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# Luo-Rudy Mammalian Ventricular Model II (dynamic), 1994

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## CellML 1.1

In 1994, Luo and Rudy published a pair of papers which described a ventricular myocyte model. This model was a development of their previous model, published in 1991 (see Luo-Rudy I ventricular myocyte model, 1991 [../repository/LR\_I\_model\_1991\_doc.html], and Figure 1 for more details.) In particular, the LR-II model incorporates a more thorough description of the processes which regulate intracellular calcium ion concentration and the movement of calcium ions through the cell and to and from the sarcoplasmic reticulum (see Figure 2 below).

This example is naturally illustrated by use of the *import* and *reuse* features of CellML 1.1. Components and units are imported from the Luo-Rudy I model into the Luo-Rudy II model. New components such as an L-type calcium current  $I_{CaL}$  and calcium buffers in the myoplasm are added, and connected up to the relevant imported components.

## Model Structure

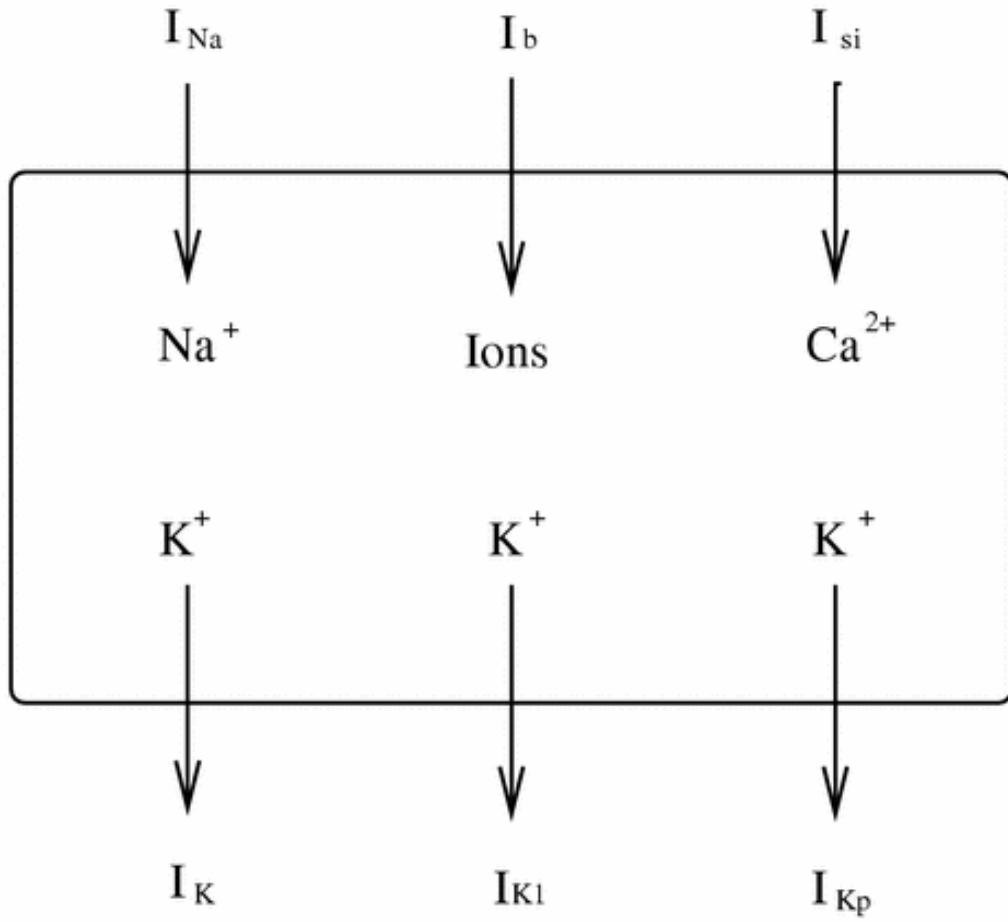
Their mathematical model of the cardiac ventricular action potential is based upon experimental data from guinea pig ventricular cells, however it provides a framework for modelling other types of ventricular cells with appropriate modifications to account for interspecific heterogeneity.

