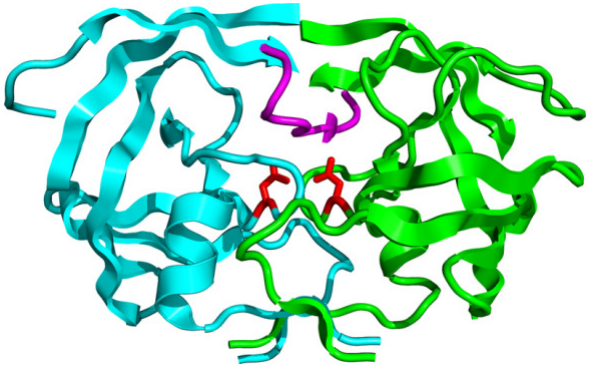
Tyr-Pro / Phe-Pro





Estado-de-transição





BACE
Catepsina D, E
Nepentesina
Pepsina
Plasmepsina
Presenilina
Renina

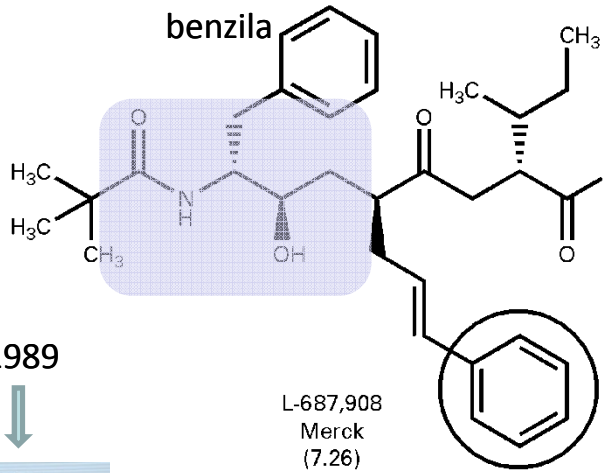
Cristalografia raios-X

MA Navia & P Fitzgerald, Merck

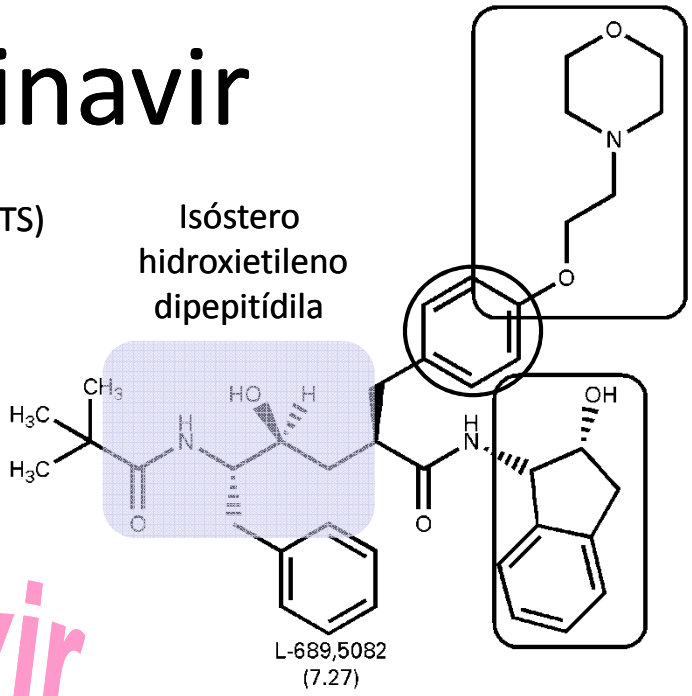
Nature, **1989**, *615*, 337

A Brik, C-H Wong, HIV-1 protease: mechanism and drug discovery, *Org. Biomol. Chem* **2003**, *1*, 5

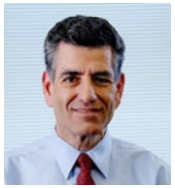
Gênese do indinavir



CALD



1989



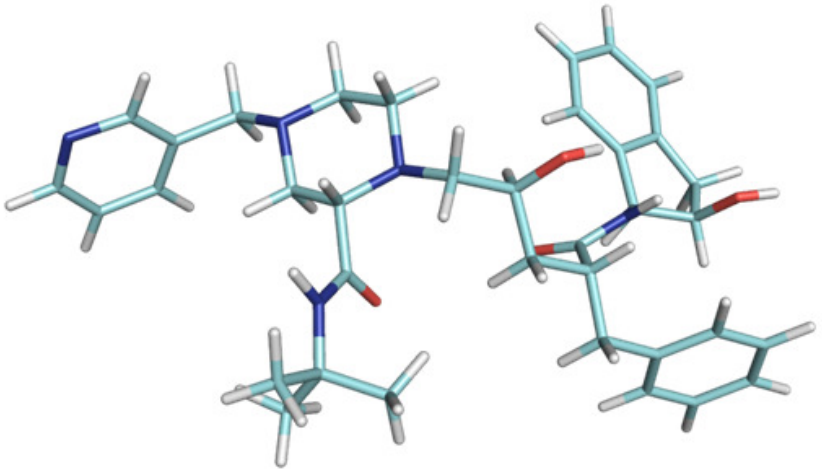
Joseph Vacca
Merck
1996

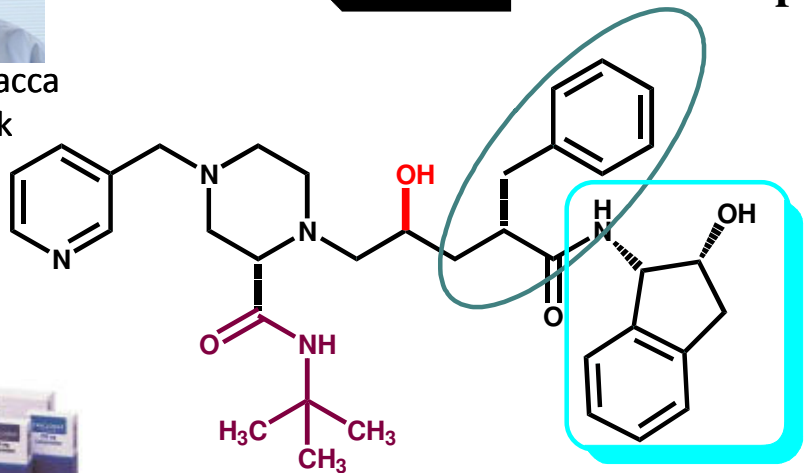
indinavir

IC_{50}< 0,03 nM

Inibidor Asp-protease (HIV)

Otimização





indinavir

Análogo ao estado-de-transição Phe-Pro

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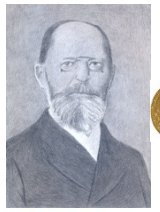
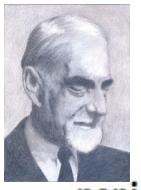
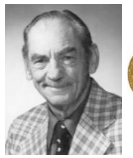
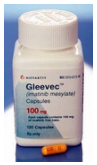
Linha do tempo...

Química Medicinal









Galeno

Fischer

Salvarsan^{R}

Fourneau

penicilina

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Bovet

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cimetidina

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aciclovir

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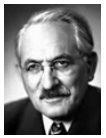
atorvastatina

ponatinibe



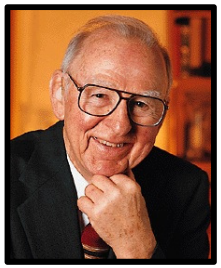
Século 21

CÂNCER...

Localização primária	casos novos	percentual
Próstata	60.180	30,8%
Traqueia, Brônquio e Pulmão	17.210	8,8%
Cólon e Reto	14.180	7,3%
Estômago	12.670	6,5%
Cavidade Oral	9.990	5,1%
Esôfago	7.770	4,0%
Bexiga	6.210	3,2%
Laringe	6.110	3,1%
Linfoma não Hodgkin	5.190	2,7%
Sistema Nervoso Central	4.820	2,5%

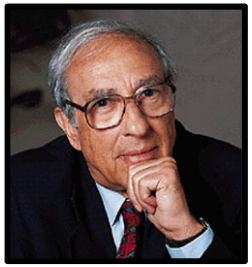
Localização primária	casos novos	percentual
Mama Feminina	52.680	27,9%
Colo do Útero	17.540	9,3%
Cólon e Reto	15.960	8,4%
Glândula Tireoide	10.590	5,6%
Traqueia, Brônquio e Pulmão	10.110	5,3%
Estômago	7.420	3,9%
Ovário	6.190	3,3%
Corpo do Útero	4.520	2,4%
Linfoma não Hodgkin	4.450	2,4%
Sistema Nervoso Central	4.450	2,4%

Tinib´s: TK's inhibitors

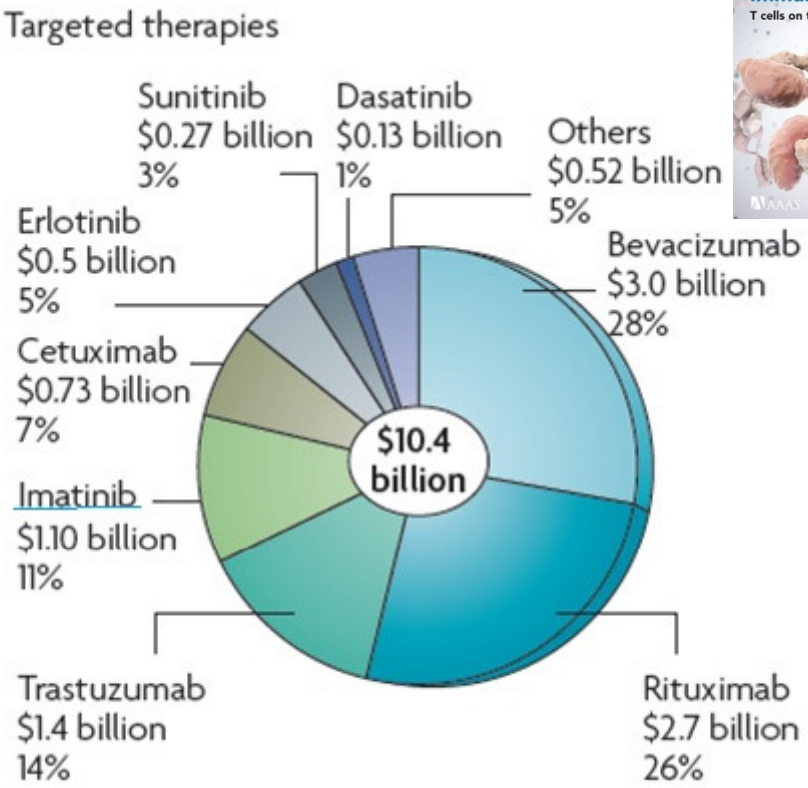


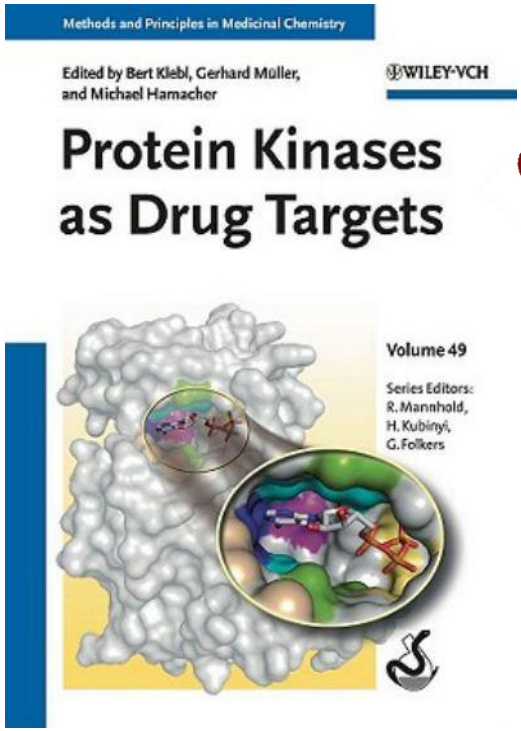
Edwin G Krebs
(1918 –2009)

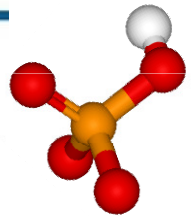
1992



Edmond H Fischer
(1920)







kinoma

Market for targeted cancer therapies. US sales of targeted therapies share of the US market based on 2009 sales.

