

# REHABILITATION OF A DIGITAL VIDEOSTROBOSCOPY SYSTEM: A PRACTICAL SOLUTION TO AN INOPERABLE AND UNSERVICEABLE DIGITAL VIDEOSTROBOSCOPY UNIT

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## ABSTRACT

**OBJECTIVES:** The objectives of this paper are to present a rehabilitated and functional videolaryngostroboscopy system from an old, unserviceable digital videolaryngostroboscopy unit adapted and fitted with readily available digital hardwares and software; and to present the examination results of patients using the rehabilitated videolaryngostroboscopy system.

### METHODS:

Study Design: Surgical Instrumentation

Setting: Tertiary Hospital

Patient: Veteran patients or their dependents presenting with dysphonia

**RESULTS:** The newly installed videolaryngostroboscopy system was successfully rehabilitated and yielded satisfactory performance in detecting laryngeal observations comparable with the old videolaryngostroboscopy unit. The new system has performed more than fifty videolaryngostroboscopic tests with successful results.

**CONCLUSION:** This study presents a rehabilitated and functional videolaryngostroboscopy system from an old, unserviceable digital videolaryngostroboscopy unit adapted and fitted with readily-available digital hardwares and software. The results of videolaryngostroboscopic study among patients using the rehabilitated videolaryngostroboscopy unit shows comparable results with the old videolaryngostroboscopy unit.

**KEYWORDS:** Videostroboscopy, videolaryngostroboscopy, laryngeal stroboscopy, videostroboscopy rehabilitation, Kay-Elmetrics stroboscopy rehabilitation

The field of medical surgical instrumentation has been continuously evolving into an ever faster phase than it has already been in the past years. However, the present highly sophisticated medical equipments come with their towering prices; their optimum operating lifetime lasts for only a few years and the cost of maintenance and repairs castigate health institutions with a huge financial burden.<sup>1,2,3</sup>

Videolaryngostroboscopy utilizes a highly sophisticated, fully-integrated medical workstation machine that provides laryngologists with a magnified view of a patient's larynx, so they can identify and assess pathologic laryngeal findings, send images and critical feedback to surgeons. It combines video-recording with a technique called stroboscopy to evaluate the function of the vocal cords, or larynx, in people with voice disorders. During speech, the vocal folds in the larynx vibrate too rapidly that it is almost impossible to examine with the use of the common light source. Stroboscopy overcomes this challenge by using a strobe light to illuminate the larynx. The strobe emits light pulses at a rate slightly slower than the vibration frequency of the vocal folds, causing the vocal folds to appear to move in slow motion. An examiner, using a rigid or flexible endoscope may observe the mucosal movement and function of the larynx.<sup>4</sup>

Our department established its Voice and Swallowing Center in 2005 and was privileged to be provided with a state-of-the-art videolaryngostroboscopy unit. However due to its continuous wear-and-tear the unit bugged-downed and was considered unserviceable by

its makers' service crew due to hardware and software malfunctions after seven years of service. Parts and software replacement was attempted but ended futile.

With the department's Voice and Swallowing unit's desire to provide continuous services to its main clientele, another attempt was done to save the strobe system by modifying and altering some of its parts and save its functional pieces without purchasing another costly digital videolaryngostroboscopy unit.

## OBJECTIVES OF THE STUDY:

The objectives of this paper are:

1. To present a method of rehabilitating an old, unserviceable digital videolaryngostroboscopy system from an old, unserviceable digital videolaryngostroboscopy unit, adapted and fitted by using readily-available digital hardwares and software.
2. To present the examination results of patients using the rehabilitated videolaryngostroboscopy system.

## METHODOLOGY AND RESULTS

Study Design: Surgical Instrumentation

Setting: Tertiary care hospital

Participants: Veteran patients or their dependents presenting dysphonia

## METHODS

### I. Identification and conservation of the Kay-Elementrics digital videolaryngostroboscopy system's functional components.

