

6 & 1 \$5HODWHG 6HL]XUH 'LVRUGHUV

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,QLWLDO 3RVWLQJ 1RYHPEHU

6XPPDU\

'LVHDPH FKDUH6FWHJHODWLFV VHL]XUH GLVRUGHUV HQFRPSDVV
 IURP VLPSON IHEULOH VHL]XUHV)6 DQG JHQHUDOLJHG HSLO
 DW WKH PLOG HQG WR 'UDYHW V\QGURPH DQG LQWUDFWDEOH
 FORQLF VHL]XUHV ,&(*7& DW WKH VHYHUH HQG 3KHQRW\SH
 'UDYHW V\QGURPH DOVR NQRZQ DV VHYHUH P\RFORQLF HSLO
 P\RFORQLF HSLOHSV\ LQ LQIDQF\ 30(, DUH XVXDOO\ DVVRFI
 FRPPRQO\ REVHUYHG SKHQRW\SHV LQFOXGH P\RFORQLF DVW
 V\QGURPH /HQQR[*DVWDXW V\QGURPH /*6 LQIDQWLOH VS
 HQFHSKDORSDWK\ DQG VHL]XUH 7KH SKHQRW\SH FDQ YDU\

'LDJQRVLV WKH VLODQR SUMORDWHG VHL]XUH GLVRUGHUV UHOL
 JHQHWLF 6HVS\6HVS\HQFH DQDO\VLV DQG GHOWLRQ WHVWLQ
 EDVLV

0DQDJHPH7LQW WPHQW RI \$QWLHHSVODHSMRQ VGUXXV \$('V LQFOX
 EHQJRGD]HSLQH V GLD]HSDP DQG FORQD]HSDP WRSLUDPDV
 HIIHFWLYH EXW SRRUO\ WROHUDW\HGHFHQD\HQ RI LWHV RQGH
 FRPSOLF6WLRQ SURWHFWLYH KHOPHWV E\ LQGLYLGXDOV ZLW
 DVWDWL6XSYHSDQDQ QHXURSV\FKRORJLFDO HYDOXDWLQ
 DQG EHKDYLRUDO GHWHULRUDWLQ ((* PRQJHQRULQJ IRU QH
 FLUFXPVWDQ\$H'W WPDDEBQJHSLQH ODPRWULJLQH DQG YLJD
 RU LQFUHDVH P\RFORQLF VHL]XUHV SKHQ\WRLQ ZKLFK FDQ
 ZKLFK D VXGGHQ ORVV RI FRQVFLRXVQHVV FRXOG OHDG WR
 GULYLQJ RU ZRUNLQ2VSDHQS(DWFKDQDQ DQG VWLULSHQV
 WUHDWPHQW RI 60(, DUH QRW)'\$ DSSURYHG IRU WKLV XVH L
 FDQ H[DFHUEDWH VHL]XUH 3HUVRQV ZLWK HSLOHSV\ VKRXO
 ODZV

*HQHWLF FRQV\$6DQWHG VHL]XUH GLVRUGHUV DUH LQKHULW
 PDQQHU \$ SURSDQSHZLWKHQVHL]XUHGLQRXQDWERDQKDYH D
 SURSRUWLQ RQGHQVWDXWLQVEYDULHV E\ SKHQRW\SH 7KH
 SUREDQG6ZLWKQDWHG VHL]XUH GLVRUGHU DQG DQ DIIHFWH
 VHYHULW\ RI WKH SKHQRW\SH LQ WKH SVRSDQ, LQFHQVH7&

DUH WKH GHVQPHWUJ\JRXV PXWDWLRQ (DFK FKLOG RI DQ
 6&1 \$HODWHG VHL]XUH GLVRUGHU KDV D FKDQFH RI LQKHU
 RI GHYHORSLOJ VHL]XUHV LV OHVV WKDQ EHFDXVH RI UH
 IRU SUHJQDQFLHV DW LQFUHDVHG ULVN LV SRVVLEOH LI WKH
 NQRZQ

'LDJQRVLV

&OLQLFDO 'LDJQRVLV

7KH FOLQLFDO&GLDQDWHGRMHL]XUH GLVRUGHUV LV FRPSOLF
 LVVXHV LQYHODWHG VHL]XUH GLVRUGHUV

- 7KH SKHQRW\SHV FRYHU D EURDG VSHFWUXP RI VHYHUL
- 7KH HSLOHSV\ SKHQRW\SHV DUH LQFRPSOHWHO\ VSHFLI
 FRQGLWLRQV DV ZHO
- 6RPH HSLOHSV\ SKHQRW\SHV UHIHU WR IHDWXUHV REVH
 SDUWLFXODU LQGLYLGXDO LQ WKH IDPLO\