Sources: company reports

World sales of imatinib in 2009: US$ 3,95 bi

S. Aggarwal, Targeted cancer therapies, *Nature Rev. Drug Discov.* **2010**, *9*, 427; P. Cohen, Timeline: Protein kinases — the major drug targets of the twenty-first century? *Nature Rev. Drug Discov.* **2002**, *1*, 309

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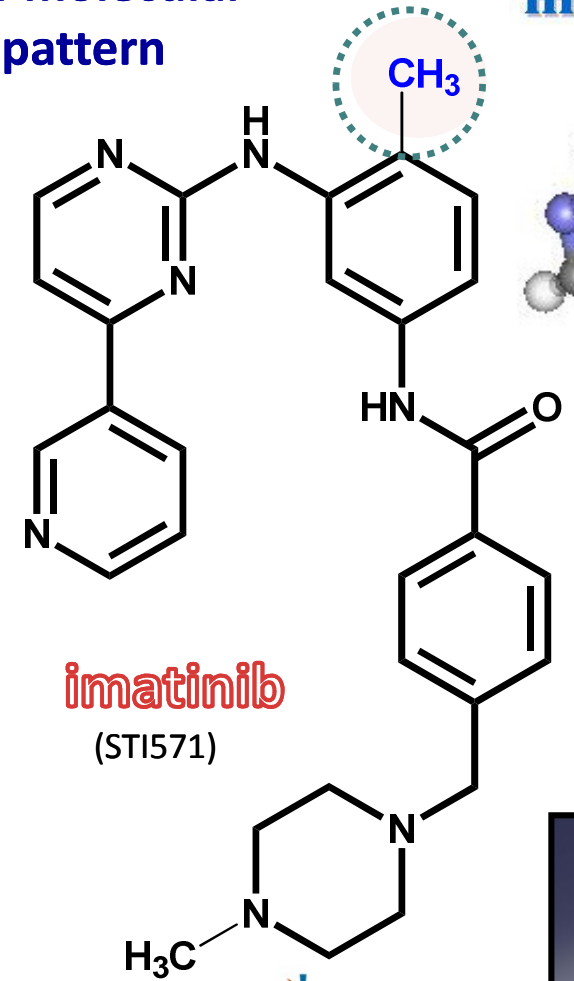
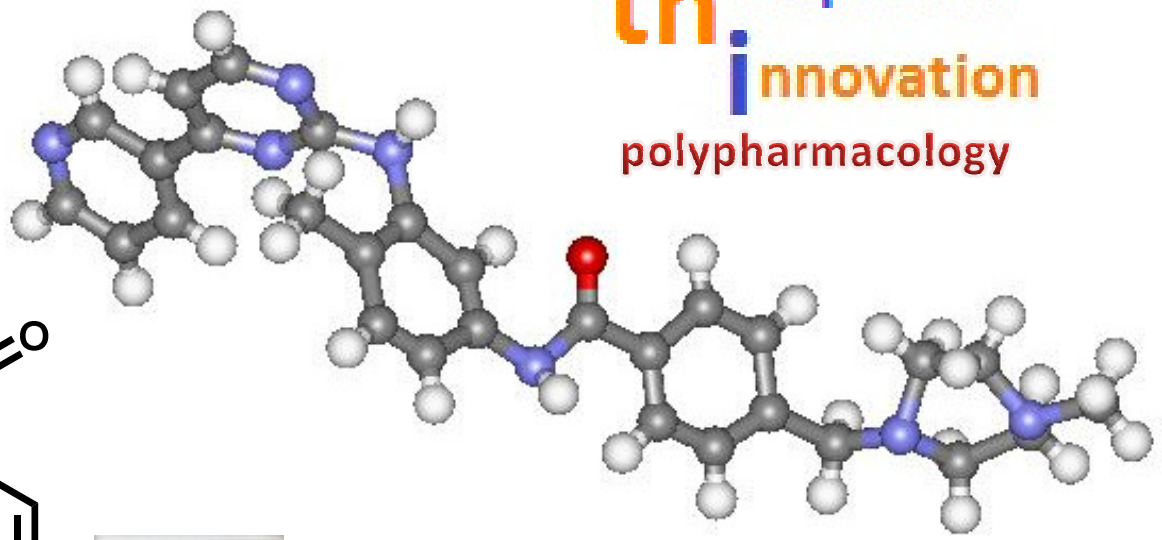
New molecular pattern

medicinal chemistry

therapeutic innovation

polypharmacology





imatinib

(STI571)

1988 – Nicholas Lydon, Brian J. Druker & Charles L Sawyers &
1995 - Compound STI571 ++
2001 – Imatinib (Gleevec^{R}, Novartis)[link]

chronic myelogenous leukemia (CML)

NOVARTIS

imatinibe

Nicholas B. Lydon
Blueprint Medicines Inc*

OREGON HEALTH & SCIENCE UNIVERSITY

Brian J. Druker*
Blueprint Medicines Inc

HHMI HOWARD HUGHES MEDICAL INSTITUTE

Charles L. Sawyers**
Blueprint Medicines Inc

& 2009 - Lasker Foundation Clinical Award (*J. Clin. Invest*. **2009**, *119*, 2863)

* B. J. Druker has been awarded with the 2012 Japan Prize in Healthcare and Medical Technology;

** C. L. Sawyers was named in 2011, Thomson Reuters Citation Laureate in Medicine;

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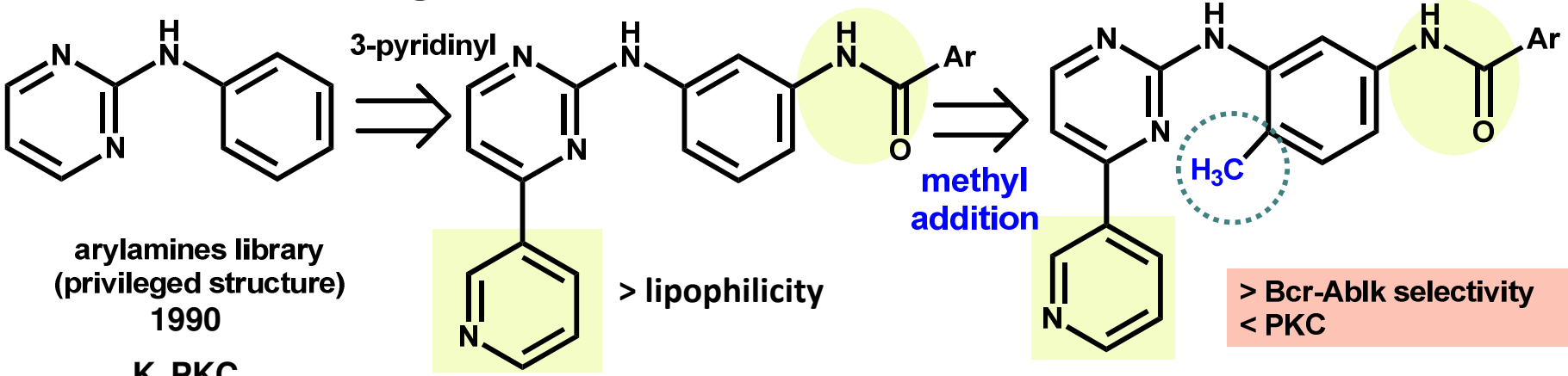
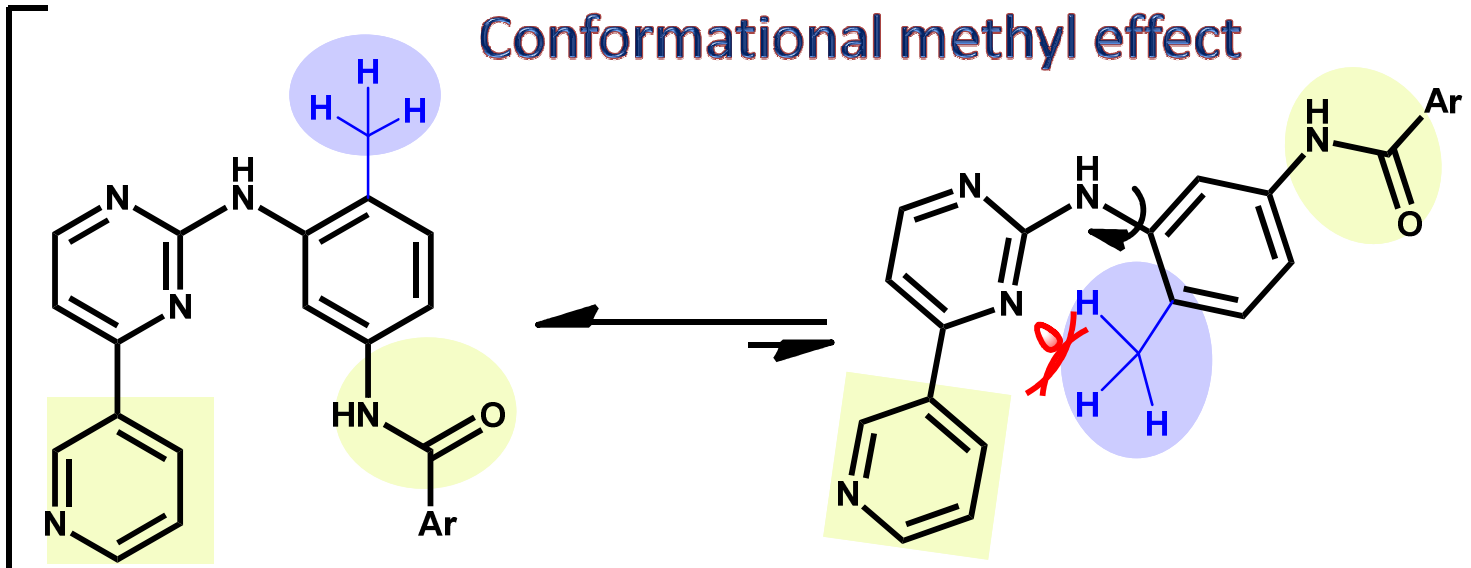
NOVARTIS

HTS

medicinal chemistry

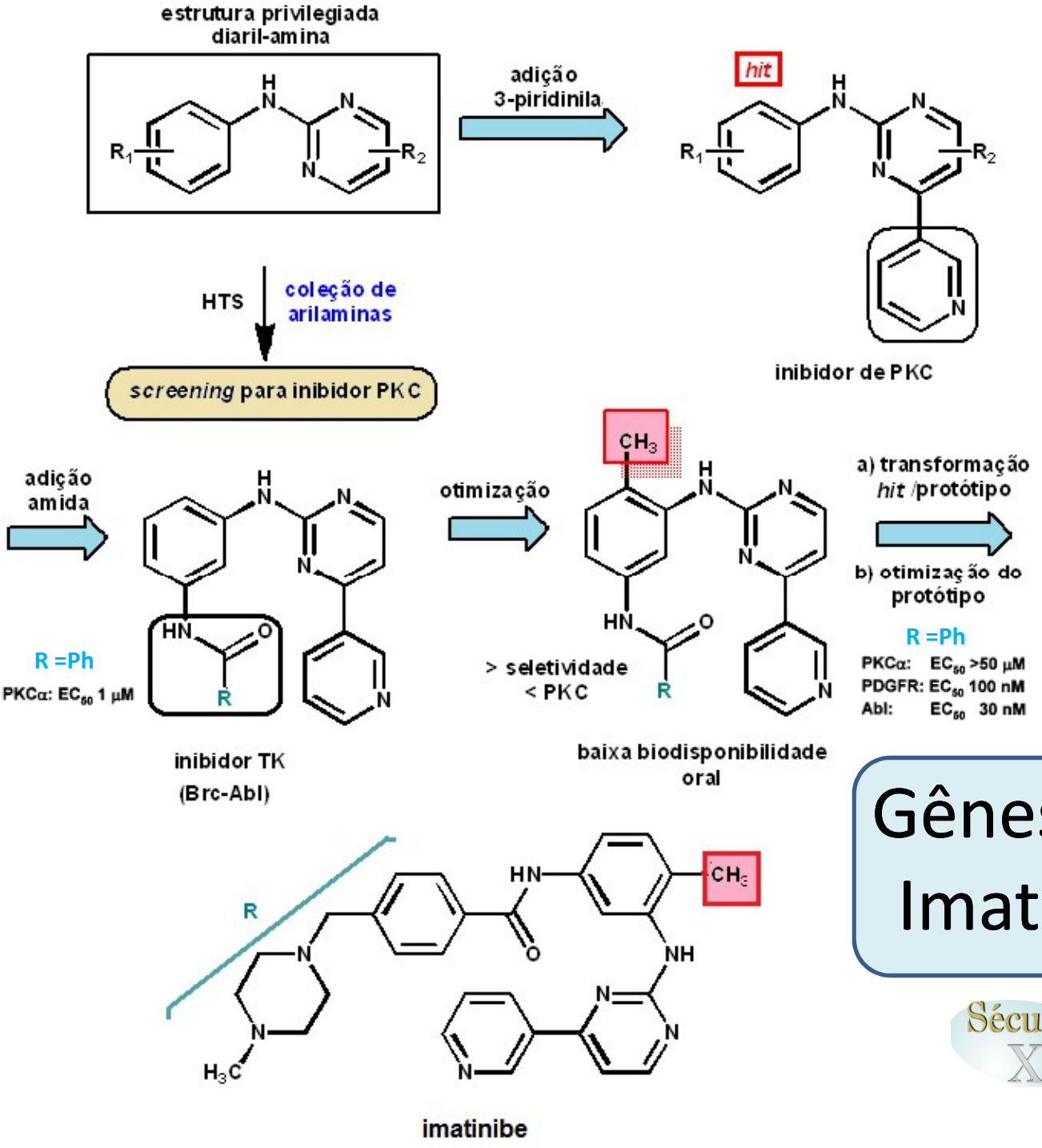


Conformational methyl effect



Steric hindrance leads to an arylamine bond rotation

E.J.Barreiro, A.E.Kümmerle, C.A.M.Fraga, The methylation effect in medicinal, Chemistry, *Chem. Rev*. **2011**, *111*, 5215