The remaining functional components or parts of the old videolaryngostroboscopy unit were identified which were used for the rehabilitation of the new videolaryngostroboscopy system. (Table 1)

### II. Identification and replacement of the non-serviceable components of the Kay-Elementrics videolaryngostroboscopy system.

#### A. Identification of the non-serviceable components of the videolaryngostroboscopy system

The technical assessment of the videolaryngostroboscopy unit identified the following components as non-functional and unserviceable: the central processing unit's computer module and internal hard drives used for video-recording, for operating system, for database and system backup and the computer-controlled 3-chip video camera. (Table 1)

#### B. Acquisition of new digital hardware systems as replacement for the non-serviceable components of the videolaryngostroboscopy system. (Table 2)

After careful planning for the rehabilitation of the videolaryngostroboscopy unit, the department acquired new alternative and available computer hardware systems

namely: a new central processing unit with a one terabit internal memory and an allotted 2GB video card (Fig.2); a high-definition network multimedia recording station (Fig.3); an audio-video capturing device (Fig.4); and a digital video camera (Fig.5).

### III. Step-by-step procedure for the rehabilitation of the unserviceable Kay-Elementrics digital videolaryngostroboscopy system (Appendix E)

#### A. Detachment of the digital videolaryngostroboscopy's unserviceable central processing unit

The unserviceable digital videostroboscopy central processing unit which housed the malfunctioned computer module and the three internal memory hard disk drives were detached from their cabling systems (monitor, printer, digital storage units, light source, etc.)

#### B. Installation of the new computer system

The newly-acquired central processing unit (CPU) installed with a genuine Microsoft Windows operating system was fitted within the system steel cart's compartment. The system's old LCD monitor was connected via a VGA cable while the keyboard, mouse and cabling systems were connected to the new CPU.

#### C. Installation of a new Network Multimedia Recording Station (Fig.3)

A one terabit (1TB) digital internal memory storage device was mounted and installed inside the network multimedia station. This served as the system's backup video recording device. This recording station can be accessed by the system's computer via a universal serial bus (USB) connection.

#### **D. Installation of a new Audio-video Grabber (Fig.4)**

The audio-video capturing device was installed together with its corresponding software program.

#### **E. Installation of a digital video color camera unit (Fig.5)**

The video-camera's video output was connected to an RCA video three-way splitter. One of the RCA splitter's female sockets served as a video input from the camera, and the other two served as video outputs to the network multimedia recording station and audio-video capturing device, which delivers both video and audio inputs to the computer system via a universal serial bus (USB) connection.

#### **F. Re-installation of the previous digital videostroboscopy unit's functional parts (Table 1)**

- a. Powered speaker
- b. Rigid 70 degree (Berciwald) endoscope
- c. Electroglottograph
- d. Laryngeal and lapel mic

- e. Printer
- f. Light source (halogen and strobe light)
- g. Foot control pedals
- h. Uninterruptible power supply and power isolation unit

#### **IV. Actual patient examination and video recording using a newly refurbished videolaryngostroboscopy system**

Testing of the software and system was done by performing actual videolaryngostroboscopic examination. The newly installed system yielded satisfactory performance in detecting laryngeal observations comparable with the old Kay-Elmetrics videolaryngostroboscopy unit, these include: vocal fold edges, amplitude, mucosal waves, vibratory behavior, glottic closure, ventricular folds, arytenoids, periodicity, salivary/mucous retention, mass/lesions, hyperfunction, vascularizations and voice frequency.

We have successfully used this newly rehabilitated videolaryngostroboscopy system in more than fifty test subjects performed by a trained laryngologist to with successful results (Table 3).

## **DISCUSSION**

Videostroboscopy is a procedure that utilizes a highly sophisticated machine that provides a magnified view of a patient's larynx and aid laryngologists in the clinical evaluation of laryngeal diseases. It combines video-

recording with a technique called stroboscopy to evaluate the function of the vocal cords in patients with voice disorders.<sup>4</sup>

In 2013, the videolaryngostroboscopy unit's system of the Voice and Swallowing Unit of our institution crashed and became inoperable. It was immediately referred to its manufacturer's service staff (Kay-Pentax), and after a thorough evaluation the assessment was due to a computer module and operating system's boot failure. The videolaryngostroboscopy unit is considered unserviceable by its manufacturer.

