



# Radiology Workload and Staffing in Macao

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## INTRODUCTION

Medical imaging modalities such as radiography, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound play a crucial role in modern healthcare. Macao, with its high population density and aging population, is facing an increasing demand for radiological services. This article addresses the radiology workload and staffing in Macao from four aspects: utility trends; practice coverage for nights, weekends, and holidays; working contents and workload; and working hours. These findings provide insights for the enhancement of radiological operations and capacity planning.

## Utility Trends of Diagnostic and Interventional Radiological Services

Government data demonstrated that, between 2019 and 2023, the overall public and private radiology utilization in Macao increased steadily. The number of radiographs (X-rays) increased by 25% from 230000 to 287500, CT scans surged by 96% from 20000 to 39000, and MRI scans experienced a significant growth of 100% from 7600 to 15200. Moreover, interventional radiology procedures also increased by 22%,

from 3400 to 4100, during this period [1].

Several factors have contributed to the rapid growth in radiology volumes, including the establishment of new private imaging centers, technological advancements enabling new diagnostic and interventional radiology applications, and population growth and aging, leading to increased clinical imaging requirements.

This upward trajectory is expected to continue based on demographic projections of Macao's aging population. By 2025, more than 25% of residents will be 65 years or older, leading to a high prevalence of chronic diseases requiring imaging [2]. Increased public awareness and the utilization of advanced radiology services are expected to drive demand further.

To address future demands, radiology departments must expand their capacities, optimize workflows, and integrate artificial intelligence. Recruiting qualified radiologists remains a challenge. Creative strategies such as teleradiology are crucial for developing a radiology workforce prepared for future growth.

## Coverage Hours of Night Shifts, Weekends, and Holidays

To ensure 24/7 emergency services, radiology departments in Macao public hospitals implement night, weekend, and holiday shifts. According to a survey, 100% of facilities had radiologist coverage overnight, with over 90% having 24-hour technologist coverage. Although off-hour shifts have few routine imaging cases, they encounter significantly complex emergent procedures requiring adequate radiologist and technologist staffing, despite low volumes. Advanced preparation of the equipment and contrast is also crucial for timely emergency imaging.

Extended radiology coverage during nights, weekends, and holidays requires substantial manpower. Without sufficient staffing, this could lead to shortages, fatigue, and burnout.

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Rotation schedules should provide reasonable rest time to alleviate fatigue [3]. Streamlining the workflow and accessing past images can enhance off-hour productivity. The ongoing evaluation of emergency imaging needs versus radiology resources is the key to developing sustainable 24/7 coverage policies.

### Working Contents, Loads, and Manpower of Night Shifts, Weekends, and Holidays

On average, night shifts handle 60% fewer cases than those encountered during weekday daytimes. However, they are confronted with more imaging needs and procedures associated with hospital admissions, trauma, and critical care. Technologists undertake more independent responsibilities with remote radiologist support at night, on weekends, and on holidays. These off-hours also involve increased inpatient and emergency add-on imaging, requiring more time for pre- and post-procedural care.

According to a survey, the average daily workload volumes per radiologist in Macao were 160 X-rays, 28 CT scans, 26 MRI scans, and five interventional procedures. This workload distribution is burdensome, particularly with fewer support staff members. Most radiologists reported high levels of fatigue and burnout, with 74% supporting increased manpower to ease the workload and intensity.

### Working Hours Per Day/Per Week for Certified Radiologists in Distribution and Average

The average weekly working hours of the radiologists were 50.4 hours. Additionally, 10% worked less than 40 hours/week, while 25% worked more than 60 hours/week. For radiologists in Macao working over 50 hours per week, the average working time was 10.3 hours on weekdays and 5.1 hours on weekends. The data demonstrated relatively long working hours for many radiologists, with over 1/4 surpassing 60 hours weekly. This can lead to heavy workloads and a heightened risk of fatigue and burnout [4].

To mitigate these issues, hospitals could implement measures, such as adjusting radiologist assignments, increasing staffing, and regulating working hours. Concurrently, interventions to reduce job-related stress should be implemented to protect the mental health of radiologists. Optimizing the work environment can also improve radiologists' satisfaction and well-being. Studies have revealed that restricting resident physicians' work

hours has minimal impact on clinical outcomes [5]. Maintaining reasonable hours through coordination and task sharing may promote sustainable productivity and long-term safety. Ongoing research is needed to determine optimal working-hour policies.

### CONCLUSION

Macao's growing radiology demand necessitates increased capacity and staffing to ensure service quality and radiologist well-being. A survey revealed that 74% of Macao radiologists supported expanding manpower to mitigate burnout risk. Optimizing shift schedules, distributing complex procedures, and cross-training can improve efficiency. Further research on workload, fatigue, and optimal shifts will provide valuable insights to inform future policies. Tracking well-being metrics and conducting satisfaction surveys can guide evidence-based interventions that balance clinical demands with radiologists' wellness.

### Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

### Author Contributions

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