Gênese do Imatinibe

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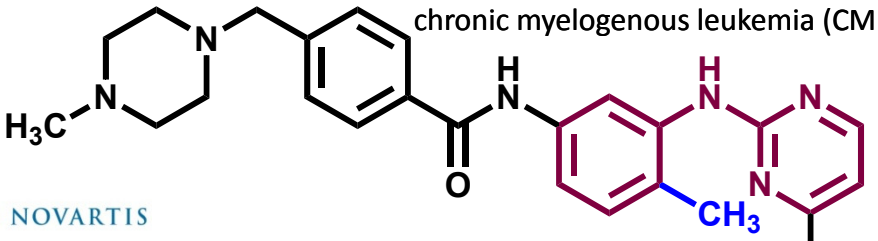
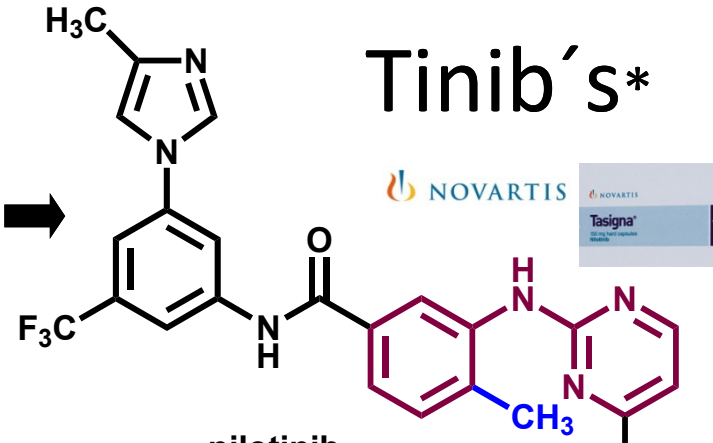
chronic myelogenous leukemia (CML) &



NOVARTIS

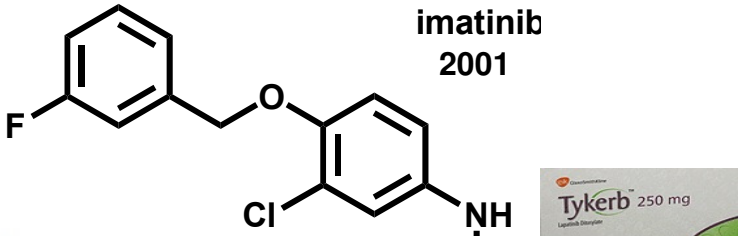
imatinib
2001

Tinib´s*

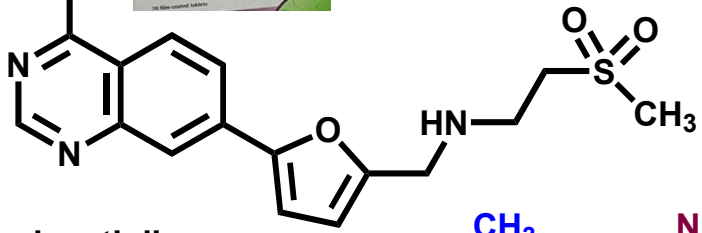


NOVARTIS

nilotinib
2006

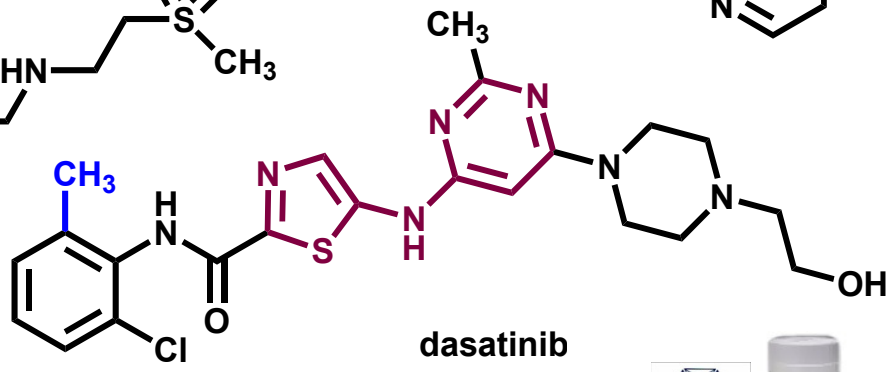


therapeutic innovation

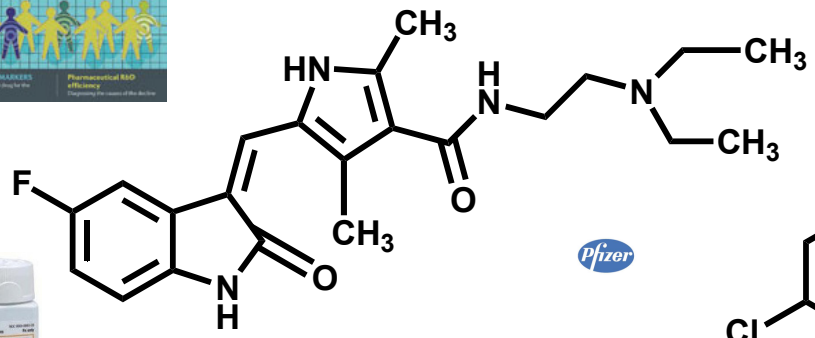


gsk

lapatinib
2007

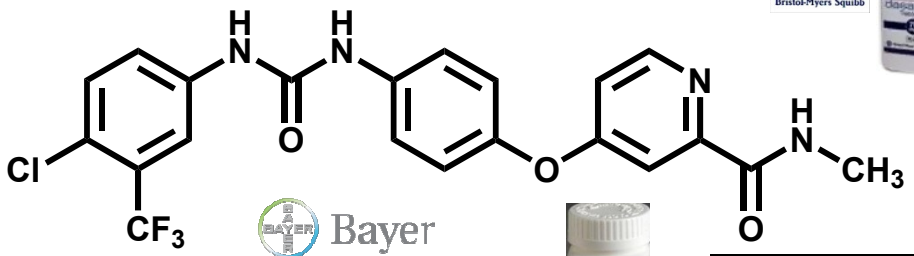


dasatinib
2007



Pfizer

sunitinib
2006



Bayer

sorafenib
2007

2011- crizotinib
2012- bosutinib

Pfizer

- **US market in 2009: US$ 18,5 bi ***
- **Imatinib world sales in 2009: US$ 4,0 bi***

- S Aggarwal, *Nature Rev Drug Discov* **2010**, *9*, 427

& R Ren, *Nature Rev Cancer* **2005**, *5*, 172

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Combination with other drugs (*e.g.* taxoids) is useful to CML imatinib-resistant cells (20 times more potent than imatinib)

therapeutic innovation

BCR-ABL1 imatinib resistence due Thr315 point (T315) mutation, promote conformation destabilization (triade Asp381, Phe382, Gly383)

imatinib

A381 P382 G383 T315

Chronic myelogenous leukemia X-rays

Gastrointestinal stromal tumors

medicinal chemistry

NOVARTIS

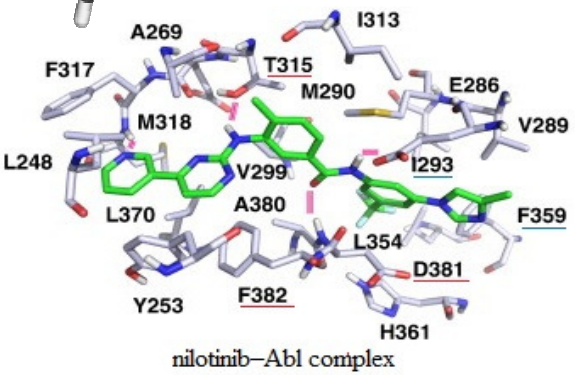
retro-amide

Tasigna (nilotinib) capsules 200 mg

nilotinib

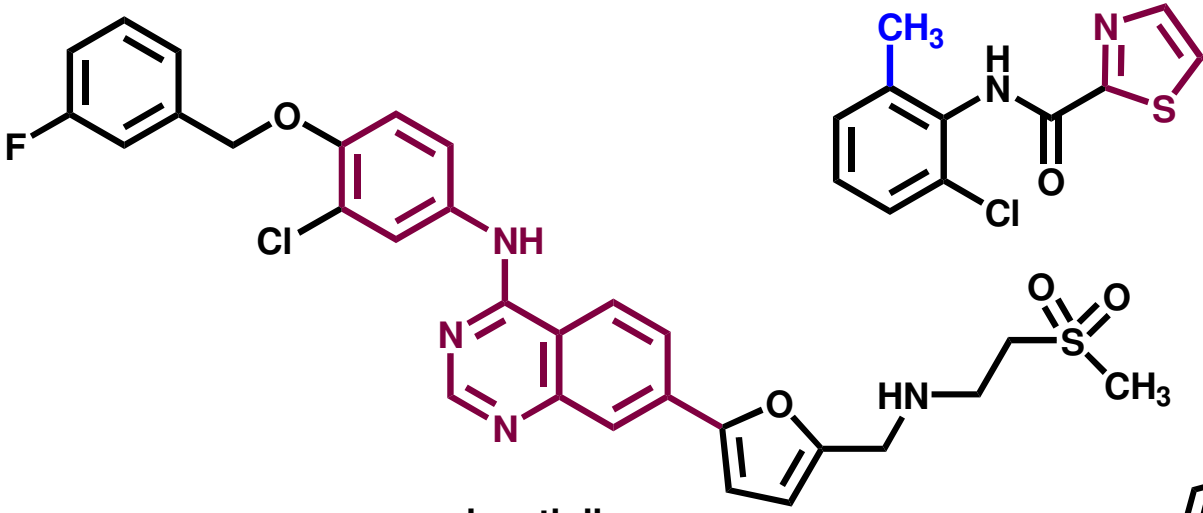
Chronic myelogenous leukemia

3-Py

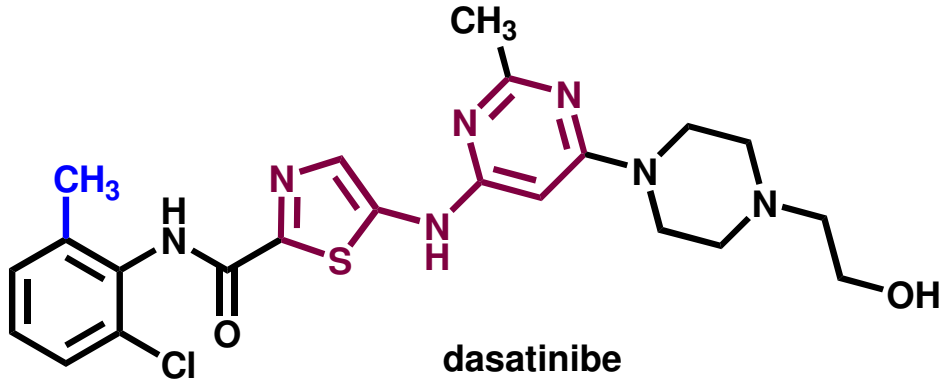


nilotinib–Abl complex

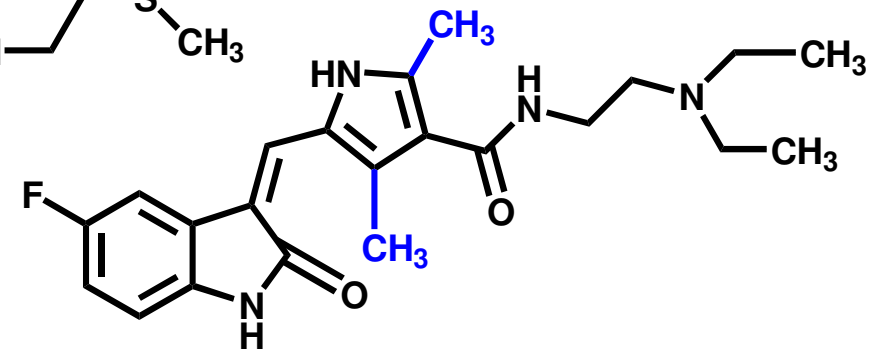
P.W. Manley, J. Zimmermann in *Case Studies in Modern Drug Discovery and Development*, X. Huang & R.G. Aslanian, Eds.,Wiley, **2012**, p.88-102