Technically, the system's central processing unit uses three hard drive internal disk memories: a 120 gigabit (GB) internal hard drive memory for operating system and other software installations, a 73GB SCSI internal hard drive for video-recording and a 120GB internal hard drive for database and systems backup. All the three hard drives are controlled by a fourth specially-engineered KDS internal drive compiling and archiving computer module.<sup>5</sup> This fourth hard drive is the one which malfunctioned; without this, all data files from all other three disks are invaluable, because this carries the Kay-Elementrics' exclusively-engineered software program for video-audio capture, processing, and playback. This rendered the videolaryngostroboscopy system inoperable and previous patients' examination records and results inaccessible.

After the manufacturer considered the unit unserviceable, the department experimented on making the unit functional by applying

available and alternative computer hardwares. The department has identified the components and parts that are functional and those that are not functional (Table 1). Finally, new computer hardwares that are needed are purchased and fitted to the old and functional components of the VLS system. The audio-video feed from the endoscope and lapel mic attached to the new camera system is connected to the USB audio-video grabber, which in turn delivers the photo and video recordings to the CPU (via the audio-video grabber software) and the network multimedia recording station (for backup). The attempt is successful and the new refurbished VLS started to operate again.

The department's videolaryngostroboscopy unit was donated at a cost of three million pesos (Php3,000,000) in 2005. At present this state-of-the-art equipment costs up to six million pesos (Php6,000,000) (Appendix C). The cost of the equipment is prohibitive especially for an institution largely dependent for its major budget from government funds.

With the difficulty in acquiring new equipment, the department has no choice but to try and experiment on making the unserviceable unit functional again in order to prevent disruption of its services to its clientele. The department spent only twenty-one thousand pesos (Php21,000) to make the unserviceable unit operate again. The amount is for the purchase of the new computer hardware, camera system and other minor materials. The cost of installation including

the cost of labor is free as it is done by the authors themselves.

The newly rehabilitated VLS system (excluding the network multimedia recording station's 1TB exclusive internal memory drive) is capable of storing thirty-two thousand endoscopic examinations and tests at approximately 30MB of data storage space per patient, this is equivalent to three thousand hours of video recording capacity, as compared to the previous system's seven hours capacity<sup>6</sup>. The network multimedia recording station's 1TB exclusive internal memory drive is presently used as a backup memory drive. Moreover, the software can perform both audio-video recording and still-photo capturing simultaneously.

The new system has satisfactorily performed more than fifty digital videolaryngostroboscopic examinations (Table 3). The results of the endoscopic examinations using the new system with its improvised digital video camera yielded comparable results (Fig.8,9). It is still able to observe similar parameters observe with a regular videolaryngostroboscopy unit like vocal fold edges, amplitude, mucosal waves, vibratory behavior, glottic closure, ventricular folds, arytenoids, periodicity, salivary or mucous retention, mass or lesions, hyperfunctions, vascularizations and voice frequency. At present, the department is able to maintain the services of the Voice and Swallowing unit for all patients.

In conclusion this study presents a rehabilitated and functional videolaryngostro-

boscopy system from an old, unserviceable digital videolaryngostroboscopy unit adapted and fitted with readily-available digital hardwares and software. The results of videolaryngostroboscopic study among patients using the rehabilitated videolaryngostroboscopy unit shows comparable results with the old videolaryngostroboscopy unit.

## ACKNOWLEDGEMENTS

I would like to sincerely extend my deepest gratitude to my mentors for helping me in the conceptualization and design of this surgical instrumentation research paper, they have extended their endless support in the analysis and realization of this project for which I would be deeply indebted. I would also like to thank Ms.KMR for her extended help to this research work, and to my family for their unwavering support. Thank you very much to all of you.

