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#### A CHARTING TOOL FOR ESTIMATING THE PSA DOUBLING TIME IN PATIENTS WITH PROSTATE CANCER

*To the Editor:* When following men after prostatectomy or the post-radiotherapy prostate-specific antigen (PSA) nadir, it is important to rapidly estimate the PSA doubling time ( $PSAdt$ ), a major predictor of treatment outcomes (1–8).

We have created a chart onto which serial PSA values can be recorded and from which accurate estimates of the  $PSAdt$  can be obtained quickly and without a calculator. The key is to plot the posttreatment PSA observations using an in-built logarithm ( $\log$ ) to the base 2 scale. This  $\log$  chart has valuable advantages over plots relying on the natural scale (nanograms/millimeter). First, it avoids having to actually calculate the  $\log_2$  of each PSA value—this conversion is taken care of by the  $\log$  scale. Second, posttreatment PSA series plotted on a  $\log$  scale yield approximately linear trajectories (piecewise-linear for radiotherapy). Third, PSA data vary less on the  $\log$  than on the natural scale. As a result of the linearity and reduction in random fluctuations, one can visually fit a straight line to the PSA data (postnadir in the case of radiotherapy). Furthermore, the use of a base 2 logarithm scale leads directly to an estimate of the  $PSAdt$ , namely, the reciprocal of the slope of the resulting line. Equivalently, one only needs to count how many horizontal (time) units on average are required to jump by 1 ( $\log_2$ ) unit on the vertical scale.

Given the considerable PSA variability, all (and not just the two most recent) measurements should be used to obtain a precise  $PSAdt$  estimate; they should preferably be spaced in time (at least 3 months), and from the same laboratory using the same assay. Finally, given the lower detection levels at lower concentration, only PSA levels greater than 0.2 ng/mL should be used.

Figure 1 shows PSA values on the  $\log_2$  scale for a man treated with radiotherapy. These data suggest about four doublings after the nadir (4 vertical units) over the 8 years postnadir (8 horizontal units); therefore, the fitted doubling time is  $8/4 = 2$  years, or approximately 0.5 doublings per year.

For each patient, PSA levels can be recorded as new data accumulate, and estimates of the doubling time revised. This procedure does not require

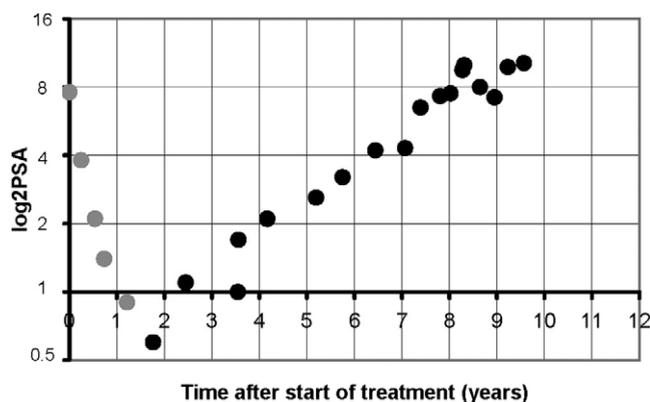


Fig. 1. Example of the practicality of the  $\log_2$  graph. The lowest observation occurred few months before the second year after radiotherapy, and the last measurement was done some months before the tenth year. Thus, after the PSA nadir, the horizontal span is about 8 years, and there are approximately 4 vertical units. The fitted doubling time is then simply  $8/4 = 2$  years, or approximately 0.5 doublings per year.

any computing device, and the chart can be kept in the patient file for quick reference.

For convenience, we provide a blank  $\log$  sheet, which can be used to record individual PSA series and to estimate the PSA doubling time (Fig. 2).

