Telomere-Based Cancer Treatment: 
Emerging Targeted Therapies

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Telomeres, the ends of chromosomes, are composed of long, repeating sequences of DNA (see Figure 1). In normal somatic cells, the ends of telomeres cannot be replicated prior to cell division, when the rest of the chromosome is duplicated (Allsopp & Weissman, 2002). Therefore, daughter cells’ chromosomes are minutely shorter than those of the parent cell after normal cell division. Cell division results in progressive shortening of each chromosome, such that after a finite number of cell divisions, telomeres become too short and the cell cannot divide further; this state is called senescence (Serrano, 2010). However, an enzyme called telomerase that rebuilds the telomere after each cell division is present in embryonic cells and in most cancer cells. Reports have shown telomerase activity in 80%–90% of cancer cells (Harley, 2008). Because the chromosomal length is maintained, cells with telomerase activity are immortal, meaning they can divide indefinitely. If the telomerase enzyme were prevented from working, cancer cells may undergo senescence and fail to divide further; therefore, the development of therapies that target telomeres or telomerase activity have been correlated to higher chances of tumor recurrence (Tatsumoto et al., 2000). Therefore, knowledge of telomerase activity level or telomere length in patients with cancer may help healthcare providers plan appropriate treatment to combat cancer progression.

At a Glance

- When telomeres are too short, cells stop dividing, become senescent, and may enter apoptosis or programmed cell death.
- Telomerase inhibition, active immunotherapy, and telomere-disrupting agents all aim to shorten telomeres and induce senescence in cancer cells.
- To date, telomere-targeting agents are being tested in clinical trials to determine dosage, toxicity, and effectiveness.

Telomeres and Telomerase

Blackburn and Gall (1978) discovered the existence of tandem repeats (5’-CCCAA-3’) located at the ends of ribosomal genes in the protozoan Tetrahymena thermophila.