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## APPENDIX A – FIGURES

FIG.1 – Kay-Elemetrics Videolaryngostroboscopy Unit (old/ original)

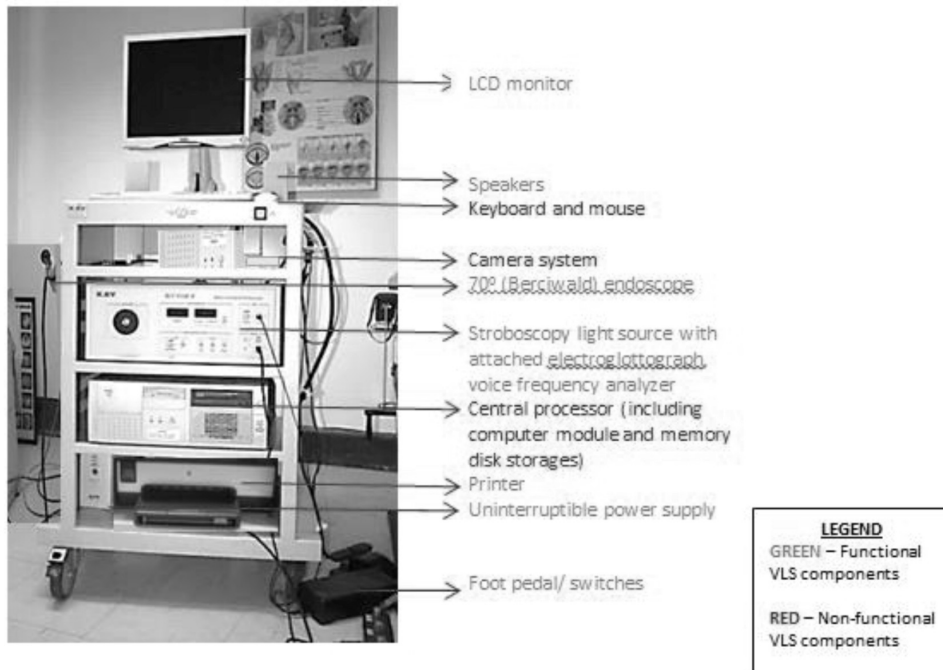


FIG.2 – Compact Central Processing Unit (new)



Intel i3-4130, 3.4Ghz 3Mb LGA1150 processor with 1TB HD SATA (Seagate) digital internal storage device (7200RPM; 64MB) in Microsoft Windows 7 operating system

FIG.3 – Recording Station (new)



AVD1089 Verbatim Network Multimedia Recording Station with High-definition 1080p video playback

FIG.4 – Installation of the Audio-video Grabber (new)



USB Audio-video Grabber with AV capturing system software

FIG.5 – Installation of the Camera System (new)



Water (WAT-202D) 3-chip color video camera

FIG.6 – The Newly rehabilitated Videolaryngostroboscopy System



FIG.7 – Actual patient examination and video recording (with informed consent for documentation)



FIG.8  
(STILL PHOTOS OF PATIENTS RETRIEVED ON  
HARD COPY FILES)



GA / 57 / M  
June 4, 2000



EL / 65 / F  
June 17, 2000

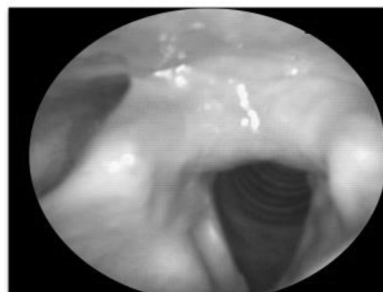


AR / 45 / F  
June 15, 2000



LM / 58 / M  
June 4, 2000

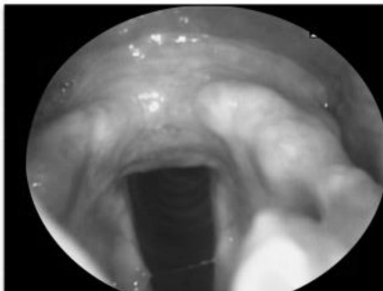
FIG.9  
(REHABILITATED SYSTEM'S STILL PHOTOS –  
Actual Patients)



