

## EDITORIAL COMMENT

# Four Score and 10 Years +\*



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**F**our score and 10 year olders can be characterized by several attributes (1):

1. Having survived that long, they are by definition survivors.
2. They typically carry more baggage with them as the prevalence of age-dependent risk factors increases with time.
3. They have more mileage on the tread—although we often use the phrase “younger than their stated age”—in actual fact their arteries are indeed 90+ years old.
4. The sex and racial makeup is different than in younger groups, in that women outnumber men by approximately 3:1, and the population is overwhelmingly Caucasian.
5. Their expectations, either realistic or not, may be different from those of younger patients.
6. They have increased potential for drug-drug interactions because of the numbers of medications they are taking.
7. Finally, their social support systems, which may affect care after any procedures, are different and may be less robust.

In this issue of *JACC: Cardiovascular Interventions*, these issues are particularly germane in the field studied by Sawant et al. (2). This report offers several important aspects and findings. As the investigators state, “the purpose” was to determine: 1) the prevalence of nonagenarians undergoing percutaneous coronary intervention (PCI) between 2005 and 2014; 2) the annual rate of nonagenarians among all

PCI patients from 2008 and 2014; 3) the clinical characteristics, occurrence of in-laboratory complications, and short-term (30-day) and long-term (1-year) mortality after PCI in nonagenarians compared with longer patients; and 4) predictors of short- and long-term mortality in nonagenarians. The fundamental highlight and strength of this study involves the backbone mechanics, namely, the Veterans Affairs Cardiovascular Assessment, Reporting, and Tracking (VA CART) program, which is a mandatory, standardized protocol of clinical data, noninvasive data, echocardiographic variables, angiographic data, and outcome data gathered in all patients undergoing PCI in all Veterans Affairs catheterization laboratories (3,4). This structure has great advantages because of its consecutive and comprehensive nature and the fact that the Veterans Affairs system deals with perhaps more of a “captive” population with more distinct characteristics by virtue of their typically being veterans.

SEE PAGE 1295

The VA CART program also has great advantages because in addition to being comprehensive, it uses electronic health records. Its limitations, however, are very real in that it captures only in-laboratory complications, which raises the issue of under-reporting of periprocedural complications. In addition, the VA CART registry does not track specific outcomes of nonagenarians who did not undergo cardiac catheterization, so issues of patient selection cannot be addressed.

In this “mandatory and universal” database, there were 67,148 veterans who underwent PCI. Two hundred seventy-four were nonagenarians (mean age  $91.8 \pm 1.6$  years) at the time of the procedure. There were important differences between nonagenarians and the younger patients: the nonagenarians were less likely to be smokers or to have diabetes, but they were more likely to have hypertension, systolic

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heart failure, cerebrovascular disease, and chronic kidney disease. The indication for PCI was different in both groups. In nonagenarians, the indication was typically for more urgent clinical situations: ST-segment elevation myocardial infarction (14.6% vs. 6.9%) and non-ST-segment elevation myocardial infarction (39.1% vs. 19.3%) ( $p < 0.001$ ). Two-thirds of the time in each group, only 1 vessel was treated with PCI. There is no additional information about the details of coronary anatomy, other than the fact that testing for ischemia (using fractional flow reserve) was performed very infrequently (<4% among nonagenarians). Such details of the remaining coronary anatomy would have been helpful for risk adjustment modeling and evaluating the effects of completeness of revascularization on early and later outcomes.

Procedural complications were assessed. Ascertainment and adjudication were by site determination and were based on data entered into the electronic health record of each center. These site-reported complications were vanishingly small and could be regarded as almost anecdotal, with no myocardial infarction or death during the procedure, although it is unclear what definition of myocardial infarction was used; almost certainly not elevation of troponin. This low event rate is surprising in view of the fact that 2.6% of nonagenarians had presented with shock (although the absolute number of patients was only 7). Although there was a difference in cardiogenic shock and in no reflow, the numbers of events were very small, raising potential issues of ascertainment. Surprisingly, although 31.8% of nonagenarians had renal failure (unknown definition) at presentation, the change in glomerular filtration rate post-procedure at 30 days was small and not statistically different compared with the younger patients.

Results of analysis of 30-day and 1-year all-cause mortality are important. Compared with the whole group of all veterans undergoing PCI ( $n = 67,148$ ), who had very low 1-month and 1-year mortality rates (1.4% and 4.2%, respectively), the nonagenarians had higher rates of unadjusted 30-day (10.6% vs. 1.4%) and 1-year mortality (16.3% vs. 4.2%).

After risk adjustment, the nonagenarians continued to have worse outcomes. An important analysis applied a multivariate fragility model, although the specifics of the frailty assessment and whether it used standardized testing were not explicitly documented. Having said that, the results were consistent with what might have been expected, namely, that the National Cardiovascular Data

Registry (NCDR) risk model (5) was highly predictive of 30-day and 1-year mortality, a finding that had not been previously validated. For every 10-point increase in NCDR risk score, there was a 2.3-fold increase in 30-day mortality and a 1.4-fold increase in risk for 1-year mortality. The highest quartile of pre-procedure NCDR risk patients had markedly decreased 30-day survival and a trend ( $p = 0.073$ ) for 1-year survival (the latter among patients had survived the initial 30 days post-procedure).

Putting this in context, this study adds significant information to the available research and to clinical practice. As documented, there is an increasing trend toward performance of PCI in nonagenarians. In contrast to younger patients, although the procedure can be performed safely, 30-day and 1-year mortality in nonagenarians is substantially increased compared with younger patients. A particularly important finding relates to the application and testing of risk stratification in this group; application of the NCDR CathPCI score (5), as could be expected, identifies that the higher the risk of the nonagenarian patients, the worse short-term and even longer term mortality is. Such information will be particularly valuable in these high-risk patients for patient selection and education of risks and benefits of these procedures. There are, however, important unresolved issues that cannot be resolved by these data. Perhaps the most important relates to patient selection for procedures in nonagenarians. We do not know how nonagenarian patients treated conservatively fared. Judged by the excellent results of PCI in these nonagenarians treated with PCI, both patient selection criteria outcome and procedural performance were excellent. The increased mortality at 30 days and 1 year may in some ways relate to the aphorism of Galen: "All who drink of this remedy recover in a short time, except those whom it does not help, who all die. Therefore, it is obvious that it fails only in incurable cases." Whether the incurability is the inevitable result of advancing age or the result of single-disease issues that could potentially be mitigated is unclear. We will need to continue to identify means to optimize care for the "longer term" in these "four score and 10 year olders."

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