7HUPV XVHG LQ WKH OLWHUDWXUH WR GHVFULEH WKH SKHQR
 HSLOHSV\ V\QGURPH WHUPLQRORJ\ DV GHILQH E\ WKH ,QWH
 ,/\$ 7HUPV XVHG WR GHVFULEH WKH SKHQRW\SHV GHORLOO
 LQFOXGH WKH IROORZLQJ

&RPPRQO\ DVVRFLDWHG SKHQRW\SHV

-)HEULOH VHL]XUH PD\ RU PD\ QRW KDYH IHDWXUHV VXJ
 6&1 \$HODWHG FRQGLWLRQ GHVFULEHG DERYH
- *HQHUDOLJHG HSLOHSV\ ZLWK IHEULOH VHL]XUHV SOXV
- 'UDYHW V\QGURPHRZGHU P\RFORQLF HSLOHSV\ LQ LQID
 SRO\PRUSKLF P\RFORQLF HSLOHSV\ LQ LQIDQF\ 30(
 1RWH 7KH WHUP 'UDYHW V\QGURPH LV SUHIHUHG EHF
 LPSOLHG E\ WKH GHVFULSWLYH QDPH V FDQ EH DEVHQV
 RWKHUZLVH VLPLODU
- 6HYHUH P\RFORQLF HSLOHSV\ ERUGHUOLQH 60(
- ,QWUDFWDEOH FKLOGKRRG HSLOHSV\ ZLWK JHQHUDOLJH
 *7& ZKLFK GRHV QRW UHSUHVHQW DQ ,/\$ GHILQH HSLO
 ODWH RQVHW 'UDYHW V\QGURPH LQ WKH ,/\$ FODVVLILF
 1RWH 7KLV FODVVLILFDW&RQGLWLRQXVHIDGLQVWKKXV
 IRU FRPSOHWHQHVV
- ,QIDQWLOH SDUWLDO VHL]XUVUZH\WKUHDOVREDSUVRFLDO
 VHL]XUHV RULHQWDQF\IRFHO\HSLOHSDQWLOH PXOWLI
 HSLOHSV\+DUNLQ DQG FROHDJXHV

/HVV FRPPRQO\ DVVRFLDWHG SKHQRW\SHV

- 0\RFORQLF DVWDWLF HSLOHSV\QDWL'DQVSHUWHURPRQFI
 DV D JURXS RI LQGLYLGXDOV ZLWK D JHQHWLF SUHGLVS
 WKH ,/\$ FODVVLILFDWLRQ V\VWHP LW LV D VXSHUVHW L
 P\RFORQLF HSLOHSV\ DV ZHO DV FKLOGKRRG RQVHW H
 VHL]XUHV

8VLQJ D YDULHW\ RI PHWKRGV WR LGHQWLIFY GHODWHV GHODWHV GHODWHV GHODWHV GHODWHV GHODWHV GHODWHV GHODWHV GHODWHV GHODWHV
 PXWDWLRQ LGHQWLILHG RQ VHTXHQFH DQDO\VLV ODGLD HW DO IRXQG GHODWHV RQ LQ
 DQG 6XOV HW DO IRXQG GHODWHV RQ LQ WKUHH RI ,Q WKHVH WKUHH VWXG
 GLG QRW KDYH D VHTXHQFH YDULDQW LGHQWLILHG RQ VHTXHQFH DQDO\VLV KDG DQ LGHQW
 ,QWHUSUHWDWLRQ RQ LQ WKHVH VWXG RQ LQ LQWHUSUHWD
 UHVXOWV FOLFN KHUH

7HVWLQJ 6WUDWHJ\

7R FRQILUP WKH GLDJQRULV D SURSHQV\ ZHUWLOWHG
 LQ D SUREDQG ZKRWH IDPLO\ KLVWRU\ LQFOXGHV WKH IROOR

- 0RUH WKDQ RQH PHPEHU ZLWK HSLOHSV\ RU IHEULOH VHTXHQFHV DUH SUHVHQW
-)HEULOH VHLJXUHV EHIRUH DJH RQH \H DU
-)HEULOH VHLJXUHV DIWHU DJH VL\ \H DU
-)HEULOH VHLJXUHV ZLWK XQXVDO VHYHULW\ LQFOXGLQ
-)HEULOH VHLJXUHV WKDW SUHFHGH XQSURYRNHG L H JHQHUDOLJHG WRQLF FORQLF P\RFORQLF P\RFORQLF D