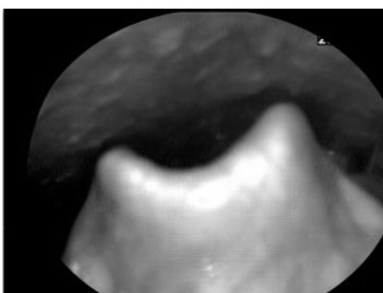
EO / 69 / M  
October 23, 2013



CA / 61 / M  
November 6, 2013



MT / 56 / F  
June 25, 2014



RB / 81 / F  
February 5, 2014

## APPENDIX B – TABLES

**TABLE 1 – KAY-ELEMENTRICS SYSTEM COMPONENTS OVERVIEW** (old unit specifications):

| Model: <i>Kay-Elementrics Digital Stroboscopy System</i> (2005)<br>Features: capture still photos, video with audio recording, add headshot, montage, create AVI and generate/print report.                                                        | Functional Unit | Non-Functional Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------|
| Flat screen LCD monitor with adjustable arm                                                                                                                                                                                                        | X               |                     |
| Powered speakers with magnet, keyboard and mouse                                                                                                                                                                                                   | X               |                     |
| Electroglottograph (EGG)                                                                                                                                                                                                                           | X               |                     |
| Computer-controlled 3-chip Toshiba camera                                                                                                                                                                                                          |                 | X                   |
| Lens and focus ring, rigid 70 degree (Berciwald) endoscope                                                                                                                                                                                         | X               |                     |
| Laryngeal and lapel mic                                                                                                                                                                                                                            | X               |                     |
| Computer module with Pentium 4 processor in Windows 2000 Professional operating system                                                                                                                                                             |                 | X                   |
| Hard drives (3): <ul style="list-style-type: none"> <li>73GB SCSI for video-recording (equivalent to 7hrs video recording) (1)</li> <li>120GB for operating system and other software (1)</li> <li>120GB for database and system backup</li> </ul> |                 | X                   |
| DVD+RW optical drive for video archiving and copying exams                                                                                                                                                                                         | X               |                     |
| 3½ floppy disc drive for transporting/ transferring reports                                                                                                                                                                                        | X               |                     |
| Kay-Elementrics software program for video-audio capture, processing, and playback                                                                                                                                                                 | X               |                     |
| Printer                                                                                                                                                                                                                                            | X               |                     |
| Uninterrupted power supply (UPS) for power backup                                                                                                                                                                                                  | X               |                     |
| 14 gauge steel cart with 5” caster wheels                                                                                                                                                                                                          | X               |                     |
| Medical grade power isolation unit                                                                                                                                                                                                                 | X               |                     |
| Foot control pedals                                                                                                                                                                                                                                | X               |                     |

**TABLE 2 – NEW CENTRAL PROCESSING UNIT SPECIFICATIONS AND ACQUISITION COSTS**

| Hardware Specifications                                                                           | Unit Price           |
|---------------------------------------------------------------------------------------------------|----------------------|
| • AVD1089 Verbatim Network Multimedia Recording Station with High-definition 1080p video playback | Php 1,300.00         |
| • Seagate SATA 1TB, 7200RPM, 64MB internal memory drive                                           | 2,300.00             |
| • USB Audio-video Grabber with AV capturing system software                                       | 500.00               |
| • C+ (PowerLogic) Compact 550-watt computer (CPU) case                                            | 1,200.00             |
| Central processing unit (CPU)                                                                     | 16,350.00            |
| • Intel i3-4130, 3.4Ghz 3Mb LGA1150 processor                                                     |                      |
| • Samsung SH-224DB 24x DVD-W SATA Internal disc writer                                            |                      |
| • Hard disk (Seagate) 1TB SATA 6GB/s, 7200RPM, 64MB                                               |                      |
| • A-shape A4Tech USB mouse+keyboard                                                               |                      |
| • Asus H81M-E H61, DDR1150                                                                        |                      |
| • Kingston 4GB 1333MHz DDR3                                                                       |                      |
| • PALit GT630 2Gb SDDR3 64bit video card                                                          |                      |
| • 1TB HD SATA (Seagate) digital internal storage device (7200RPM; 64MB)                           |                      |
| • AVR 500 watts with 110 volt socket                                                              |                      |
| <b>TOTAL</b>                                                                                      | <b>Php 21,650.00</b> |