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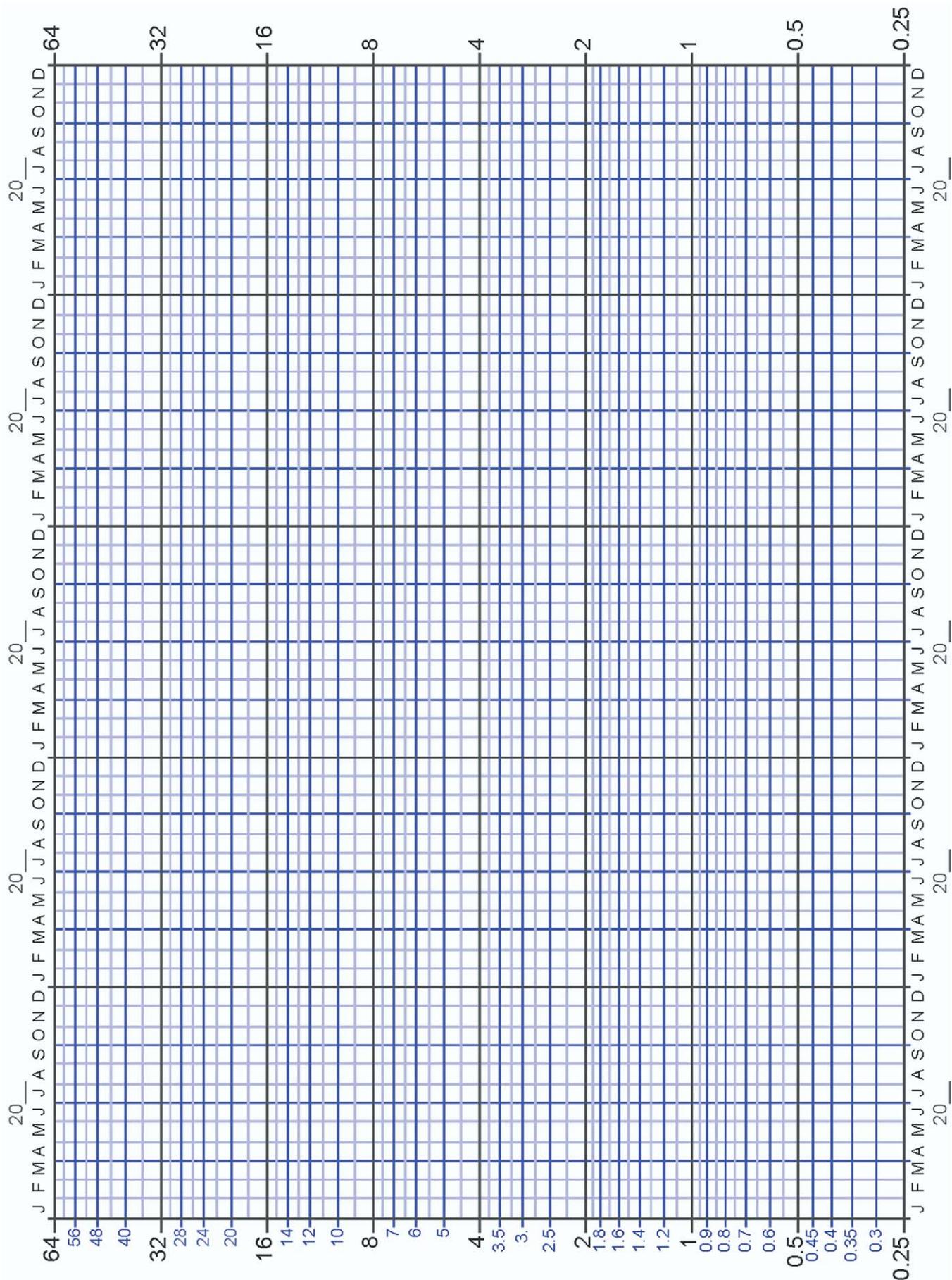


Fig. 2. Proposed prostate-specific antigen (PSA) recording sheet for estimating PSA doubling time (PSAdt). One major horizontal unit corresponds to 1 year, and 1 major vertical unit represents 1 PSA doubling.