

-RXUQDO RI &RPPXQLW\ 0HGLFLQH +

7HOHVXUJHU\ DQG 5RERWLF 6XUJHU\ (WKLFDO

6 FHDQX 6QJHOHVFD@HU1DXWUD\$FX  
2EVWHWULFV DQG \*IQDHRORJ\ &OLQLF &UDLRYD (PHUJHQF\ &RXQW\ +RVSLWDO 3KRHLQ[ 0HGLFDO &HQV  
7HDFKLQJ \$VVLVWDQW 8QLYHUVLW\ RI 0HGLFLQH DQG 3KDUPDF\  
8QLYHUVLW\ RI 0HGLFLQH DQG 3KDUPDF\  
\$VVRFLDWH 3URIHVVURU 2EVWHWULFV DQG \*IQDHRORJ\ &OLQLF )LQDQWURSLD &OLQLFDO +RVSLWDO  
&RUUHVSRLQJLQJ DXWKRU 6LGRQLD 0DULD 6DFHDQX &UDLRYD (PHUJHQF\ &RXQW\ +RVSLWDO#&UDLRYD  
5HFHLYHG-&GDWH \$FFHSHQG GDWH 3XEOLVKHG GDWH -XQH  
&RSULJKW < 6DFHDQX HW DO 7KLW LV DQ RSHQ DFFHVV DULFODH GLVWULEXWHG XQGHU WKH WHU  
XVH GLVWULEXWLRQ DQG UHSURGXFWRQ LQ DQ\ PHGLXP SURYLGHG WKH RULJLQDO DXWKRU DQG VRXU

\$EVWUDFW  
5RERWLFJHU\ DVXUJLFDQ SURFHGXUH WKDW SODFHV D FRPSXWHU RU D FRPSXWH  
DQG SDWLHQW GXULQJ VXUJHU\ DQG LQYROYHV WKH WRWDO FRQWURO RI WKH V  
VXUJHU\ DUH QHZ FRQFHSWV WKDW DUH YHU\ QHFHVVDU\ IRU WKH PHGLFDO SUDF  
RSSRUWXQLWLHV FUDWHDG /HJDO DQG HWKLFDO LPSOLFWRQV OLQNHG WR WK  
VXUJHU\ VKRXOG EH FODULILHG IRU SURSHU XVH DQG IRU HOPELQ@YL@JXQH  
HWKLFDO DQG OHJDO UHTXLUPHQWV UHJDUGLQJ WHOHVXUJHU\ DQG URERWLF VXU  
ZRUG > @

.H\ ZRUGV

5RERWLF DVXUJLFDQ/XUJHU\ PDOSUDFWLPH (WKLFDO GLVWULFV@DδδÀδVVVXUJHU\  
7HOHPHQWRULQJ D SK\VL7@δ0FRQWDFW EHWZ  
,QWURGXFWRQ GH•€δ 0 € p0RI ODSURVFRSL  
V\$PH WLPH OHDGLQJ WR EHW

5RERWLF DVVLVWHG VXUJHU\ ZDV ILUVW GHYHORSHG DEOHWKALHSD@WPHO@GRI  
1\$72 DV D QHHG WR SURYLGH VXUJLFDQ DVVLVWDQFH WR VRO@GLDQV Q8VWHLFWDQ  
WKH EDWVOHILHOG > @ 3KLO \*UHHQ ZDV WKH ILUVW WRFRFRSDHON BQ &FRQRPL  
V\WHP FRQVLVWLQJ RI WZR FDFHUDV DQG D WHOHUREM \$VWVWHP DZDUDFRHG QV  
VXUJLFDQ WDEOH VLWXDWHG LQ WKH EDWVOHILHOG WWKDWDFHHV@R7RRVDFSHDWE  
WUDQVPLWWLQJ LPDJHV RI VXUJHU\ WR D FRPSXWHU VLWXDWHG DW D EHUWDL  
GLVWDQFH IURP ZKLFK D VXUJHRQ ZDV FRQWUROOLQJ WKH VXUJLFDQ WHOHPHQWRUL  
> @ EDUULHUV DQG HOPLWV  
HWKL`@δ0À``€€`3t`@•P0€

6LQFH WKH\ ZHUH ILUVW XVHG WHOHVXUJHU\ DQG URERWLF DVVLVWHG VXUJHU\  
KDYH EFRPH LQFUHDVLQJ@ XVHG LQ WKH PHGLFLQH EHFDXVH RI WKH PD@JHQ  
DGYDQWDJHV WKH\ SURYLGH > @ DUH FKDUDFW@ULV@ δ±E  
GRFWRUV IURP GL7y7UP

7KH LPSRUWDQFH RI WHOHPHGLFLQH WHOHVXUJHU\ DQG GLVWDQFH VXUJHU\GLY  
QRW UHVWULFWHG RQ@ WR WKH DELOLW\ RI SHUIRULQJ \$W@KRXK WHOHPHGLFL  
DUHDV ZKHUH WKHVH DUH QRW RWKHUZHUV SRVVLEOH DQF@LQJ WKH EFRWRUV  
WHOHPHQWRULQJ ZKLFK LQYROYHV WUDLQLQJ PHGLFDO DSSURFHVW@H@QGHG W  
SHUIRULQJ WKRVH SURFHGXUHV > @ HPLJUDW@LR@ R7P0  
FRXQWU\ RU DQ\ RWKHU

5RERWLF DVVLVWHG VXUJHU\ ZDV LQLWLDOO\ VFFHVVIOδÀ0@DV OVLWXDWOW@IC  
VXUJHU\ > @ \$V URERWLF VXUJHU\ KDV EFRPH LQFUHDVLQJ@ SUHVHQW LQW  
SUDFWLPH

7HOHVXUJHU\ LV GHILQ@ δY@@`0DQ\ VXUJLFDQ SURFHGXUH SHUIRUP@ δY@PÀ  
VXUJHR @` TVpD ``€P À`@δ0 WHDP @` @tVpDQ\ GLVWDQFH IURP WKH SDW@LHQW  
3uUDQFK RI  
ZKLFK LQYROYHV XWLQVLQJ PHGLFDO LQIRUPDW@LR @`EPÀ VUD  
FDUH > @

:LWK WHOHPHGLFLQH RU URERWLF DVVLVWHG VXUJHU\ WKH HWKLFDO SULQFLSO  
RI