**TABLE 3 – PATIENT’S VIDEOLARYNGOSTROBOSCOPIC EXAMINATIONS PERFORMED BY THE NEWLY REHABILITATED VIDEOLARYNGOSTROBOSCOPIC SYSTEM**

| Date      | Patient | Age/Sex | Diagnosis                                      | Test Success  | Test Fail   |
|-----------|---------|---------|------------------------------------------------|---------------|-------------|
| 18-Sep-13 | R.A.    | 74/M    | Laryngopharyngeal reflux disease               | X             |             |
| 23-Oct-13 | P.M.    | 59/M    | True vocal cord polyp, right                   | X             |             |
| 23-Oct-13 | E.O.    | 69/M    | Normal findings                                | X             |             |
| 23-Oct-13 | R.P.    | 52/M    | Laryngopharyngeal reflux disease               | X             |             |
| 25-Oct-13 | M.O.    | 62/F    | Fungal infection, tongue base                  | X             |             |
| 06-Nov-13 | M.A.    | 56/M    | Anterior commissure polyp                      | X             |             |
| 06-Nov-13 | C.A.    | 61/M    | Laryngopharyngeal reflux disease               | X             |             |
| 06-Nov-13 | S.B.    | 70/M    | Laryngopharyngeal reflux disease               | X             |             |
| 08-Nov-13 | D.B.    | 54/M    | Normal findings                                | X             |             |
| 08-Nov-13 | R.D.    | 80/F    | Normal findings                                | X             |             |
| 15-Nov-13 | A.C.    | 74/M    | Presbylaryngeus                                | X             |             |
| 04-Dec-13 | Z.A.    | 37/F    | Incomplete glottic closure etio?               | X             |             |
| 06-Dec-13 | M.A.    | 61/F    | Normal findings                                | X             |             |
| 11-Dec-13 | E.S.    | 70/M    | Normal findings                                | X             |             |
| 13-Dec-13 | E.R.    | 64/F    | Laryngopharyngeal reflux disease               | X             |             |
| 13-Dec-13 | J.L.    | 68/M    | True vocal cord polyp, left                    | X             |             |
| 08-Jan-14 | F.A.    | 77/M    | True vocal cord mass rt t/c malignant          | X             |             |
| 08-Jan-14 | B.B.    | 82/M    | True vocal cord mass ant. commissure           | X             |             |
| 08-Jan-14 | H.I.    | 69/M    | True vocal cord mass lt t/c malignant          | X             |             |
| 22-Jan-14 | A.C.    | 50/M    | Laryngopharyngeal reflux disease               |               | X           |
| 22-Jan-14 | N.S.    | 62/M    | Laryngopharyngeal reflux disease               | X             |             |
| 27-Jan-14 | M.P.    | 51/F    | Laryngopharyngeal reflux disease               | X             |             |
| 29-Jan-14 | H.H.    | 63/M    | True vocal cord cyst left                      | X             |             |
| 05-Feb-14 | R.O.    | 52/M    | True vocal cord paralysis, left                | X             |             |
| 05-Feb-14 | R.B.    | 81/F    | Normal findings                                |               | X           |