The complete original paper reference is cited below:

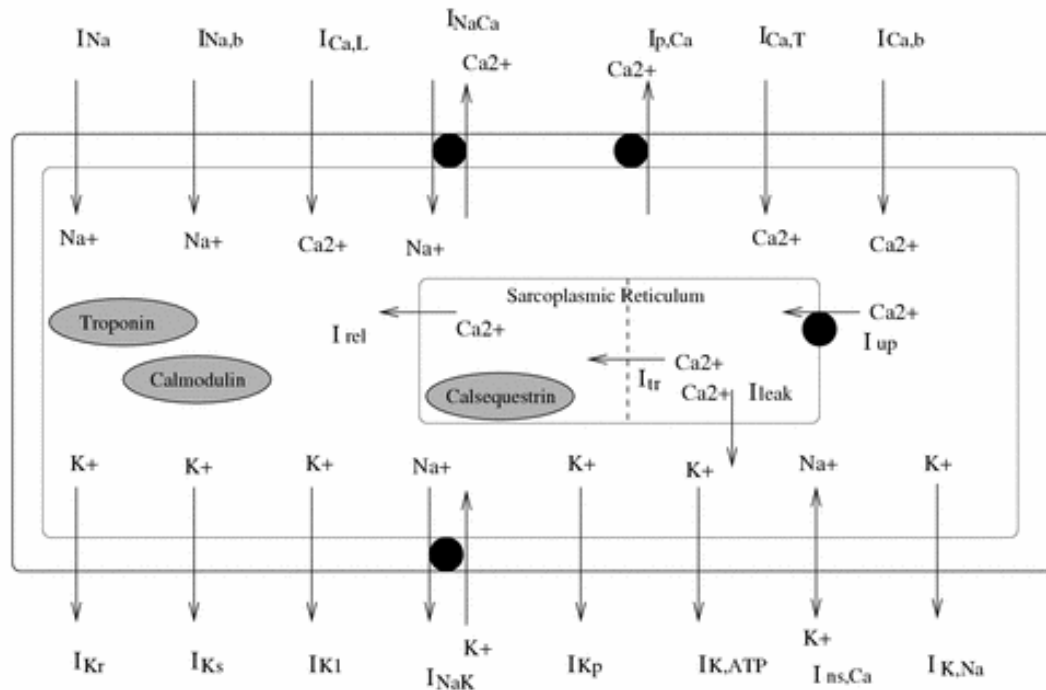
A Dynamic Model of the Cardiac Ventricular Action Potential - Simulations of Ionic Currents and Concentration Changes [<http://circres.ahajournals.org/cgi/content/abstract/74/6/1071>], Ching-hsing Luo and Yoram Rudy, 1994, *Circulation Research* [<http://circres.ahajournals.org/>], 74, 1071-1097.

The Luo-Rudy II ventricular model has become a classical study. Several more recent ventricular and atrial cell models have been published using the Luo-Rudy dynamic model as their foundation and building upon those equations. Since the model was published in 1994, it has been updated several times, incorporating new experimental data taken from papers written by other authors. These modifications have been taken into consideration in another CellML model (see the Updated Luo-Rudy Mammalian Ventricular Model II [../repository/updated\_LR\_II\_model\_doc.html]).

The raw CellML description of the CellML 1.1 version of the Luo-Rudy II model can be downloaded in various formats as described in the section "Download This Model".



**Figure 1.** A schematic diagram describing the current flows across the cell membrane that are captured in the LR-I model.



**Figure 2.** A schematic diagram describing the ionic currents, pumps and exchangers that are captured in the LR-II model. The intracellular compartment is the sarcoplasmic reticulum (SR), which is divided into the two subcompartments, the network SR (NSR) and the junctional SR (JSR). Ca<sup>2+</sup> buffers are present in both the cytoplasm and the JSR.

## Download This Model

- [LR\\_II\\_model\\_1\\_1\\_1994.xml](#) [../models/import/LR\_II\_model\_1994\_reuse.xml] — the raw XML.
- [LR\\_II\\_model\\_1\\_1\\_1994.html](#) [../models/import/LR\_II\_model\_1994\_reuse.html] — an HTML version for browsing online.
- [LR\\_II\\_model\\_1\\_1\\_1994.pdf](#) [../models/import/LR\_II\_model\_1994\_reuse.pdf] — a PDF version suitable for printing.
- [cellml\\_LR\\_II\\_model\\_1\\_1\\_1994.tar.gz](#) [../downloads/cellml\_LR\_II\_import\_ex\_1994.tar.gz] — a gzipped tarball with the XML and this documentation.