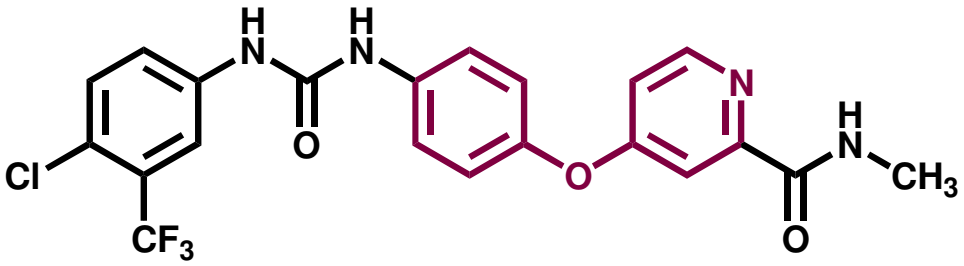
lapatinibe



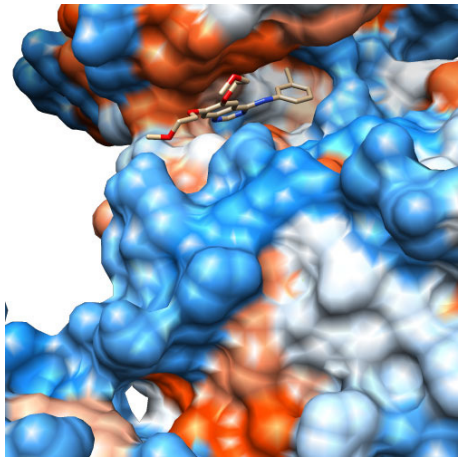
dasatinibe



sunitinibe



sorafenibe



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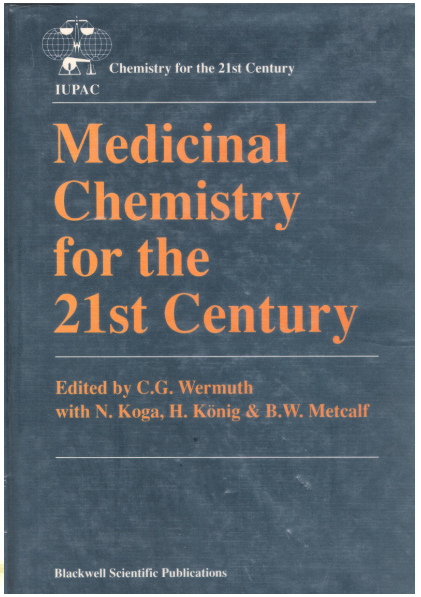
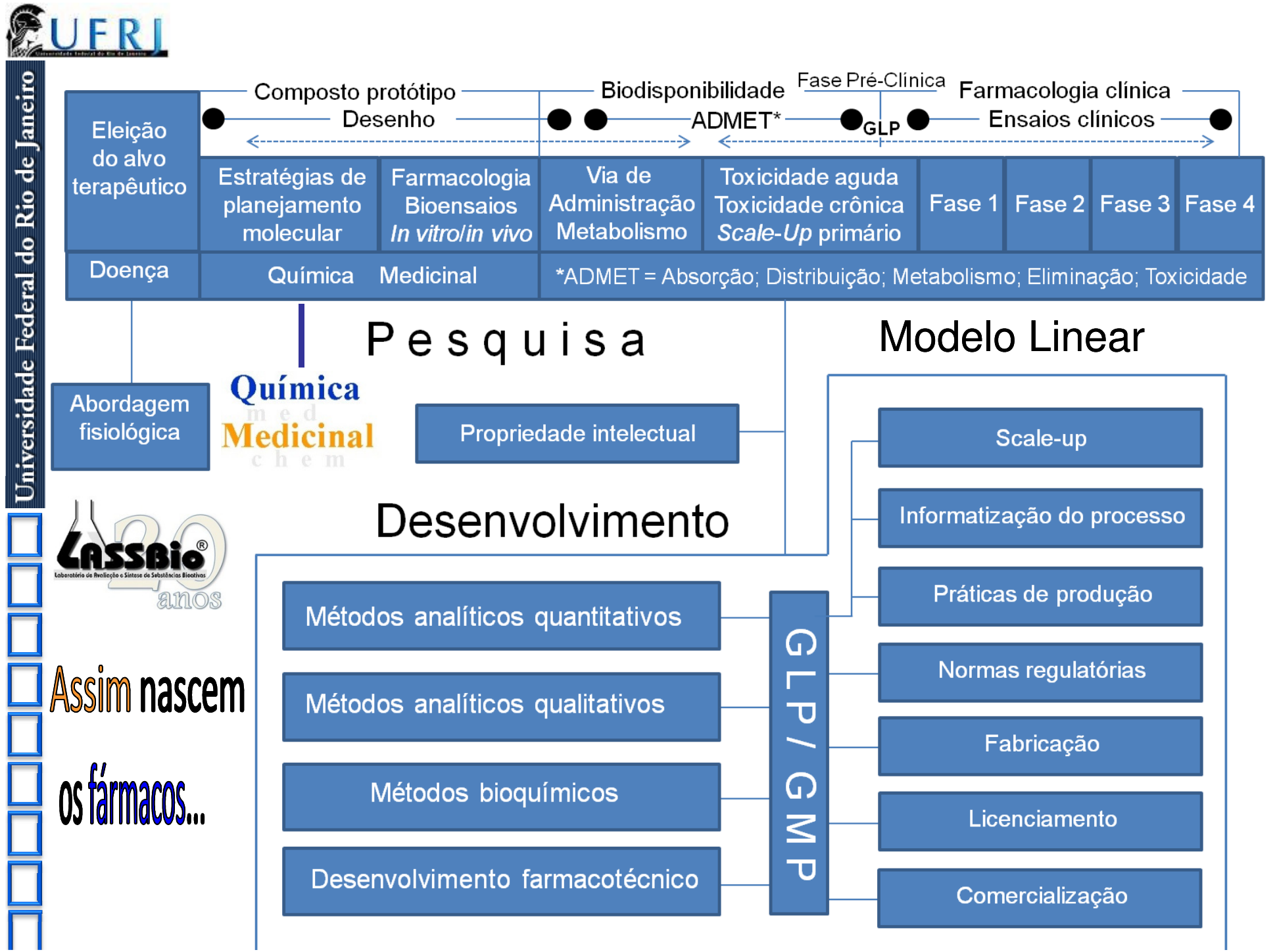
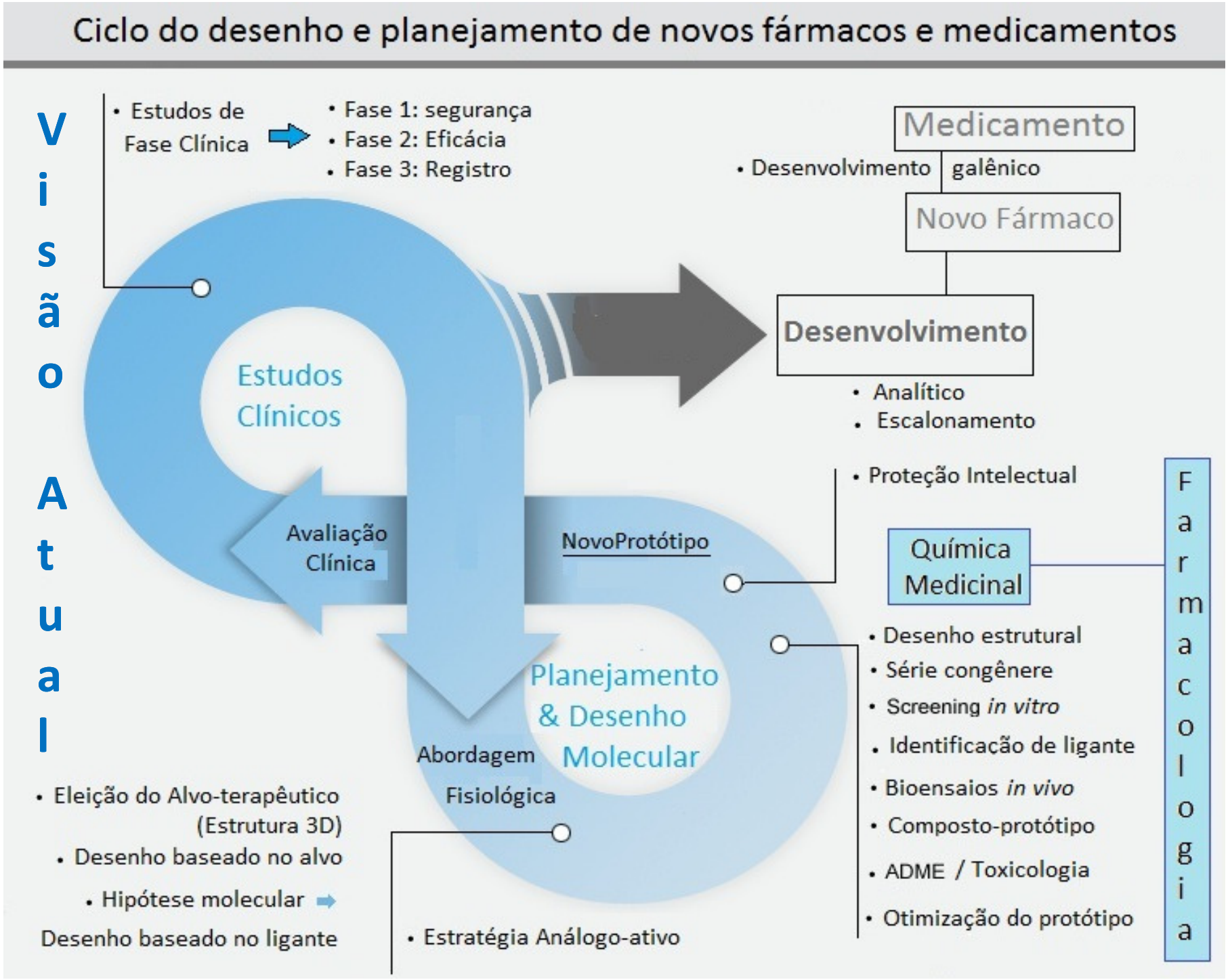
Fármacos do século 21



Drug hunters


UFRJ
Universidade Federal do Rio de Janeiro
Composto protótipo
Desenho
Biodisponibilidade
ADMET*
Fase Pré-Clínica
GLP
Farmacologia clínica
Ensaios clínicos
Eleição do alvo terapêutico
Estratégias de planejamento molecular
Farmacologia Bioensaios In vitro/in vivo
Via de Administração Metabolismo
Toxicidade aguda Toxicidade crônica Scale-Up primário
Fase 1
Fase 2
Fase 3
Fase 4
Doença
Química Medicinal
*ADMET = Absorção; Distribuição; Metabolismo; Eliminação; Toxicidade
Pesquisa
Modelo Linear
Abordagem fisiológica
Química
med
Medicinal
chem
Propriedade intelectual
Desenvolvimento
LASSBio®
Laboratório de Avaliação e Síntese de Substâncias Bioativas
20 anos
Métodos analíticos quantitativos
Métodos analíticos qualitativos
Métodos bioquímicos
Desenvolvimento farmacotécnico
GLP / GMP
Scale-up
Informatização do processo
Práticas de produção
Normas regulatórias
Fabricação
Licenciamento
Comercialização
Assim nascem os fármacos...

Ciclo do desenho e planejamento de novos fármacos e medicamentos



Current Drug Therapy, 2008, *3*, 000-000

New Insights for Multifactorial Disease Therapy: The Challenge of the Symbiotic Drugs

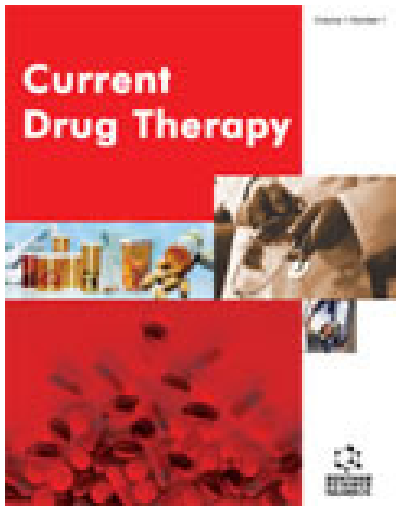
Eliezer J. Barreiro and Carlos Alberto Manssour Fraga

LASSBio
Laboratório de Avaliação e Síntese de Substâncias Bioativas

Laboratório de Avaliação e Síntese de Substâncias Bioativas (LASSBio), Faculdade de Farmácia, Universidade Federal do Rio de Janeiro, P.O. Box 68023, 21944-971, Rio de Janeiro, RJ, Brazil.

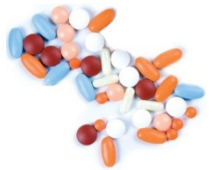
Abstract: Some physiopathological processes involved in the genesis of diseases could suggest the necessity of designing bioligands or prototypes that aggregate, in only one molecule, dual pharmacodynamical properties, becoming able to be recognized by two elected bioreceptors. This approach can have distinct aspects and, when a novel ligand or a prototype acts in two elected targets belonging to the same biochemical pathway, *e.g.* arachidonic acid cascade, it receives the denomination of dual or mix agent. On the other hand, if these two targets belong to distinct biochemical routes and both are related to the same disease, we can characterize the agents able to modulate it as symbiotic ligands or prototypes. In the present work, we provide some examples and applications of the molecular hybridization concept for the structural design of new symbiotic ligands and prototypes, especially those applied in the treatment of chronic-degenerative disorders.

Key Words: Symbiotic drugs; molecular hybridization; multifactorial diseases; therapeutic innovation; drug design; dual compounds.



Medicina personalizada

Simple drugs do not cure complex diseases



UFRJ Volume 41 , Number 1 ACCOUNTS OF CHEMICAL RESEARCH January , 2008

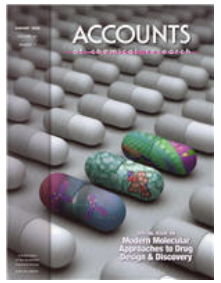
Universidade Federal do Rio de Janeiro

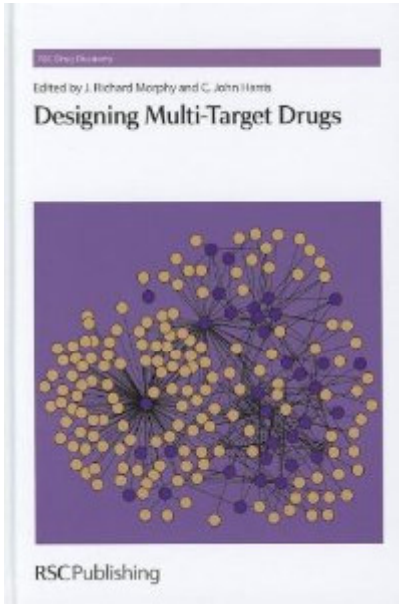
Hybrid Molecules with a Dual Mode of Action:Dream or Reality?

BERNARD MEUNIER

Palumed, rue Pierre et Marie Curie, BP 28262, 31262 Labège Cedex, France

RECEIVED ON APRIL 4, 2007





Curr Med Chem. 2011;18(32):4949-75.

Multi-target-directed ligands in Alzheimer's disease treatment.

