



Editorial: Biomedical Engineering Approaches for HIV/AIDS Prophylaxis, Diagnostics and Therapy☆



HIV/AIDS remains one of the most significant public health concerns worldwide. Official numbers of 2014 from the Joint United Nations Programme on HIV and AIDS (UNAIDS) show that nearly 37 million people were living with the virus, and around 2 million new infections occurred that year [1]. The early years of the pandemic were characterized by a staggering rise in global numbers, and the total HIV-positive population has not stopped growing ever since (Fig. 1). However, a slow but decreasing trend is now clear for the yearly number of new cases since the mid-1990s, as well as for the amount of AIDS-related deaths for the last decade. AIDS changed from a rapidly progressing and fatal illness

back in the 1980s to a chronic and manageable disease in the present [2]. This shift has only been possible due to the social, political and economic efforts of many bodies, both at the individual and organizational levels, and in academic, industrial, public and non-governmental sectors. Understanding the underlying mechanisms of viral infection and natural disease progression has been crucial in providing hints and opportunities for the development of many antiretroviral compounds with different mechanisms of action (Fig. 2), combination drug regimens, improved techniques of viral detection and diagnosis/monitoring of infection, and effective preventative strategies [3]. Indeed, many

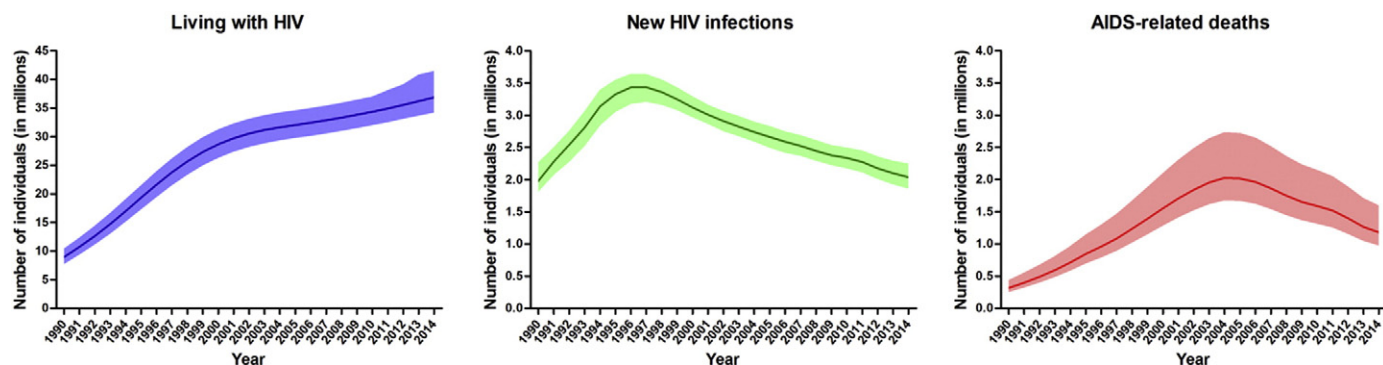


Fig. 1. Estimated global annual number of people living with HIV, new cases of HIV infection and AIDS-related deaths in 1990–2014. Shaded areas represent upper and lower uncertainty values. Please note the different scales in y-axes. Plotted from UNAIDS data (available from URL: <http://data.un.org/>).

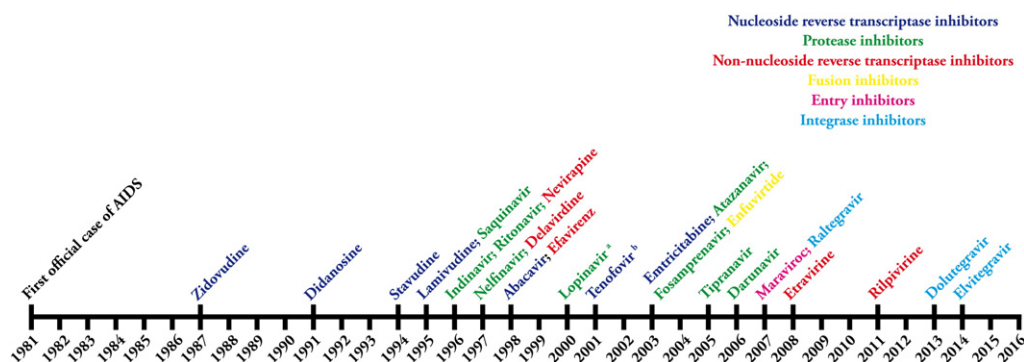


Fig. 2. Currently available antiretroviral drugs and year of approval by the US FDA. Data from Drugs@FDA (available from URL: <http://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm>). ^a Only available in combination with ritonavir; ^b Tenofovir is a nucleotide reverse transcriptase inhibitor, available as tenofovir disoproxil fumarate.

☆ This review is part of the Advanced Drug Delivery Reviews theme issue on “HIV/AIDS_dasNeves_Sarmiento_Sosnik”.

advances were made since the first reported clinical cases of AIDS (Fig. 3) but the end of the pandemic still seems far away.