| 12-Feb-14 | P.V.    | 64/F    | Laryngopharyngeal reflux disease               | X             |             |
| 21-Feb-13 | H.S.    | 61/F    | Laryngopharyngeal reflux disease               | X             |             |
| 21-Feb-13 | R.D.    | 76/M    | True vocal cord polyp, right                   | X             |             |
| 05-Mar-14 | A.R.    | 54/F    | True vocal cord Nodule, lt; LPR                | X             |             |
| 12-Mar-14 | B.A.    | 76/M    | Normal findings                                | X             |             |
| 26-Mar-14 | M.A.    | 57/M    | Squamous papilloma                             | X             |             |
| 02-Apr-14 | L.C.    | 91/F    | Presbylaryngeus                                | X             |             |
| 02-Apr-14 | R.G.    | 65/M    | True vocal cord polyp, right                   | X             |             |
| 23-Apr-14 | S.B.    | 85/F    | Presbylaryngeus                                | X             |             |
| 23-Apr-14 | J.V.    | 55/F    | True vocal cord Cyst, anterior commissure      | X             |             |
| 23-Apr-14 | O.L.    | 67/M    | True vocal cord cyst left                      | X             |             |
| 14-May-14 | D.D.    | 60/M    | Presbylaryngeus                                | X             |             |
| 14-May-14 | A.B.    | 38/F    | True vocal cord nodules, bilateral             | X             |             |
| 19-May-14 | R.R.    | 51/F    | Dysphonia 2 trauma                             | X             |             |
| 21-May-14 | J.S.    | 77/F    | Spasmodic dysphonia                            | X             |             |
| 28-May-14 | Y.J.    | 49/F    | Subglottic polyp, ant.rt; Pseudosulcus vocalis | X             |             |
| 02-Jun-14 | R.C.    | 62/F    | Normal findings                                | X             |             |
| 17-Jun-14 | J.R.    | 60/F    | Normal findings                                | X             |             |
| 17-Jun-14 | R.T.    | 85/F    | Normal findings                                | X             |             |
| 24-Jun-14 | F.G.    | 75/F    | True vocal cord nodule post.third, bilateral   | X             |             |
| 25-Jun-14 | M.T.    | 56/F    | True vocal cord nodule, bilateral              | X             |             |
| 02-Jul-14 | M.G.    | 69/M    | True vocal cord mass, lt. prob malignant       | X             |             |
| 16-Jul-14 | C.N.    | 60/M    | Normal findings                                | X             |             |
| 25-Jul-14 | L.S.    | 71/F    | True vocal cord nodule, left                   | X             |             |
| 25-Jul-14 | J.A.    | 68/M    | Normal findings                                | X             |             |
| 20-Aug-14 | O.P.    | 63/M    | Normal findings                                | X             |             |
| 10-Sep-14 | E.O.    | 86/F    | Presbylaryngeus                                | X             |             |
| n=52      |         |         |                                                | (n=50)<br>96% | (n=2)<br>4% |

