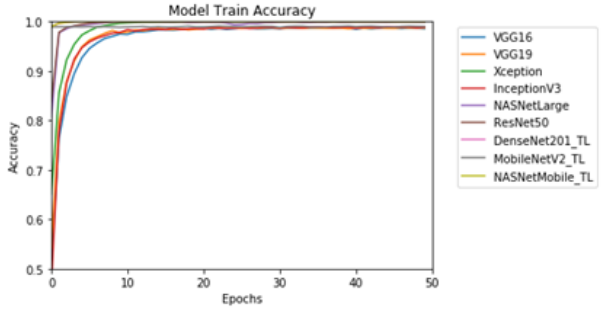
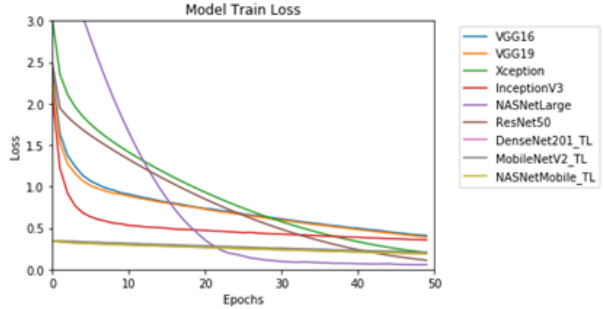
Supplementary Figure 1. Comparing accuracy, loss and ROC of nine CNNs. Both training and validation processes were run for 50 epochs. (Upper panel: accuracy; middle panel: loss; lower panel: ROC, lower left: InceptionV3, lower right: MobileNetV2 transferred with InceptionV3).

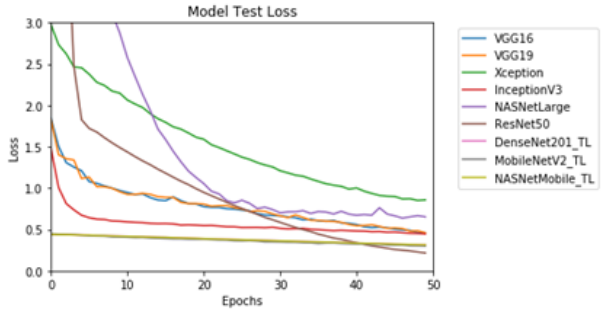
Supplementary Figure 2. Model training and confusion matrix of the two best-performing models (InceptionV3 and MobileNetV2 transferred with InceptionV3).

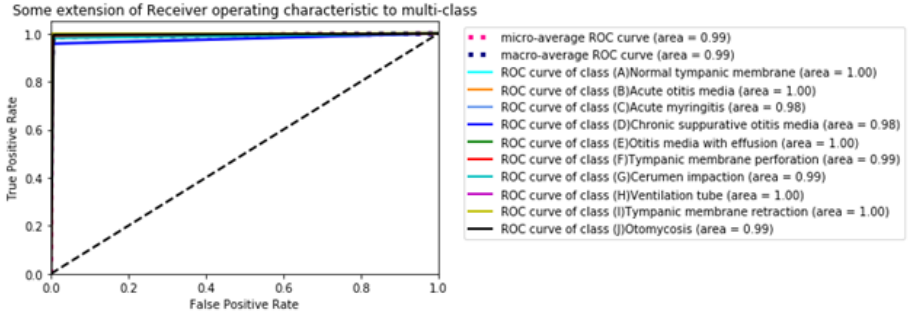
Supplementary Table 1. Characteristics of middle ear diseases.