3UHQDWDO IRUDWRULVN SUHJQDQLHV UHTXLUH SULRU LGHQW
 PXWDWLRQ LQ WKH IDPLO\

*HQHWLFDOO\ 5HODWHG \$OOHOLF 'LVRUGHU

2WKHU SKHQRW\SHV DVVRFLDWHG ZLWK PXWDWLRQV LQ

- 3DQD\LRWRSRORXV V\QGURPH >*URVVR HW DO @
-)DPLODO KHPLSOHJLF PLJUDLQH >'LFKJDQV HW DO @
-)DPLODO DXWLVP VHH \$XWLVP 2YHU\HZ >:HLVV HW D
- \$ FRQWLJRXV JHQH GHODWHV V\QGURPH RI VHYHUH H G\VPRUSKLF IHDWXUH\ V\QGURPH GHODWHV WKUHH PRVVRPDO C T T 2QH DIIHFWHG LQGLYLGXDO KDV EHHQ GHVFULE

&OLQLFDO 'HVFULSWLRQ

1DWXUDO +LVWRU\

7KH QDWXUDO 6&1 \$ 5HODWHG HSLOHSV\LV VLVVVRQJO\ LQIOXH
 ZKLFK FDQ UDQJH IURP VLP SOH IHEULOH VHLJXUHV)6 DQG
 VHLJXUHV SOXV *()6 DW WKH PLOG HQG WR VHYHUH P\RFOR
 LQWUDFWDEOH FKLOGKRRG HSLOHSV\ ZLWK JHQHUDOLJHG WR
 HQG >.LPXUD HW DO ODQWHJDJD HW DO)XMLZDUD
 ZLWK LQWUDFWDEOH VHLJXUHV H J 'UDYHW V\QGURPH XVX
 IRUP RI SURJUHVVLYH GHPHQWLD

7KH SKHQRW\SH YDULHV HYHQ DPRQJ IDPLO\ PHPEHUV ZLWK

7KH IHDWXUHV DQG FRXUVH IRU 6&1 \$ 5HODWHG P\RFORQLF GHODWHV RQ LQ
 VXPPDULJHG LQ 7DEOH LQFOXGH WKH IROORZLQJ

)HEULOH VHLJXUHV LQ 7KH RI FKLOGKRRG VHLJXUHV WKDW RFF
 IYHU 7KH HSLGHPLRORJLF GHILQLWLRQ UHTXLUHV WKH IRO

*HQH5HYLHZV 6&1 \$ 5HODWHG 6HLJXUH 'LVRUGHU

6HYHUH P\RFORQLF HSLOHSD\GHEVHUGHSUOLRQ HV 60(, >)>
ZKR KDYH VRPH EXW QRW DOO RI WKH IHDWXUHV RI 60(, >)>

,QWUDFWDEOH FKLOGKRRG HSLOHSD\ ZLWK JHGHUQDGGJHG WR
DV JHGHUDOLJHG VHLJXUHV LQFOXGLQJ DEVHQFH VHLJXUHV D
RQVHW LQ LQIDQF\ RU FKLOGKRRG +RZHYHU SDUWLDO VHLJ
LQGLYLGXDOV >%RQDQQL HW DO @ /RFDOLJHG HSLOHSD\
FRPSOH[SDUWLDO VHLJXUHV PD\ DOVR EH VHHQ &KLOGUHQ
VHLJXUHV RIWHQ GHYHORS FRJQLWLYH LPSDLUPHQW 7KH GL
V\QGURPH LV QRW FOHDU DQG WKH IRUPHU LV QRW LQFOXGH