Bajda M, Guzior N, Ignasik M, Malawska B.

Curr Med Chem. 2011;18(31):4722-37.

Designed multiple ligands for cancer therapy.

O'Boyle NM, Meegan MJ.

⇨ Designing Multi-Target Drugs

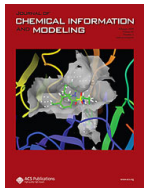
R. Morphy & C. J. Harris, Editors
Royal Society of Chemistry,
2012

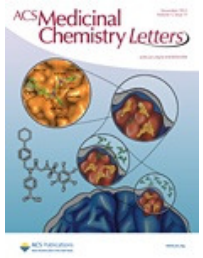
ACS Medicinal Chemistry Letters

ACS Med Chem Lett **2013**, 000

ACS Publications

pubs.acs.org/acsmedchemlett





Exploring the Chemical Space of Multitarget Ligands Using Aligned Self-Organizing Maps

Janosch Achenbach,[†] Franca-Maria Klingler,[†] René Blöcher,[†] Daniel Moser,[†] Ann-Kathrin Häfner,[†] Carmen B. Rödl,[†] Simon Kretschmer,[†] Björn Krüger,[‡] Frank Löhr,[§] Holger Stark,[†] Bettina Hofmann,[†] Dieter Steinhilber,[†] and Ewgenij Proschak*[,†]

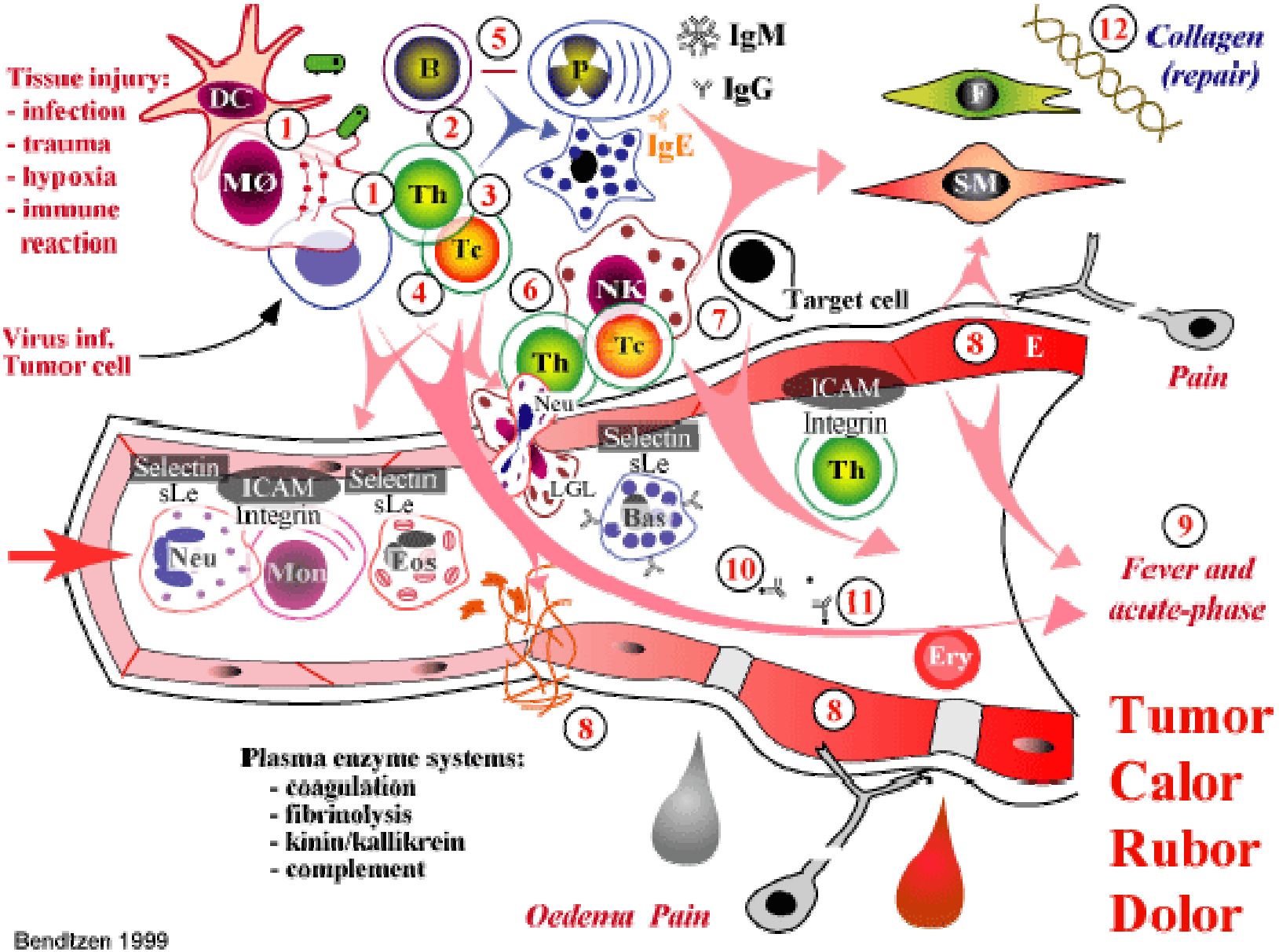
[†]Institute of Pharmaceutical Chemistry, ZAFES/OSF, Goethe University, Max-von-Laue-Strasse 9, D-60438 Frankfurt am Main, Germany

[‡]Chemical R&D—Drug Design, Merz Pharmaceuticals GmbH, Eckenheimer Landstrasse 100, D-60318 Frankfurt, Germany

[§]Institute of Biophysical Chemistry, Goethe University, Max-von-Laue Strasse 9, D-60438 Frankfurt am Main, Germany

JL Medina-Franco et al., Shifting from the single to the multitarget paradigm in drug discovery, *Drug Discov. Today* **2013**, *18*, 495; JL Medina-Franco et al., Multitarget structure-activity relationships characterized by activity-difference maps and consensus similarity measure, *J Chem Inf Model* **2011**, *51*, 2427.

Inflamação: Doença crônica não transmissível



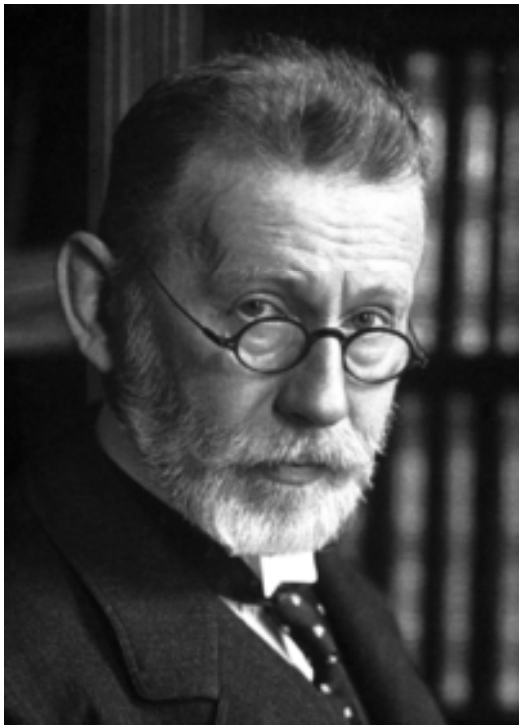
Ehrlich-Fischer Paradigm

Emil Fischer

The Nobel Prize in Chemistry 1902

medicinal chemistry

The Nobel Prize in Physiology or Medicine 1908



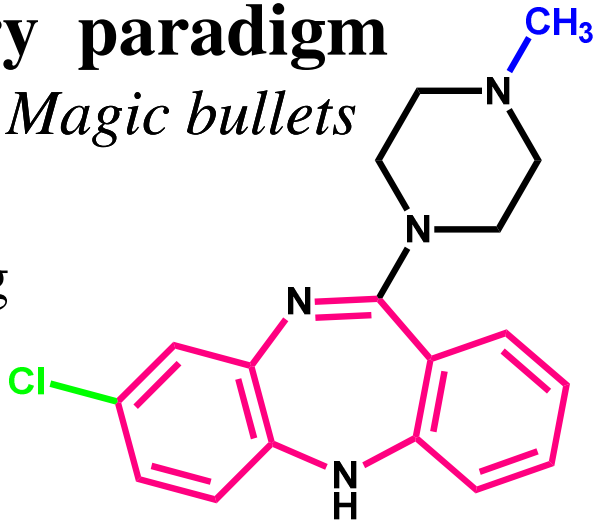
Paul Ehrlich

- **One-target-one-ligand: the 20th century paradigm**

  One-ligand / one-disease – *Lock & Key & Magic bullets*

  e.g. propranolol, cimetidine, captopril

  Clozapine, an "atypical" neuroleptic drug has affinity for the D_4 central receptor & D_2, D_3, 5-HT_{2A}, 5-HT_3, α1 and 2 - is an exception considered as "*promiscous*" drug



clozapine

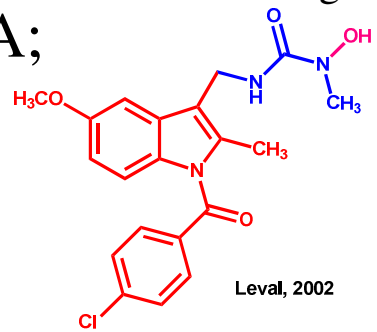
- **Ligands for multi-target: the 21th century paradigm**

  Dual, binary, dimeric, bivalent, mixed, multi ligands

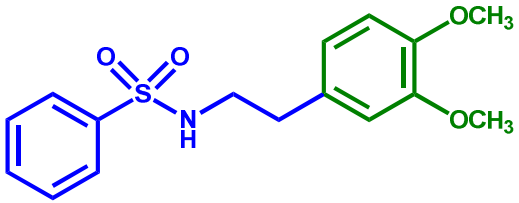
  5-LOX/COX-2 ; TXS/TP_{ant}; COX-1/LTA_4 hydrolase

  5-$HT_{1A}R_{ant}$/SSRI; TP_{ant}/IP_{ag}; SSRI/PDE-4; M3/PDE-4

  TNFα/PDE-4A;

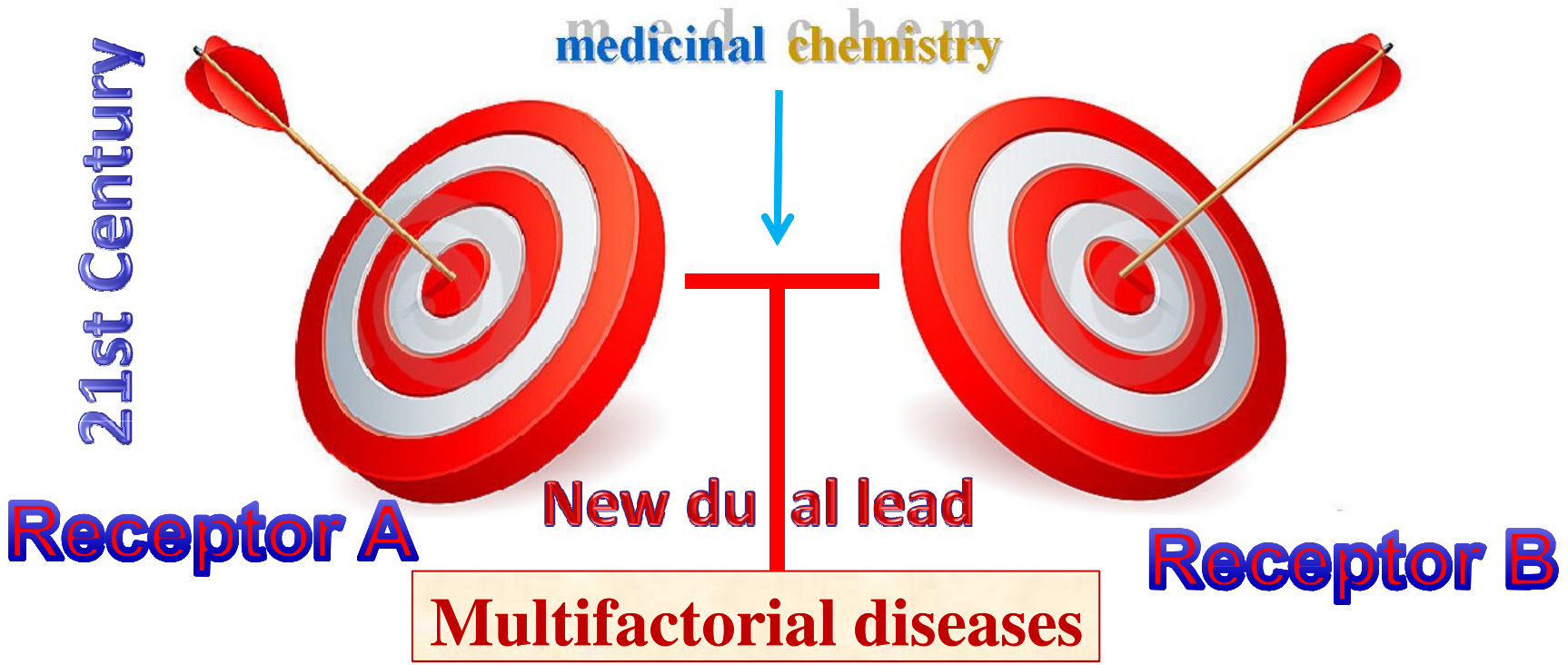


Leval, 2002



Zapata-Sudo, 2012

The multi-target drug design



The rational multi-target drug design is related to find a new lead-compound with a dual recognition pattern by two receptors which are involved with a multi-factorial disease pathology. A multiple-target lead can be rationale design by combining *pharmacophoric molecular fragments* for each target (A + B), applying drug design strategies of medicinal chemistry.