Recent years have seen further and exciting advances. For example, various preventative biomedical strategies have gained significant evidence-based support, including antiretroviral treatment in HIV-discordant couples, as well as oral and topical antiretroviral pre-exposure prophylaxis (PrEP) [7–9]. Furthermore, reports of long-term

control of infection after early antiretroviral therapy followed by treatment discontinuation, fast-track developments of gene therapy (particularly related to host co-receptor expression), and even “cure” of the famous “Berlin patient” are bringing new hope towards an AIDS-free generation [10,11]. Most of these advances would not have been possible without the growing understanding of the fundamental biology of HIV/AIDS, as well as the remarkable contributions of biomedical

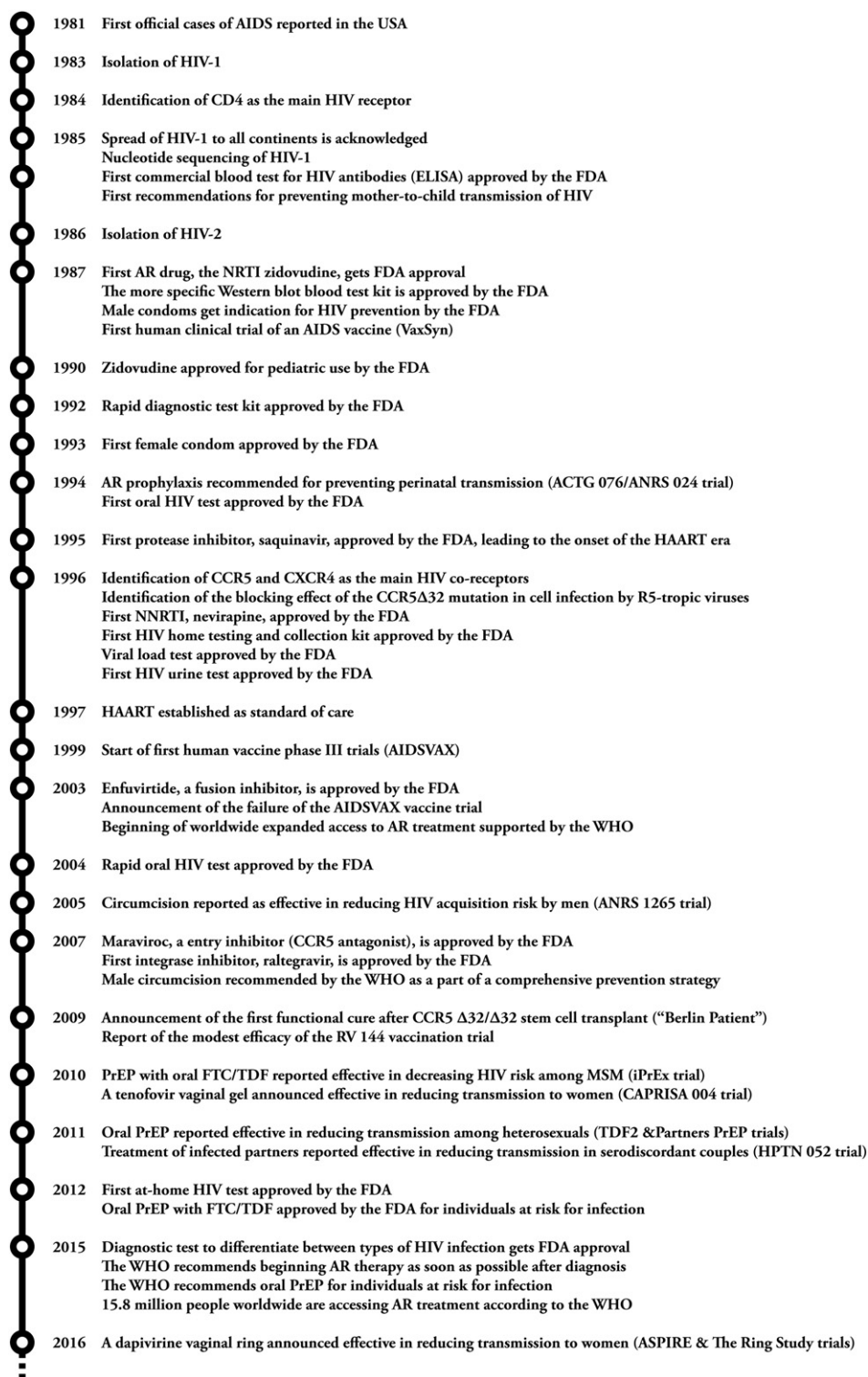


Fig. 3. A timeline of HIV/AIDS pandemic evidencing some of the most significant medical and biomedical developments in prevention, diagnostics and treatment. Data collected from [4–6].
Abbreviations: AR, antiretroviral; FDA, United States Food and Drug Administration; FTC, emtricitabine; HAART, highly active antiretroviral therapy (currently referred to as cART – combination antiretroviral therapy); MSM, men who have sex with men; NRTI, nucleoside reverse transcriptase inhibitor; PrEP, pre-exposure prophylaxis; TDF, tenofovir disoproxil fumarate; WHO, World Health Organization.

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