,QIDQWLOH SDUWLDO VHLJXUHV ZLWK IRDDEOHJHBM EHJLQ
ZLWK PXOWLSOH LQGHSHQGHHQW JRQH RI VHLJXUH RQVHW LQ
SDUWLDO VHLJXUHV DUH RIWHQ WKH ILUVW PDQLHVWDWLRQ
IHEULOH VHLJXUHV 6HYHULW\ YDULHV DQG SKDUPDFRUHVLV
0\RFORQLF VHLJXUHV DUH UDUH EXW PD\ EH SUHFLSLWDWHG
LQDFWLYDWH WKH VRGLXP FKDQQHO LQFOXGLQJ SKHQ\WRLQ
GHWHULRUDWLRQ PD\ RFFXU HVSHFLDOO\ ZKHQ VHLJXUH FR
(OHFWURHQFH SKDORJUDSK\ VKRZV PXOWLIRFDO LQGHSHQGH
GLVFKDUJHV PD\ EH VHHQ

7DEOH 3KHQRW\SH 1L\$5WODWHG 6HLJXUH 'LVRUGHUV

'LVRUGHU	'LVWULEXWLRQ
6LPSOH IHEULOH VHLJXUHV)6	8QNQRZQ
)HEULOH VHLJXUHV SOXV)6	8QNQRZQ
*HQHUDOLJHG HSLOHSD\ ZLWK IHEULOH VHLJXUHV SOXV *)(6	
6HYHUH P\RFORQLF HSLOHSD\ LQ LQIDQF\ 60(,	
,QWUDFWDEOH FKLOGKRRG HSLOHSD\ ZLWK JHGHUQDOLJHG WRQLF FORQLF VHLJXUHV ,&(*7&	

0XOOH\ HW DO

)XMLZDUD HW DO

7KH IHDWXUHV DQG FRXUVH IRU WKH 0&1 \$5WODWHG 6HLJXUH 'LVRUGHUV
LQFOXGH WKH IROORZLQJ

0\RFORQLF DVWDWLGHSHQGHG DV WKH FRPELQDWLRQ RI P\RFOR
DW\SLFDO DEVHQFH VHLJXUHV \$OWKRXXJK LVRODWHG P\RFOR
RFFXU WKH\ DUH QRW FKDUDFWHULVWLF RI WKLV V\QGURPH
*DVWDWXW V\QGURPH \$JH RI RQVHW UDQJHV EHWZHHQ VHYH
PRVW RIWHQ EHJLQV DIWHU DJH WZR \HDUV 'HYHORSPHQW S
FRXUVH LV YDULDEOH DQG FDQ UDQJH IURP VSRQWDQHRXV
LPSDLUPHQW WR LQWUDFWDEOH VHLJXUHV ZLWK VHYHUH PHQ
,Q RQH VHULHV RI LQGLYLGXDOV ZLWK 0\$(LQFOXGLQJ R
FRQWUROV WKUHH LQGLYB&X \$5WODWHG 6HLJXUH 'LVRUGHUV
RQH RI WKH WKUHH KDG D SKHQRW\SH FRQVLVWHQW ZLWK 0\$(
0\$(ZDV QRW SUH&1 \$5WODWHG 6HLJXUH 'LVRUGHUV

/HQQR[*DVWDWXW V\QGURPHG /D\$ VORZ VSLNH ZDYHV RQ ((* G
GHOD\ DQG PXOWLSOH W\SHV RI JHGHUQDOLJHG VHLJXUHV SD

*HQH5HYLHZV 6&1 \$ 5HODWHG 6HLJXUH 'LVRUGHUV

DWRQLF VHL]XUHV /*6 XVXDOO\ EHJLQV GXULQJ FKLOGKRRG
FDQ EH VHHQ LQ WKLV V\QGURPH DQG VWDWXV HSLOHSWLFX
2QO\ D PLQRULW\ RI SHUVRQV ZLWK \$WKDW\LSKHQRW\DSHOKDQ
FRQWH[W RI D IDPLO\ LQ ZKLFK 'UDYHW V\QGURPH RFFXUV >6
SRRUO\ FKDUDFWHUL]6&1,DVVRFLDFOHGU*3KHWHUW SKHQRW\
WKH ODUJHU FRKRUW RI /*6

,QIDQWLOHGMSLDPG\ DV FOXVWHUHG VHL]XUHV WKDW VKRZ EU
DVVRFLDWHG ZLWK D VORZ ZDYH WUDQVLHQW RQ ((* RIWHQ
WKH EDFNJURXQG %RWK ILQGLQJV PD\ EH LQWHUPL[HG ZLWK
VHL]XUHV VKRZV KLJK YROWDJH VORZLQJ DQG D PXOWLIRFDQ
>\$U]LPDQRJORX HW DO 6&@ \$LVVRFLDFOHGU*3KHWHUW SKHQRW\
KDV EHHQ UHSRUWHG RQFH >:DOODFH HW DO @ 7KH VLQJ
UHSRUWHG FDVHV DOWKRXJK SXEOLFDWLRQ ELDV PDNHV LW

