Appendix B

The Relationship between the Full DRG and Per Diem Payments

The first step in decomposing the impact of the postacute care transfer policy change into its price and volume components is to identify the mathematical relationship between average per diem payments and the DRG standardized amount. The second step is to link per diem payments to the average length of stay of short-stay patients in a DRG.

B.1 The Standard Transfer Payment Rate

The relationship between the *average* DRG per diem payment, $\overline{PD}$, the daily per diem rate, PD, and i-th patient's length of stay, LOS, can be expressed in the following mathematical form:

$$\text{(B-1)} \quad \overline{PD} = \frac{\sum_{i=1}^{N^{PD}} \left[2PD + PD\left(LOS_i - 1\right)\right]}{N^{PD}}$$

where

$$\text{(B-2)} \quad PD = \frac{SA \times DRGWT}{GLOS}.$$

Subscripts denoting the DRG and hospital have been dropped.

The component, *PD,* represents the hospital's actual per diem rate, defined as the DRG standardized amount, *SA*, factored up by the DRG weight, DRGWT, and divided by the national geometric mean length of stay (*GLOS*). Eq. (B-1) is summed *only* over short stay

PAC transfer patients paid on a per diem basis, N^{PD}. The bracketed numerator of eq. (B-1) divides payment of each short-stay patient into two components. The first captures the double per diem on day 1 while the second adds additional per diems through the day before the geometric mean stay is reached. For example, a patient in for 5 days would be eligible for [2+(5-1]=6 per diems, so long as LOS was at least one day less than GLOS for the DRG.

Eq. (B-1) can be rewritten as:

(B-3) $$\overline{PD} = \frac{\sum_{i=1}^{N^{PD}} \left[PD(LOS_i + 1) \right]}{N^{PD}} = \text{PD} \left[\frac{\sum_{i=1}^{N^{PD}} LOS_i}{N^{PD}} + \frac{\sum_{i=1}^{N^{PD}} 1}{N^{PD}} \right]$$

So that

(B-4) $$\overline{PD} = PD\left(\overline{LOS}^{PD} + 1\right)$$

where $\overline{LOS}^{PD}$ equals the average length of stay of all postacute care transfer patients paid on a per diem basis. Substituting eq. (B-2) into eq. (B-4) gives the mathematical relationship between the average total per diem payment and average length of short-stay patients:

(B-5) $$\overline{PD} = SA \times DRGWT\left(\frac{\overline{LOS}^{PD} + 1}{GLOS}\right)$$

The bracketed term in (B-5) can be interpreted as the discount factor on full payment resulting from a short-stay PAC patient paid under the standard per diem policy.

The relationship between per diem payments and DRG standardized amount can be intuitively conveyed by the following numerical example:

Patient	**LOS**	**GLOS**	**Full DRG Pay**	**Aver. LOS^{PD}**	**PD**	**Total PD Payment**	
A	5	10	$5,000	5	$500	(5000/10)(5+1) =	3,000
B	4	10	$5,000	5	500	(5000/10)(4+1) =	2,500
C	6	10	$5,000	5	500	(5000/10)(6+1) =	3,500
							$9,000

$$\text{Average PD Payment} = \frac{\$9,000}{3} = \$3,000$$

or, using eq. (B-5)

$$\text{Average PD Payment} = \$5,000\left[(5+1)/10\right] = \$5,000(.6) = \$3,000$$

Formula (B-5) weights the DRG's full payment by a "discount factor" in brackets. The factor is the arithmetic mean LOS of short-stay patients plus 1 day, relative to the geometric mean. In the above example, the arithmetic mean LOS=5, the geo-mean = 10, and the discount factor = 0.60, implying a 40 percent average per diem discount on heretofore full DRG payment.

B.2 The Blended PAC Payment Rate

The blended payment "per diem" for short-stay PAC patients begins with half the full DRG rate (=SA x DRGWT) and adds "half per diem payments" on for each day in the hospital. The average of such payments, $\overline{PD}$, across all patients in a DRG can be written as:

(B-6) $$\overline{PD} = \sum_{i=1}^{N^{PD}} \left[.5(PD)(GLOS) + PD \; + \; .5(LOS_i - 1)PD \right] / \, N^{PD}$$

where PD=SA x DRGWT/GLOS, or the daily allowable per diem. The numerator has three components: (1) half the full DRG payment, which is written as the daily per diem times the geo-mean; (2) a single full per diem for the first day; and (3) a half per diem for subsequent days beyond the first (with the overall LOS not to exceed the geo-mean minus 1 day (see footnote 2, chapter 2). Taking PD outside the brackets of (B-6) and expanding the third term gives

(B-7) $$\overline{PD} = \sum_{i=1}^{N^{pd}} PD\left[.5GLOS \; + \; 1 \; + \; .5GLOS - .5 \right] / \, N^{pd} \cdot$$

Combining terms, taking out .5, and dividing through the remaining elements of (B-7) by the total number of short-stay patients gives

(B-8) $$\overline{PD} \; = \; .5PD\left[\frac{\sum^{N^{pd}} GLOS}{N^{pd}} + \frac{\sum^{N^{pd}} 1}{N^{pd}} + \frac{\sum^{N^{pd}} LOS_i}{N^{pd}} \right].$$

Simplifying,

(B-9) $$\overline{PD} = .5PD\left[GLOS + \overline{LOS}^{pd} + 1 \right]$$

where $\overline{LOS}^{pd}$ = the arithmetic mean of short-stay PAC patients. Substituting the definition for PD = SA x DRGWT/GLOS and re-arranging gives

(B-10) $$\overline{PD} = SA \times DRGWT\left[.5 + (.5)\frac{\overline{LOS}^{pd} + 1}{GLOS}\right].$$

Thus, the average per diem total payment across eligible PAC patients in a DRG begins with half the total payment with an average add-on of half the arithmetic mean plus 1 day divided by the geometric mean.

The discount factor for the blended per diem is always greater (i.e., less discount) than the standard transfer policy for the same relative arithmetic-to-geometric mean stay. The gap disappears, however, one day short of the geo-mean for both per diem algorithms. The relative discount between the standard and blended payment formulas is:

(B-11) $$\overline{PD}_{\text{std}} / \overline{PD}_{\text{blnd}} = 2\left[\lambda / (1 + \lambda)\right]$$

for DRGs where $\lambda = \left(\overline{LOS} + 1\right) / GLOS$ is identical.