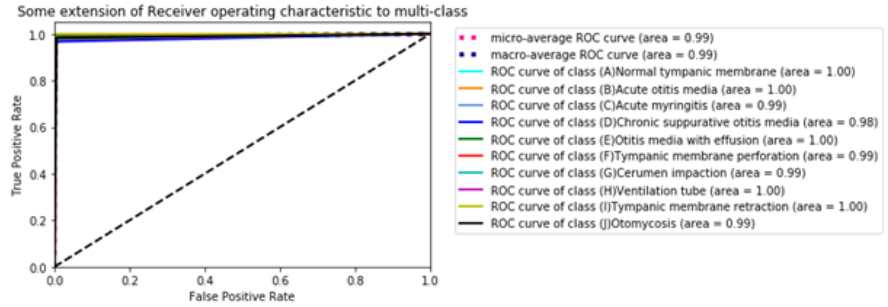
Supplementary Figure 1



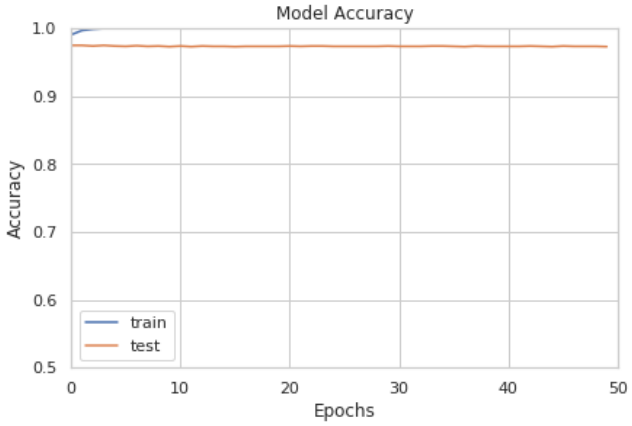


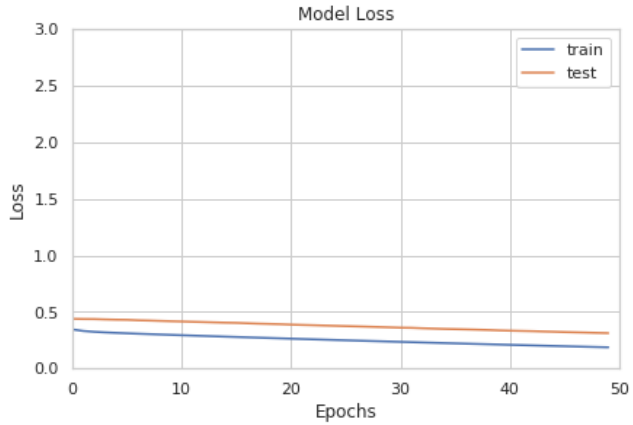


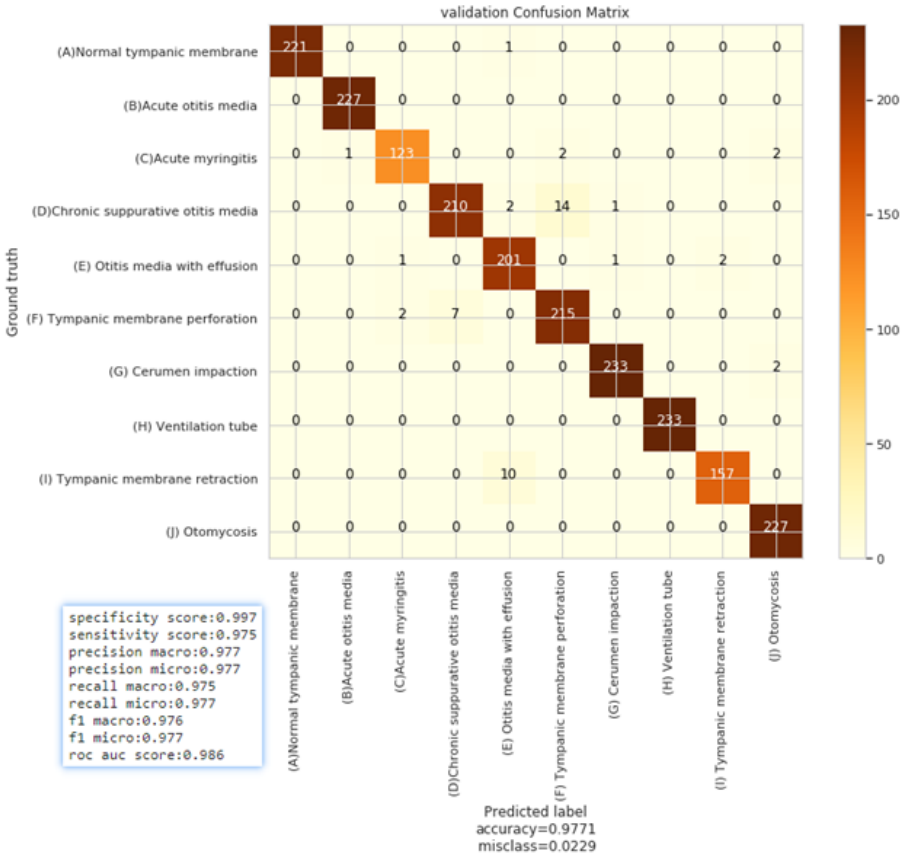




Supplementary Figure 2







Supplementary Table 1

Disease classification	Image number before and after Augmentation	Description in our Apps	Reference
Normal tympanic membrane	1072→1072	A thin, grayish and semi-transparent tissue separates the middle ear from external ear. Cone of light appears in the anteroinferior quadrant of eardrum and the lateral process of malleus points to the side from which it comes.	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 99, pp. 1479-1480) Lippincott Williams & Wilkins.
Acute otitis media	49→1127	A rapid infection of middle ear mostly occurs in children. Bulging of the eardrum by accumulation of fluid in the middle ear also caused otalgia and hearing loss. Managements by physicians are suggested.	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 99, pp. 1479-1480) Lippincott Williams & Wilkins.
Acute myringitis	56→728	The infection confined to tympanic membrane and shows swollen and inflamed eardrum. The discharge may extend to	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 99, pp. 1479) Lippincott

		external canal wall and causes otalgia and otorrhea. Managements by physicians are suggested.	Williams & Wilkins.
Chronic suppurative otitis media	226→1052	CSOM is a disease combined of hearing impairment, otorrhea and sometimes dizziness. It can cause purulent discharge through a perforation in the tympanic membrane, leading to thickening of the middle-ear mucosa. Managements by physicians are suggested.	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 149, pp. 2399-2400) Lippincott Williams & Wilkins.