9DFFLQH UHODWHG HQFHSKHORSDDVDXQG GHQ]RQVHW RI VH
HQFHSKDORSDWK\ LQ LQIDQWV KRXUV DIWHU LPPXQLJDWLR
6&1 \$PXWDWLRQV LQ FKLOGUHQ GLDJQRVHG ZLWK SRVW

*HQRW\SH 3KHQRW\SH &RUUHODWLRQV

0XOOH\ HW DO 6&1\$PXWDWLRQV LQ FOXVWHU LQ WKH & WHU
ORRSV FRQQHFWLQJ 6 DQG 6 HVSHFLDOO\ LQ WKH ILUVW WH
0XWDWLRQV WKDW SUHGLFW SUHPDWXUH SURWHLQ WUXQFDV
FRQVLVWHQW FRUHHODWLRQ EHWZHHQ PXWDWLRQ W\SH PXV
IRXQG

\$Q HVWLPDWHG RI WKH PXWDWLRQ SRVLWLYH 60(, FDVHV K
PXWDWLRQ ZKLFK LV DVVRFLDWHG ZLWK D PLOGHU SKHQRW\
>0XOOH\ HW DO @

3HQHWUDQFH

6&1 \$UHODWHG VHL]XUH GLVRUGHUV VKRZ LQFRPSOHWH SHQH

3HQHWUDQFH PD\ YDU\ E\ SKHQRW\SDRQ\ PXWDWLRQ)HUWLD
WKH SHQHWDQFH WR EH IRU WKH *()6 SKHQRW\SHGHZKHU
D SHQHWDQFH RI IRU WKH IDPLOLDO VLPSON IHEULOH VH

3UHYDOHQFH

7KH SUHYDOHQFH UHODWHG VHL]XUH GLVRUGHUV LV XQNQRZQ

'LIIHUHQWLDO 'LDJQRVLV

)RU FXUUHQW LQIRUPDWLRQ RQ DYDLODELOLW\ RI JHQHWLF V
VH\HQH7HVWV /DERUDWRU\ 'LUHFWRU\

7KH SKHQRW\SHV W&1\$PXWDWLRQV ZLWK QHLWKHU QHFHVVDU
GLDJQR\WKH UHODWHG VHL]XUH GLVRUGHU 2WKHU FRQGLWLRQ
PXWDWLRQV LQ RWKHU JHQHV PD\ EH DVVRFLDWHG ZLWK WK

,W LV PRVW LPSRUWDQW WR LGHQWLI\ SRWHQWLDOO\ WUHDW
>\$U]LPDQRJORX HW DO 5RJHU HW DO @

• 3\ULGR[LQH GHSHQGHW VHL]XUHV DQG % UHODWHG HS

-)ROLQLF DFLG UHVSQRVLYH VHL]XUHV D UDUH FDXVH IROLQLF DFLG DGPLQLVWUDWLRQ
- ,QERUQ HUURUV RI PHWDEROLVP LQFOXGLQJ PLWRFKRQ GLDJQRVHG E\ WKH SUHVHQFH RI DEQRUPDO VHUXP FRQ DPPRQLD DPLQR DFLGV DQG RU DEQRUPDO FRQFHQWUD
- *OXFRVH WUDQVSRUWHU W\SH GHILFLHQF\ ZKLFK LV G FRQFHQWUDWLRQV DQG UHVSRRGV WR WKH NHWRJHQLF
- +HSDWLF SRUSK\ULDV ZKLFK XVXDOO\ GHPRQVWUDWH S DQG UHGXFHG PRQRS\UUROH SRUSKRELOLQRJHQ 3%* G

,I WKH IDPLO\ KLVWRU\ LV QHJDWLYH RU XQDYDLODEOH VSR FDXVH QHHG WR EH LQFOXGHG LQ WKH GLIIHUHQWLDO GLDJQRQVSHFLILF LPDJLQJ ILQGLQJV 6RPH JHQHUDO FDWHJRULH IROORZLQJ >\$UJLPDQRJORX HW DO 5RJHU HW DO @

