ciency on bone are not confined to rickets and osteomalacia, as Holmes and Kummerow continue to believe, but include also accelerated loss of cortical bone due to secondary hyperparathyroidism (2).

4) All the papers documenting excessive intake of vitamin D were taken from the pediatric literature.

5) That per capita manufacture of vitamin D in the US amounts to 90 μg/day is interesting, but not relevant until much more is known about its fate.

6) A tabulation of the unexpectedly wide variety of foods containing vitamin D is useful, but the amount of vitamin *added* during manufacture and the amount *ingested* may be far apart. Also, many of the foods listed contribute little to the diet of most old people.

7) The results of carcass analysis of livestock fed excessive amounts of vitamin D, by vitamin D bioassay, are of questionable relevance to human health for reasons explained in our paper (p 1017).

8) Unpublished experiments concerning a possible relationship between vitamin D intake and coronary artery histology in swine, despite lack of elevated 25(OH)D levels, require many more details for proper evaluation.

9) There is no acceptable epidemiological or experimental evidence relating differences in vitamin D intake in the range 0 to 50 μg/day with the incidence of coronary or any other kind of arterial disease in human subjects.

I agree that there is no good reason for vitamin D fortification of any food other than milk, that too much vitamin D is given to livestock, and that hypervitaminosis D may be harmful for reasons in addition to hypercalcemia. But until evidence to the contrary is forthcoming, I stand by our recommended policy, and believe that ensuring a total intake of 15 to 20 μg/day will benefit some elderly Americans and do no significant harm.

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Carnitine plasma levels during total parenteral nutrition

Dear Sir:

In a recent communication, Hahn et al (1) have concluded that adult patients in total parenteral nutrition (TPN) can maintain normal plasma levels of carnitine for at least 30 days and that, therefore, they usually do not require any carnitine supplement.

Even though our data confirm Hahn's data, at least considering the first 20 days of TPN after surgical trauma (see **Table 1**), we think that plasma levels of carnitine are not a reliable guide for the estimation of carnitine requirements in these patients.

By monitoring plasma levels, it is evident that body stores of carnitine are depleted after few weeks of TPN, even supplying lysine in TPN solutions; therefore, in this large lapse of time, endogenous synthesis is not sufficient—even though plasma levels do not change.

To ascertain whether critically ill or depleted patients during TPN might benefit from exogenous supplementation of carnitine, one should start by explaining some alterations which have been observed in these patients—despite normal plasma levels—such as a shift in relative amounts of

TABLE 1*

	Postoperative days			
	1–2	3–5	6–9	10–20
n	15	20	15	17
FC	48 ± 15	41 ± 15	41 ± 13	46 ± 19
AC	11 ± 9	13 ± 13	11 ± 9	16 ± 10

* Mean ± SD (μmol/l) of free carnitine (FC) and acyl-carnitine (AC); n = number of studies performed in 40 nonseptic patients after surgery.

The variability of our data is similar to the one reported by Hahn et al in Table 3 of their paper (1), considering that they show the SE.

TABLE 2*

	n	FC	n	AC
Controls (15 patients)	15	248 ± 200	15	138 ± 189
Surgery (20 patients)	34	363 ± 290†	23	273 ± 481
Sepsis (15 patients)	38	985 ± 826†	23	204 ± 183

* Mean ± SD of daily urinary excretion (μmol/24 hr) of free carnitine (FC) and acyl-carnitine (AC) (*t* test: † = $p < 0.001$)

esterified and free carnitine in plasma, muscle, and urine, and increased urinary loss (2–5).

For instance, with regard to urinary loss, there is evidence that increased carnitine excretion in stress situations—which leads to depletion of body carnitine—may represent a clue to the importance of carnitine in protein metabolism. In fact, carnitine excretion increases not only when lipolysis is enhanced, but also whenever protein catabolism is increased: this is most apparent in these clinical situations associated with increased energy requirements and increased oxidation of endogenous substrates. The excretion of carnitine increases in rough correlation with the increasing metabolic rate: the higher the catabolic response of the body, the larger the amount of carnitine excreted, from normal state (controls) to the catabolic state of clean surgical injury, up to the hypercatabolic state of sepsis (see our data in **Table 2**), or severe burns as Cederblad (4) has shown. Cederblad observed a mean daily excretion of 2477 μmol/24 h in day 2 postburn (free carnitine = 80%), which was still significantly high in day 7 (1057 μmol/24 h; free carnitine = 68%). A statistically significant correlation was found between the percentage surface area burned and the mean value of carnitine excretion. Moreover, our data, as well as Cederblad's (4) and Tanphaichitr's (5), show an increased excretion of free carnitine, with little or no increase in urinary acyl-carnitine. On the contrary, a condition characterized by increased lipolysis, such as starvation, was found to increase the excretion of acyl-carnitine (6–8). Finally, it has been shown that carnitine is important also for oxidation of branched-chain amino acids. In fact, in vitro, leucine and valine oxidation is enhanced by carnitine (9, 10). Since it is well known that branched-chain amino acids are an important endogenous source of energy in any catabolic state (and they are commonly administered during TPN), it is likely that the aforementioned alterations of carnitine metabolism may correlate also with an increased utilization of such amino acids.

In conclusion, to define nutritional therapy, one must take into account the fact that in the injured patient severe derangements of energy metabolism occur, which may or may not involve carnitine-dependent pathways. Independently from its plasma levels, carnitine supplementation during TPN in the future may prove to be advisable as a support to energy metabolism.

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Reply to letter by Nanni, Pittiruti, and Castagneto

Dear Sir:

We were happy to see that Nanni et al obtained results similar to ours. We agree that plasma levels of total carnitine in themselves may not be a reliable guide for estimating carnitine requirements. However, we have found no evidence in the literature that decreased plasma total carnitine levels in themselves are deleterious to patients. Thus, newborns fed soy-bean formulas orally or intravenously seem to prosper even though plasma levels of carnitine are low. Similarly the one adult patient mentioned in our paper had very low plasma levels but did not seem to suffer from any signs or symptoms that could be related to carnitine lack.

Obviously patients fed intravenously are not in perfect health and hence may be breaking down their own tissues and thus may have large urinary losses of carnitine. However, newborns fed a soy-bean formula excrete less carnitine in their urine than do normal babies (1).

There is no doubt that more work is required before carnitine requirements can be quantitated. We speculate that in intravenously fed patients, requirements probably depend on the primary disease. In hepatic cirrhosis, for instance, one would expect carnitine synthesis to be depressed and plasma levels to fall sooner than in patients with healthy livers (2).

Finally, even though plasma levels of total carnitine are not necessarily indicative of body stores of this substance, it is nevertheless interesting that in the newborn body stores are low and plasma levels fall rapidly if no extraneous carnitine is supplied.

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