

generated field tests showed that telephone modulation frequencies used in the international Global System Mobile and TDMA-50 cellular telephone technologies did not result in ICD sensing interference at the predicted electrical field intensity. Near-field tests were performed using both analog and digital cellular telephones that were in service or in the test mode, and the results showed no interaction with the normal operation of ICDs. However, the static magnetic field generated by the cellular telephone placed over an ICD at a distance of 0.5 cm or less may activate the internal reed switch and result in temporary suspension of the detection of ventricular tachycardia and fibrillation. Fetter et al.¹² suggested keeping mobile phones at least 15 cm away from pacemakers when using the phone. Results of these studies suggest that the interference with ICDs by cellular telephones is small and model dependent and that *in vitro* experimental results might not be able to reflect *in vivo* conditions in real life.

Occasionally, cellular telephones and other telecommunication equipment may cause malfunctioning of medical equipment, including life-support equipment. Adler et al.¹³ reviewed such malfunctioning, related it to Israeli and worldwide standards, and analyzed the characteristics of the interference in terms of amplitude and frequency. Accordingly, they proposed two different levels of restrictions on the use of mobile phones within hospitals: prohibition of the use of wireless telecommunication equipment in intensive care areas and operating theaters¹³ and, in all other areas, turning off mobile phones within 1 m of medical devices and not transmitting (but only receiving) calls with a portable 2-way radio within 5 m of medical devices.

While the interference with medical apparatus by the use of cellular telephone seems small and limited, it could be a matter of life and death when it occurs. Therefore, extra precautions are justified and advisable.

II. Subjective symptoms

Van Leeuwen et al.¹⁵ evaluated the three-dimen-

sional temperature rise induced by a mobile phone using a realistic head model. This was done numerically with the consecutive use of an FDTD (finite difference time domain) model to predict the absorbed electromagnetic power, and a thermal model describing bio-heat transfer by both conduction and blood flow. They calculated a maximum rise in brain temperature of 0.11 °C for an antenna with an average emitted power of 0.25 W. The maximum temperature rise was at the skin, but the temperature rises were far too small to have lasting effects. Whereas the authors mentioned that variations in skin thickness might interfere with the experiment, we believe that factor was not likely to have a substantial impact on the study results.

The electromagnetic waves of mobile phones were suspected to be able to change the neural electrochemical potential. Using mobile phones for a long period of time may interfere with conduction of the neural system. Hocking and Westerman¹⁴ reported a case of neurological abnormalities in a patient after prolonged use of a mobile phone. The patient had permanent unilateral dysesthesia of the scalp, slight loss of sensation, and abnormalities on current perception threshold testing of the cervical and the trigeminal nerves.

Oftedal et al.¹⁶ conducted a cross-sectional study of 17,000 people in Norway and Sweden who used mobile phones in their jobs and found about 31% of the respondents had experienced at least one symptom in connection with mobile phone use. Following sensations of warmth on and behind/around the ear, a burning sensation in the facial skin and headaches was the most commonly reported. Most symptoms began during or within half an hour after a call and lasted for up to 2 h. Relatively few of them, however, had consulted a physician or been on sick leave because of the symptoms, and only about 45% had taken steps to reduce the symptoms. These results suggest an awareness of symptoms, not necessarily a serious health problem. Furthermore, differences in the social economic status and languages used in the questionnaire between the two countries and different levels of public concern of the health effects of mobile phones in particular might have affected results of the study.