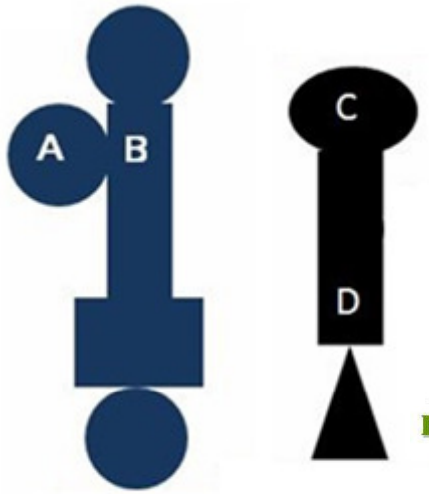
JL Medina-Franco et al. Shifting from the single to the multitarget paradigm in drug discovery, *Drug Discov. Today* **2013**, *18,* 495; C Hiller, J Kühhorn, P Gmeiner, Class A G-Protein-Coupled Receptor (GPCR) Dimers and Bivalent Ligands, *J. Med. Chem.* **2013**, *56*, 6542; G Phillips, M Salmon, Bifunctional compounds for the treatment of COPD, *Annu. Rev. Med. Chem*. **2012**, *47*, 209; S Reardon, A world of chronic disease, *Science* **2011**, *333*, 558.

Bases racionais para desenho de ligantes múltiplos

Universidade Federal do Rio de Janeiro

Subunidades farmacofóricas

A B C D



Intuição química

Combinação de farmacóforos

Hibridação molecular

(D L A C)

medicinal chemistry

Séries congêneres

Novos padrões moleculares híbridos

Padrão de reconhecimento molecular

Biorreceptor –A **Biorreceptor-B**

Século 21

***Chave mestra* para Múltiplas fechaduras**

Current Medicinal Chemistry, 2007, *14*, 103-112

Molecular Hybridization: A Useful Tool in the Design of New Drug Prototypes

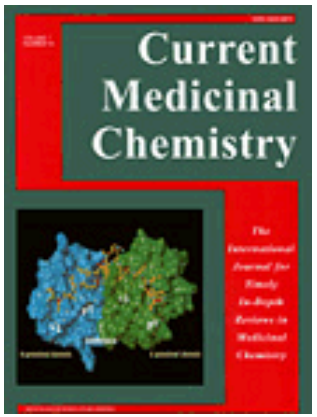
Cláudio Viegas-Junior[1], Amanda Danuello[1], Vanderlan da Silva Bolzani[1], Eliezer J. Barreiro[2] and Carlos Alberto Manssour Fraga*[,2]

[1]*Instituto de Química, Universidade Estadual Paulista "Júlio de Mesquita Filho", P.O. Box 355, 14801-970 Araraquara, São Paulo, SP, Brazil*

[2]*Laboratório de Avaliação e Síntese de Substâncias Bioativas (LASSBio), Faculdade de Farmácia, Universidade Federal do Rio de Janeiro, P.O. Box 68023, 21944-971, Rio de Janeiro, RJ, Brazil*

Abstract: Molecular hybridization is a new concept in drug design and development based on the combination of pharmacophoric moieties of different bioactive substances to produce a new hybrid compound with improved affinity and efficacy, when compared to the parent drugs. Additionally, this strategy can result in compounds presenting modified selectivity profile, different and/or dual modes of action and reduced undesired side effects. So, in this paper, we described several examples of different strategies for drug design, discovery and pharmacomodulation focused on new innovative hybrid compounds presenting analgesic, anti-inflammatory, platelet anti-aggregating, anti-infectious, anticancer, cardio- and neuroactive properties.

Keywords: Molecular hybridization, Drug design, Hybrid compounds, Pharmacophoric group combination.



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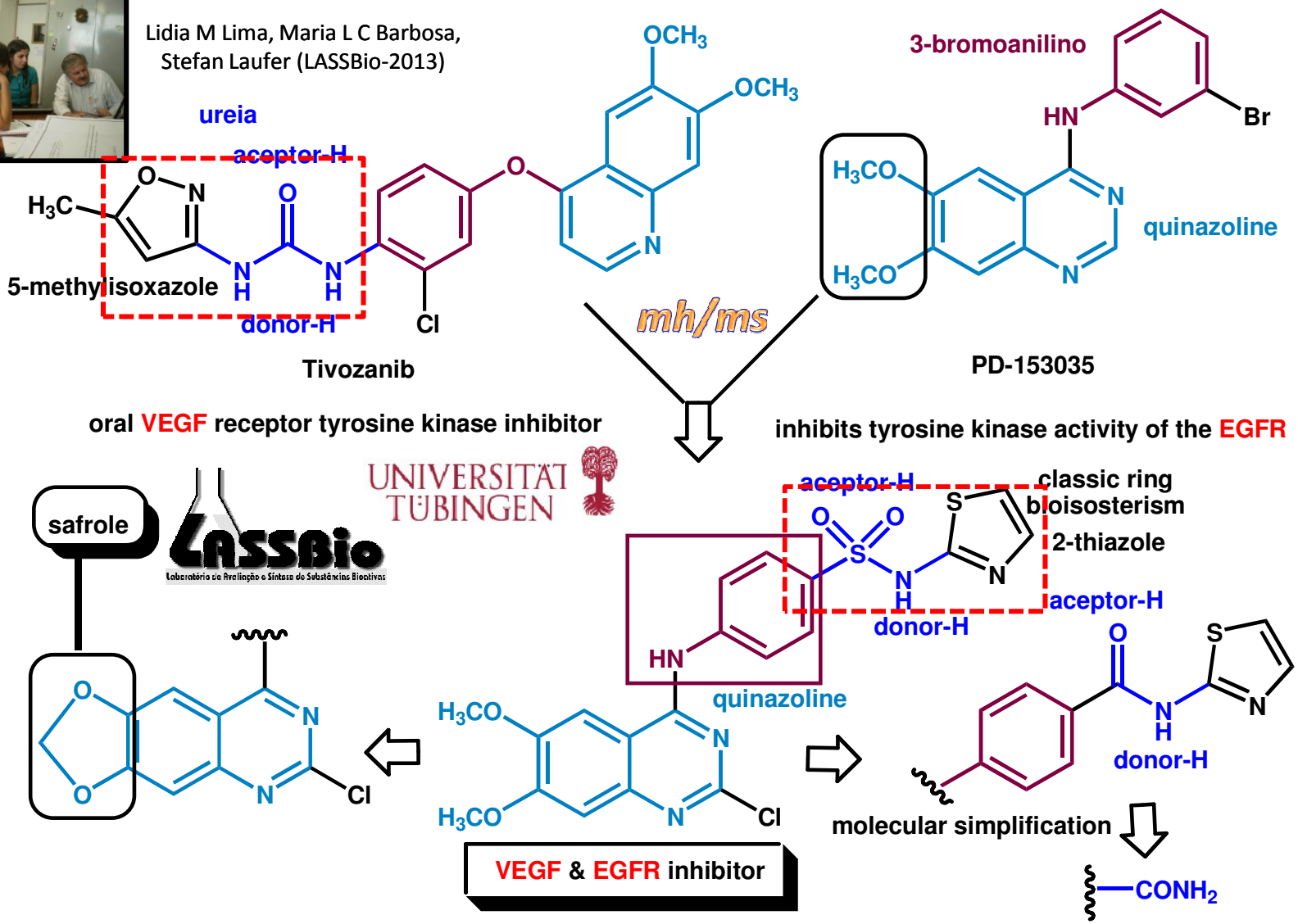
Novos tinibes duais

Lidia M Lima, Maria L C Barbosa, Stefan Laufer (LASSBio-2013)



M L C Barbosa, L M Lima, R Tesch, C M R Sant'Anna, F Totzke, M HG Kubbutat, C Schächtele, S A Laufer, E J Barreiro, Novel 2-chloro-4-anilino-quinazoline derivatives as EGFR and VEGFR-2 dual inhibitors, *Eur J Med Chem* **2014**, *71*, 1-14.

Universidade Federal do Rio de Janeiro

Novel 2-chloro-4-anilino-quinazoline derivatives as EGFR and VEGFR-2 dual inhibitors

Maria Letícia de Castro Barbosa [a,b], Lídia Moreira Lima [a,b], Roberta Tesch [a], Carlos Mauricio R. Sant'Anna [c], Frank Totzke [d], Michael H.G. Kubbutat [d], Christoph Schächtele [d], Stefan A. Laufer [e], Eliezer J. Barreiro [a,b,*]

[a] Laboratory of Evaluation and Synthesis of Bioactive Substances (LASSBio), Federal University of Rio de Janeiro, P.O. Box 68024, 21944-971 Rio de Janeiro, RJ, Brazil
[b] Graduate Program of Chemistry (PGQu), Chemistry Institute, Federal University of Rio de Janeiro, Rio de Janeiro, RJ, Brazil
[c] Department of Chemistry, Federal Rural University of Rio de Janeiro (UFRRJ), Seropédica, RJ, Brazil
[d] ProQinase GmbH, Freiburg, Germany
[e] Department of Pharmaceutical/Medicinal Chemistry, Institute of Pharmacy, Eberhard-Karls-University Tübingen, Tübingen, Germany

European Journal of Medicinal Chemistry 71 (2014) 1–14

LASSBio – Laboratório de Avaliação e Síntese de Substâncias Bioativas

UNIVERSITÄT TÜBINGEN

Novel molecular pattern with EGFR/VEGFR dual activity!

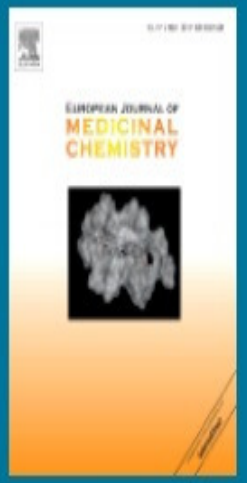
LASSBio-1630

dual

IC_{50} (EGFR) = 0.90 μM

IC_{50} (VEGFR) = 1.17 μM

MLC Barbosa, Tese de Doutorado, Instituto de Química, UFRJ, 2013.



Sample Issue

European Journal of Medicinal Chemistry

Published under the auspices of the French Société de Chimie Thérapeutique (SCT)

Entirely in English & accepting submissions from any country

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Original article Volume 71, 7 January 2014, Pages 1–14

Novel 2-chloro-4-anilino-quinazoline derivatives as EGFR and VEGFR-2 dual inhibitors

Maria Letícia de Castro Barbosa[a, b], Lídia Moreira Lima[a, b], Roberta Tesch[a], Carlos Mauricio R. Sant'Anna[c], Frank Totzke[d], Michael H.G. Kubbutat[d], Christoph Schächtele[d], Stefan A. Laufer[e], Eliezer J. Barreiro[a, b,]

"...discovery *consists* of seeing what everybody else has seen *and* thinking what nobody else has not thought..."

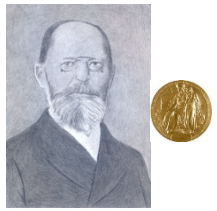
1937

Albert Szent-Györgiy (1893-1986)

Universidade Federal do Rio de Janeiro

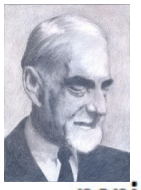
Linha do tempo...