Otitis media with effusion	363→1067	A common condition in patients with recent URI or nasal allergy. The presence of otitis media with effusion includes observable air-fluid levels, prominent lateral process of malleus due to negative pressure in the middle ear. Nasopharynx should be checked in Asians.	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 99, pp. 1479-1480) Lippincott Williams & Wilkins.

Tympanic membrane perforation	103→1133	A hole or tear in the thin tissue of the eardrum. It may be vulnerable to infection and cause CSOM or cholesteatoma. Regular follow-up by physicians or repaired by otolaryngologist is suggested.	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 150, pp. 2413) Lippincott Williams & Wilkins.
Cerumen impaction	99→1287	Accumulation of earwax made by normal epithelium in the external canal. The disease may hide behind the thick substances. Suggest removal by physicians	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 146, pp. 2351-2352) Lippincott Williams & Wilkins.
Ventilation tube	87→1131	A very small tube that's placed on the eardrum. It helps by evacuate the disease process in the middle ear. It drops 6-12 months after the procedure.	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 146, pp. 2345, 2353) Lippincott Williams & Wilkins.
Tympanic membrane retraction	57→741	A condition in which a part of the eardrum lies more medial side than its normal position. Most arise from pars tensa due to negative pressure state in the middle ear. Some cause hearing	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 151, pp. 2433-2437) Lippincott Williams & Wilkins.

		loss or retraction pocket, a warning sign of cholesteatoma. Routine check-up is suggested.	
Otomycosis	49→1127	A fungal ear infection characterized by otorrhea, inflammation and pruritus. The symptom will relieve after proper treatment of physicians.	Bailey, B. J., Johnson, J. T., & Newlands, S. D. (Eds.). (2013). Head & neck surgery--otolaryngology. (Chap. 146, pp. 2445) Lippincott Williams & Wilkins.