## APPENDIX C

### (MTC OPTO Proposal)



### MTC OPTO - MEDIC, INC.

3rd Floor, OHI Bldg., 179 Yakal Street, San Antonio Village, Makati City, Philippines  
 ☎ (63-2) 887-0658 ☎ (63-2) 382-4564 0917-8448058  
 E-Mail: [sales@mtceyecare.com](mailto:sales@mtceyecare.com)

September 17, 2013

In response to your query, MTC Opto-Medic is very pleased to provide you with the following:

| I set KayPentax Digital Video Stroboscope Model 9295E |       | P 6,500,000.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| consisting of the following:                          |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Rhinolaryngeal Stroboscope                            | 9400  | <p>The light source for endoscopy and stroboscopy includes:</p> <ul style="list-style-type: none"> <li>• Halogen (constant) and xenon (flash) light sources</li> <li>• Laryngeal and Audio Microphones</li> <li>• Pitch triggering by laryngeal microphone or EGG input</li> <li>• Digital display of pitch, phase &amp; amplitude measurements</li> <li>• Four modes of operation (slow, fast, locked, and manual)</li> <li>• Interface to computer for pitch, amplitude &amp; phase information</li> <li>• Foot switch &amp; pedal for remote control of instrument function</li> <li>• Isolation transformer (maintains line leakage to current) levels less than 50 microamps)</li> </ul>                                                                                                                                                                                                                                                                                      |
| Rigid Endoscope                                       | 9106  | Rigid telescopic laryngeal endoscope (70° forward angle with Integrated fiber optic cable) with a 10 mm diameter. Excellent Endoscope for stroboscopic and high-speed images.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Camera, 3-CCD                                         | 9212  | Camera with 3 1/2- inch CCD sensor, S-Video, variable AGC, 470-line Resolution, computer-controllable, and C-mount. NTSC format                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 22-37 mm Zoom Lens Coupler                            | 9118  | Adjustable focal length (22-37 mm) lens with eyepiece adapter. Suitable for all scopes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Digital Video Capture Module                          | 9200C | <p>Digital video computer system with all hardware and software for recording examinations and interfacing to camera, light source, and printer.</p> <p>System Features:</p> <ul style="list-style-type: none"> <li>• Computer (current model Pentium 4 at 3.4+GHz)</li> <li>• 2 GBytes of system RAM</li> <li>• A total of 1400 GBytes (1.4 TeraBytes) of hard disk storage</li> <li>• Four removable hard drives (each with 200 GBytes)</li> <li>• 2 Internal hard drives (each 300 GBytes)</li> <li>• External DVD+-R/RW with CD-R/RW writing capability</li> <li>• SM, SD, MMC, MS, CF and microdrive card interface ports</li> <li>• Windows XP Professional</li> <li>• Professional-level video capture with RGB 24 (4:4:4 sampling)</li> <li>• Hardware and software for computer control of camera</li> <li>• SQL database software for patient and examination database management</li> <li>• Electroglottograph input (EGG, Model 6103, purchased separately)</li> </ul> |



## MTC OPTO - MEDIC, INC.

3rd Floor, OHI Bldg., 179 Yakal Street, San Antonio Village, Makati City, Philippines  
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### Digital Video Stroboscopy Model 9295E..... Page 2

|                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |       | <ul style="list-style-type: none"><li>• Comprehensive educational video on use of stroboscopy for assessing Dysphonia (3 DVDs and 1 eBook).</li><li>• Video Viewer for Kay Digital Video to share exams</li><li>• Vocal Parts and Vocal Pathology Parts I and II</li><li>• Database of Stroboscopic Recordings of Laryngeal Pathologies</li><li>• Digital Strobe Voice Analysis Program</li></ul> <p>NOTE: Computer specifications updated without notice.</p> |
| Printer, Color | 9264C | Color ink-jet printer (digital) which uses 8½" x 11" paper and 4" x 6" high-gloss photography paper. Suitable for reports and image printing. Two paper trays.                                                                                                                                                                                                                                                                                                 |
| Cart           | 9272E | Portable custom-designed cart (14-gauge steel) for KAY systems. Includes shelves and racks for all components with 5" diameter casters. NOTE: Available to KAY stroboscopy and high-speed video customers only. (220V)                                                                                                                                                                                                                                         |

**PRICE** : FOB Manila.  
**TERMS** : C.O.D  
**DELIVERY** : Within 60-90 days upon receipt of P.O.  
**WARRANTY** : One year on parts and services.

Thank you for the opportunity to submit our best offer for your requirements. We look forward to meet with you personally for a thorough discussion of our proposal.

Very truly yours,

**MTC OPTO-MEDIC, INC.**

## APPENDIX D – TERMINOLOGY

|      |                                                                          |
|------|--------------------------------------------------------------------------|
| VLS  | Videolaryngostroboscopy                                                  |
| CPU  | Central processing unit                                                  |
| VGA  | Video graphics array                                                     |
| USB  | Universal serial bus                                                     |
| RCA  | Phono or cinch (audio-video) connector<br>(Radio Corporation of America) |
| KDS  | Klee Data System                                                         |
| SCSI | Small Computer System Interface                                          |
| TB   | Terabit                                                                  |
| GB   | Gigabit                                                                  |
| MB   | Megabit                                                                  |
| LPR  | Laryngopharyngeal reflux disease                                         |
| TVC  | True vocal cord                                                          |

## APPENDIX E - GRAPHIC DIAGRAMATIC RECONSTRUCTION OF THE VLS UNIT