Química Medicinal



Galeno

Fischer



Salvarsan^{R}

Fourneau

penicilina

Fleming

Bovet

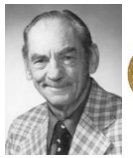
indometacina

cimetidina

lovastatina

aciclovir

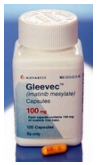
Elion



Hitchings

Black

imatinibe



estatina

indinavir

150 | 1902 | 1907 | 1911 | 1941 | 1945 | 1957 | 1962 | 1975 | 1980 | 1981 | 1987 | 1988 | 1996 | 2001

500aC | 1889 | 1908 | 1935 | 1943 | 1948 | 1959 | 1964 | 1982 | 1985 | 1991 | 2013

Hipocrates

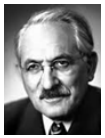
Paracelso

AAS

Ehrlich

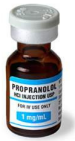
Domagk

estreptomicina



Ahlquist

Kornberg



propranolol

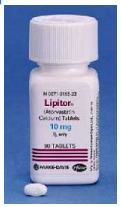
Hodgkin

Vane

Goldstein

Brown

atorvastatina



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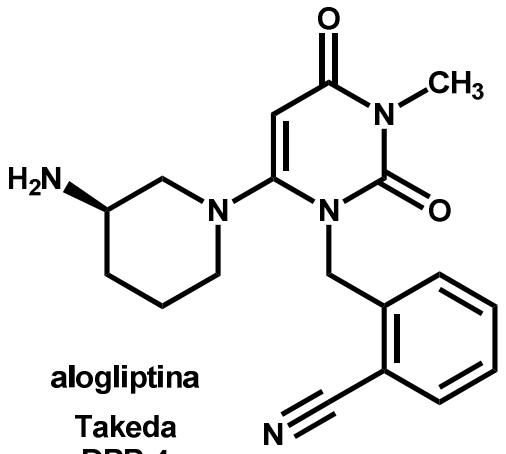
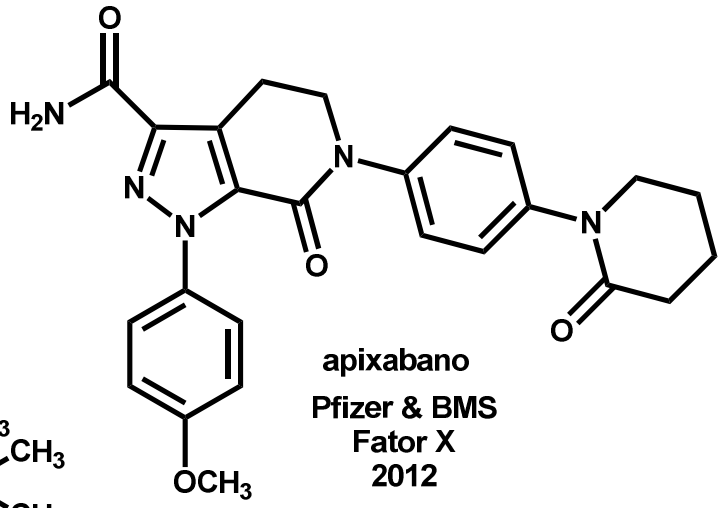
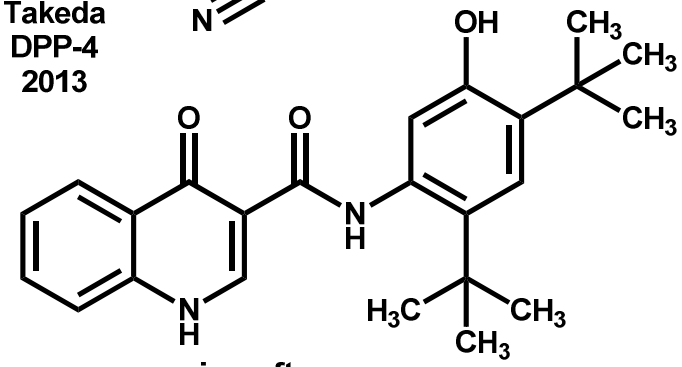
Inovações terapêuticas de 2012 e 2013



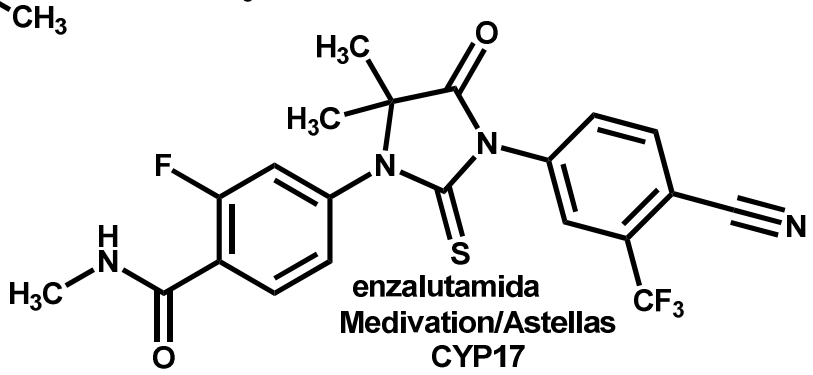
alogliptina
Takeda
DPP-4
2013



apixabano
Pfizer & BMS
Fator X
2012



ivacaftor
Vertex
CFTR
2012



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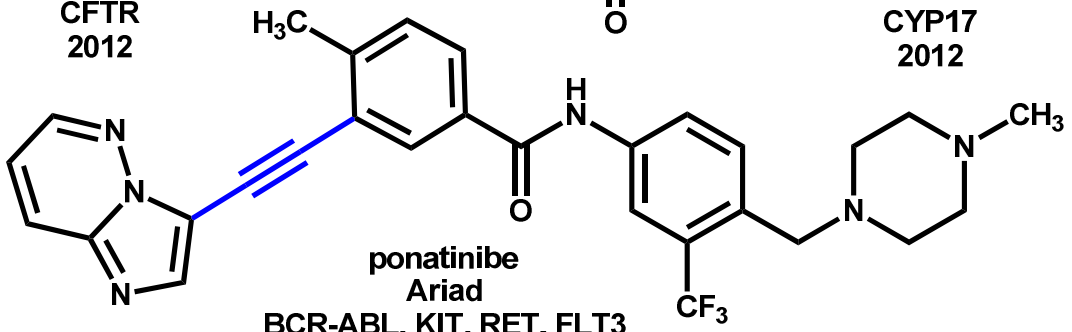
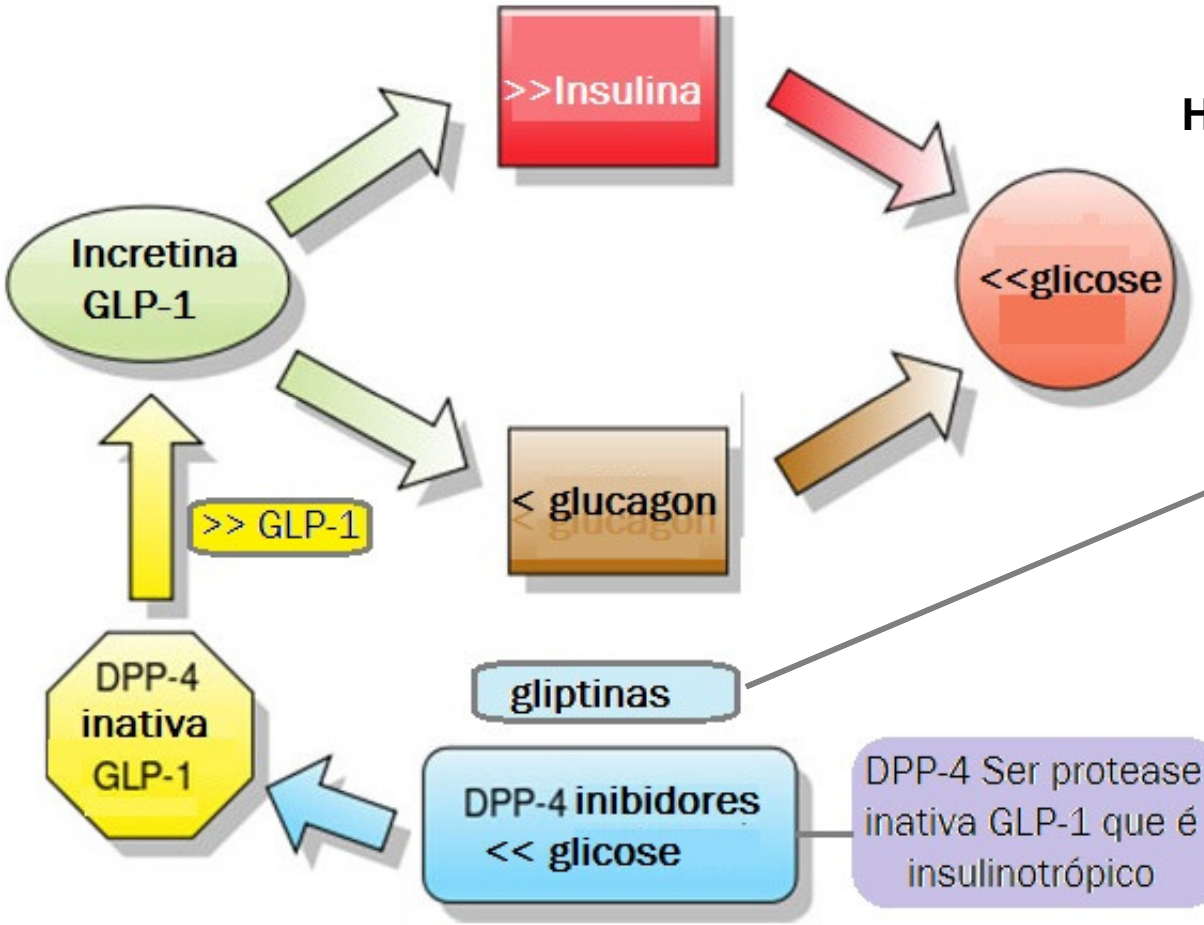
Medivation/Astellas
CYP17
2012



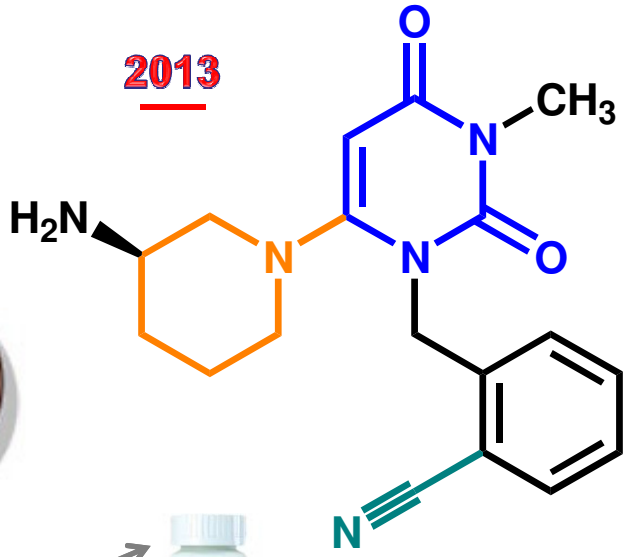
ponatinibe
Ariad
BCR-ABL, KIT, RET, FLT3
2013

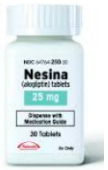
http://ejb-eliezer.blogspot.com

Inovações terapêuticas recentes



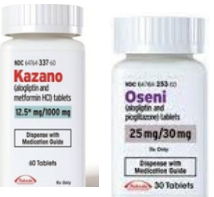
2013





alogliptina

Takeda



syrrx

San Diego high-throughput crystallography-based drug discovery company*

* M Ratner, Syrrx acquisition signals maturation of structure-based discovery, *Nature Biotechnology* **2005**, *23*, 400

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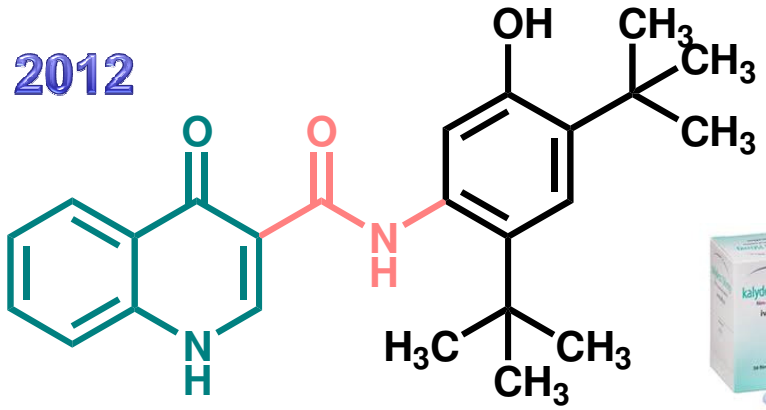
2012

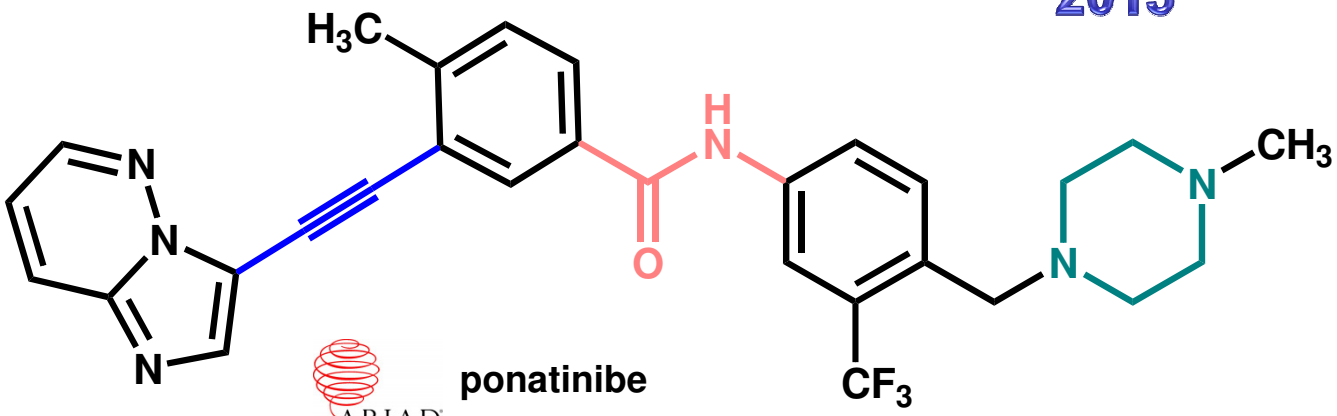


fibrose cística

US$ 311.000/ano

VERTEX **ivacaftor**

2013



ARIAD **ponatinibe**

Bcr-Abl TKi

MCL

computational and structure-based drug design platform & optimization

2006 (Lead) → 2008 (clin.) → 2012 (1º apr) → 2013 (FDA)

US$ 118.000/ano
US$ 45 mi (2013)

