Breast cancer is a deadly disease that continues to disrupt the lives of millions of women and their families worldwide, and it is the second leading cause of cancer-related deaths in women in the United States. Breast cancer affects one in eight women in the United States. These statistics are frightening despite decades of innovative research that led to the development of newer targeted therapies. This book attempts to comprehensively summarize breast cancer as a disease, the factors that make it particularly lethal, and the current state of breast cancer research. The contents are broadly divided into five informal sections as outlined in the next few paragraphs.

One factor that particularly makes breast cancer deadly is the enormous heterogeneity associated with it. Cell surface receptors, such as estrogen receptor (ER), progesterone receptor (PR), or HER2/neu (ErbB2) receptor, have been targeted for therapeutic intervention in breast cancers with significant success. However, even this highly successful targeted approach has not been useful for treating ‘all’ breast cancers, especially those that are negative for these receptors, the triple-negative breast cancers. Chapters 1 through 6 form the first section of this book. These chapters introduce readers to the most up-to-date statistics (Chap. 1) and epidemiological data (Chap. 2) on breast cancer; summarize our current understanding of racial disparity in breast cancer (Chap. 3); introduce the signaling pathways being pursued (Chap. 4); comment on the heterogeneity in breast cancer (Chap. 5) and also brief the readers on the challenges posed by triple-negative breast cancers (Chap. 6).

Not much is known about the factors that may predispose individuals to breast cancer and this has also resulted in debate on the models systems to be evaluated in modern day breast cancer research. The second section in this book, Chaps. 7 through 10, touches upon some of these topics. Included in this section is a chapter that links obesity and diabetes to breast cancer (Chap. 7), followed by a chapter that discusses the clinical and pathological progression of early breast cancer into an invasive disease (Chap. 8). The final two chapters in this section summarize the models available to breast cancer researchers (Chap. 9) and also introduce readers to the state-of-the-art 4-dimensional culture models that have been proposed recently (Chap. 10).
Although the rate of mortality from breast cancer has decreased in developed countries, the incidence of breast cancer has actually risen, all due to early detection. It is estimated that more than 90% cancer-related deaths are due, directly or indirectly, to cancer metastasis. Bone is one of the earliest and most common sites of breast cancer metastasis. Breast cancer metastasizes to bones in approximately 70–80% of patients with advanced disease, and similarly brain metastasis of breast cancer is also a very challenging clinical problem. It is believed that 20–40% of all patients with metastatic cancer end up with brain metastases. We cover these topics in the third section of this book (Chaps. 11, 12). These chapters provide detailed information on our current understanding of the processes of bone (Chap. 11) and brain (Chap. 12) metastases of breast cancer.

In addition to metastatic disease, drug resistance is a major concern for researchers and clinicians, because it is a big hindrance in the successful management of cancer patients. A number of targeted therapies are available for cancer subtypes that are marked by the expression of ER, PR, and overexpression of HER2. Some cancers do not respond to the therapy at all, right from the beginning, and others eventually develop resistance to the targeted therapy. Breast cancers that have acquired drug resistance are usually far more aggressive and difficult to treat. Section 4 of this book, Chaps. 13 through 15, deals with this clinical problem associated with breast cancer. Here, readers are first introduced to clinical problems associated with the resistance to taxanes and anthracyclines in invasive breast cancers (Chap. 13); followed by the problems and current research on tamoxifen resistance in ER expressing breast cancers (Chap. 14), and finally we discuss the resistance mechanisms in HER2 overexpressing breast cancers (Chap. 15).

With a better understanding of breast cancer as a disease and the various challenges it poses, as detailed in the first four sections of this book, we finally showcase the current state of breast cancer research in Sect. 5 (Chaps. 16 through 22). We look at the novel molecular targets/signaling pathways being pursued, and also present the cutting edge approaches to better understand and tackle this disease. We start with a look at some promising novel chemical compounds for therapy (Chap. 16), and then summarize our understanding of Notch signaling pathway in breast cancer (Chap. 17). The next two chapters introduce readers to systems biology approach (Chap. 18) and epigenetics approach (Chap. 19), the two upcoming areas of breast cancer research. We round off by discussing the current understanding of cancer stem cells and miRNAs in breast cancer progression and therapeutics. Chapter 20 introduces readers to these two exciting areas of research, and finally readers are briefed on the therapeutic potential of cancer stem cells (Chap. 21) and miRNAs (Chap. 22) with particular note on how these fields of breast cancer research have advanced in last few years.

It is an honor to be able to work with the experts and leading scientists in individual fields, and be able to compile this very comprehensive volume detailing almost all the aspects of current breast cancer research. I take this opportunity to thank all the authors who, selflessly, worked hard and contributed their knowledge to this book. My special thanks to the publisher, Springer, for entrusting me with this project, with special mention of Fiona Sarne, the editor at the publishing office.
for helping me in every way possible. Finally, I cannot thank enough my wife Huma and daughter Nuha for their unconditional love and support throughout.

It is my pleasure to present this volume to the scientific community for a better understanding of breast cancer. I hope this will help spark new ideas and innovative research for the benefit of scores of patients dealing with this deadly disease.

Aamir Ahmad