Indicação: leucemias raras

http://ejb-eliezer.blogspot.com

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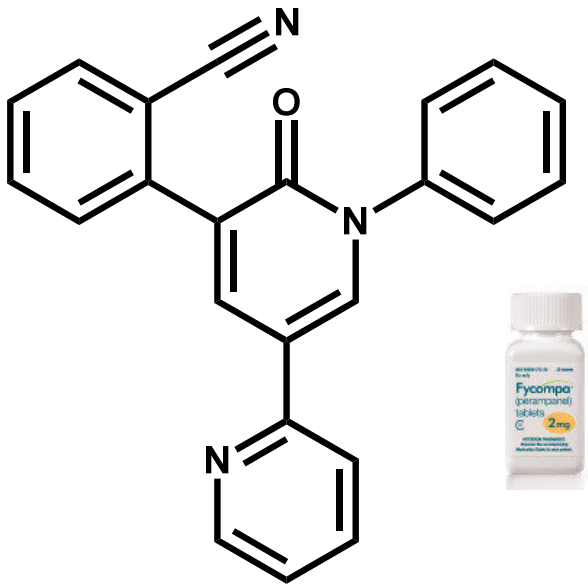
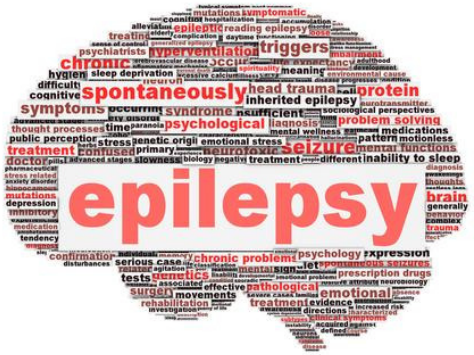
2014

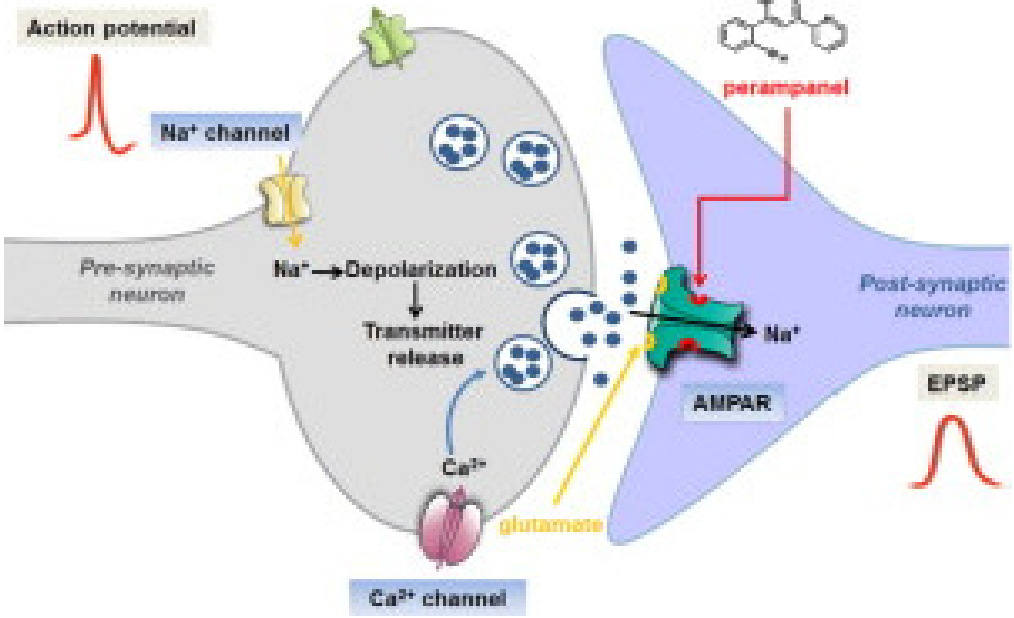


Eisai

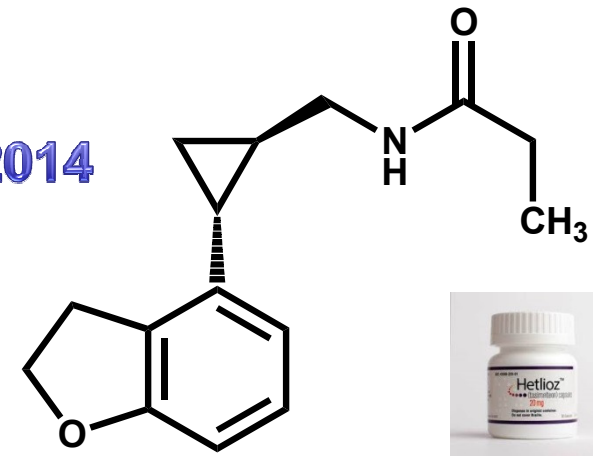
perampanel



1912 – fenobarbital
(E Fischer)

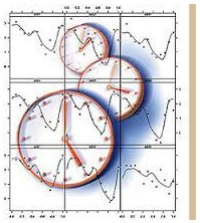


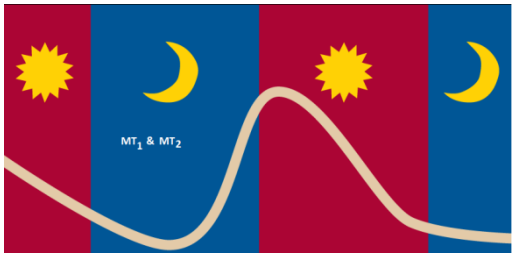
2014



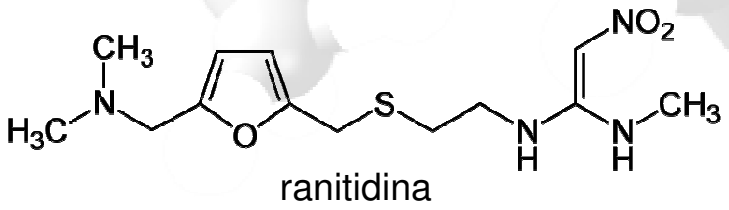
tasimelteon

VANDA PHARMACEUTICALS INC.





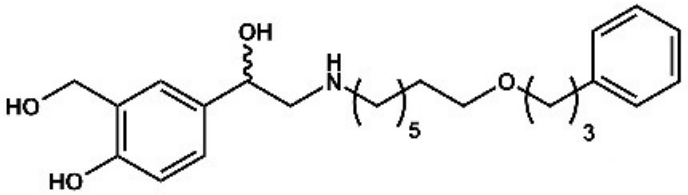
"... when it comes to drug discovery you're not trying to make complicated molecules, but make molecules that will be effective ... "



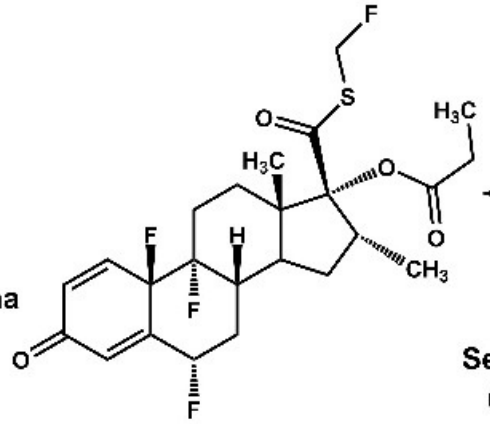
ranitidina

Barry J. Price

Research Director Glaxo (1967-1995)



salmeterol



fluticasona

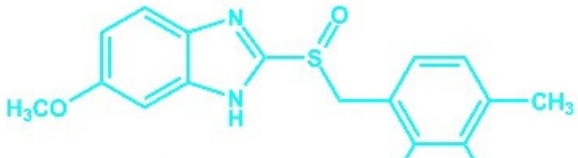
Seretide®
(GSK)

etanercepte
(Enbrel®, Angem/Pfizer)
(biofarmaco)

em US$ bilhões

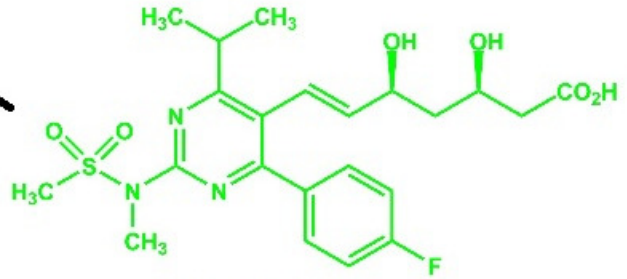
1 | 2,0 | 7,1-7,4 | 7,6 | 7,7 | 8,2 | 9,1 | 41,2

infliximabe
(Remicade®, Janssen)
aripiprazola (BMS)
insulina (Sanofi)



esomeprazol
(AZ)

adalimumabe
(Humira®, Abbott)
(biofarmaco)



rosuvastatina
(AZ)

Depoimento de Márcia Angeli

Epílogo


UFRJ
Universidade Federal do Rio de Janeiro
A Química
Medicinal
é simplesmente
fascinante!

UFRJ

Universidade Federal do Rio de Janeiro

Química Medicinal

med chem

=

||

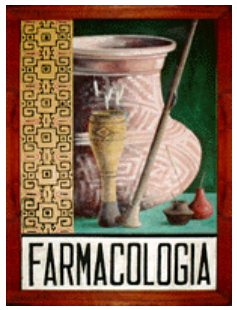
Q + B

QUÍMICA

(orgânica)

+

farmacologia



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Universidade Federal do Rio de Janeiro

Programa de Pós-Graduação em Farmacologia & Química medicinal

Programa de Pós Graduação em Farmacologia e Química Medicinal

29 de abril de 2008

O Instituto de Ciências Biomédicas (ICB) da Universidade Federal do Rio de Janeiro mantém o Programa de Pós-Graduação na modalidade *stricto sensu* que permite obter graus de Mestre e Doutor em Ciências (Farmacologia e Química Medicinal). Os cursos de Mestrado e Doutorado são reconhecidos pela CAPES com conceito 4 e credenciados pelo Conselho Federal de Educação, tendo participações significativas na formação de recursos humanos. O Mestrado e o Doutorado recebem alunos novos regularmente duas vezes ao ano, através de seleções realizadas em fevereiro/março ou julho/agosto.

"Medicinal chemistry or pharmaceutical chemistry is a discipline at the intersection of chemistry and pharmacology involved with designing, synthesizing and developing drugs."

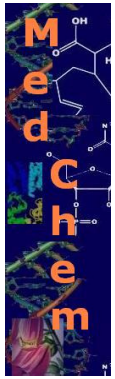
CAPES

Conceito 5

Farmacologia Química Medicinal

Interface Química-Biologia em Química Medicinal

Interdisciplinaridade



Único programa de pós-graduação (M/D) com este perfil na América Latina


ELIEZER J.
BARREIRO
CARLOS ALBERTO MANSSOUR
FRAGA
QUÍMICA
MEDICINAL
AS BASES MOLECULARES DA AÇÃO DOS FÁRMACOS
3ª
EDIÇÃO
Em
2014 !
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www.farmacia.ufrj.br/lassbio

LASSBio

Laboratório de Avaliação e Síntese de Substâncias Bioativas

20 Anos

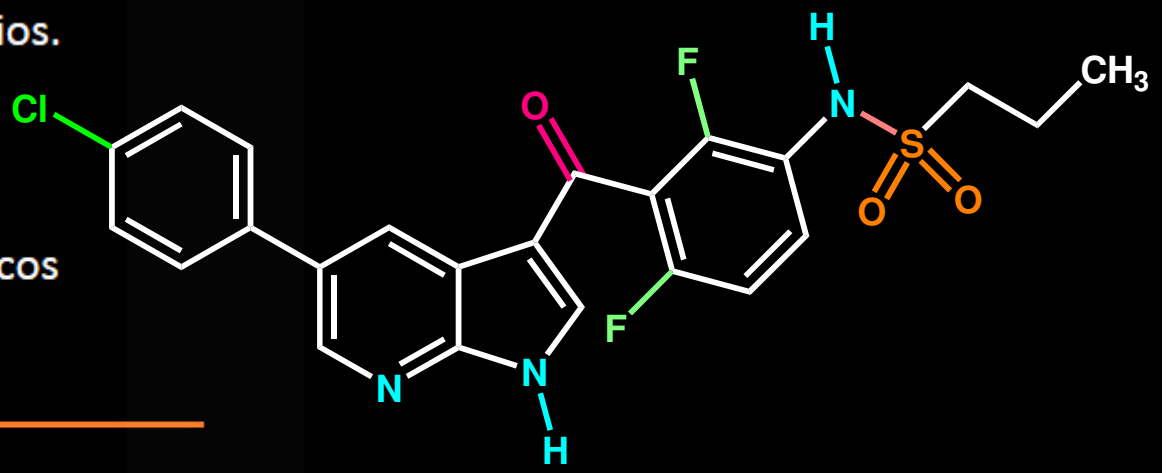
Blog com histórias & fofocas sobre fármacos

De fármacos e suas descobertas

Pretende-se tratar de temas, opiniões, comentários sobre a Ciência dos Fármacos, seu uso seguro e benefícios. História da descoberta/invenção de fármacos e aspectos da formação qualificada de universitários e pós-graduandos nas Ciências dos Fármacos também são de interesse.

sexta-feira, 27 de dezembro de 2013

A descoberta do vemurafenibe, primeiro fármaco para o tratamento do melanoma metastático



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"...Para achar água é preciso

descer terra adentro,

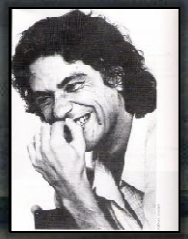
Encharcar-se no lodo.

Mas há os que preferem

olhar os céus,

E esperar pelas chuvas..."

Oduvaldo Vianna Filho



(em "Cúmplice da Paixão", Dênis de Moraes
Ed. Nórdica, RJ, 1991).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Obrigado
pela atenção!
ejbarreiro@ccsdecania.ufrj.br