- 7UDXPD
- +\SR[LD
- 6HTXHODH RI PHQLQJLWLV RU KHPRUUKDJH
- ,QIHFWRXV RU DXWRLPPXQH FHUHEULWLV
- 9DVFXOLWLV
- 3DUDQHRSDVWLF V\QGURPH
- 7R[LQV LQFOXGLQJ GUXJ ZLWKGUDZDO
- (QGRFULQRSDWK\

,I WKH IDPLO\ KLVWRU\ LV SRVLWLYH IRU RWKHU LQGLYLGXD VKRXOG LQFOXGH WKH IROORZLQJ LQKHULWHG HSLOHSV\ V\Q HW DO @

- %HQLJQ IDPLOLDO QHRQDWHO VHL]XUHV
- %HQLJQ IDPLOLDO LQIDQWLOH VHL]XUHV
- %HQLJQ FKLOGKRRG HSLOHSV\ ZLWK FHQWURWHPSRUDO
- &KLOGKRRG RFFLSLWDO HSLOHSV\
- \$EVHQFH HSLOHSLHV
- \$XWRVRPDO GRPLQDQW QRFWXUQDO IURQWDO OREH HSL
-)DLOLDO WHPSRUDO OREH HSLOHSLHV
-)DLOLDO IRFDO HSLOHSV\ ZLWK YDULDEOH IRFL

\$W OHDVW VHYHQ 1% ULQV IHEULOH LQGLHG 7DEOH >C @ 7KH SKHQRW\SH LQ VLPSON IHEULOH VHL]XUHV LV XVX VHL]XUHV DVVRFLDWHG ZLWK *()6 VHH &OLQLFDO 'HVFULSW \$ULQDPL @

7DEOH *HQHVDQG/RFL\$VVRFLDWHGZLWK6LPSON)HEULOH6HL]XUH

/RFXV1DPH	*HQH&KUPEROVRPDO/RFXV
)(%	T T
)(%	S
)(% 6&1\$	T
)(%	T T
)(%	T T
)(%	S
)(%	T

7KHPRGHIRLQKHULWDQFHIRUPRVW*()6LVXQNQRZQ2QO
ODUJHIDPLO\ZLWK*()6ZHUH6&1\$5HODWHG6HL]XUH

HQHWLFORFLNQRZQWR EHDVVRFLDWHGZLWK()6LQFOX

- 9ROWDJHJDWHGVRGLXPFKDQQHOJHGHV
 - 6&1\$(VFD\JHWDO(VFD\JHWDO:DOODFH
@
 - 6&1%:DOODFHJHWDO:DOODFHJHWDO\$XG
 - 6&1\$6XJDZDUDJHWDO@
- *\$%\$UHFHSWRUJHGHV
 - *\$%5*>%DXODFJHWDO:DOODFH0DULQLJHWDO
 - *\$%5*>'LEEHQVJHWDO@

0DQDJHPHQW

(YDOXDWLRQV)ROORZLQJ,QLWLDO'LDJQRVLV

7RHVWDEOLVKWKHH[WHQWRIRGLVH&KUPEROVRPDO/RFXV
GLVRUGHUWKHIROORZLQJHYDOXDWLRQVDUH UHFRPPHQGH

- 1HXURORJLFH[DPLQDWLRQ
- &RJQLWLYHQHXURSV\FKRORJLFDHYDOXDWLRQ
- %HKDYLRUDOQHXURSV\FKRORJLFDHYDOXDWLRQ
- (OHFWURHQFHSKDORJUDP((LQFOXGLQJYLGHR((W
VHPLRORJ\LVXQFOHDU

7UHDWPHQWRIRI0DQLIHVWDWLRQV

&DUH LV EHVW SURYLGHG E\ D SK\VLFLDQ H J SHGLDWULF
SKDUPDFRWKHUHS\IRUWKLVGLVRUGHU

7KHIIHFWLYHQHVVRIRISKDUPDFRORJLFWUHDWPHQWPD\EH
DEQR6&1\$FKDQQHOVGLVSURSRUWLRQDWHO@DIDQFWW\$DQWQH
DVVRFLDWHGVHL]XUHVUHVSRQG RSWLPDOO\WRDQWLHSLOH
UHFHSWRU

*HQH5HYLHZV 6&1\$5HODWHG6HL]XUH'LVRUGHUV

- &ORED]DP PJ P]J&ORED]DP LV QRW)'\$ DSSURYHG IR
WKH 86
- 6WLULSHQWRO 6WLULSHQWRO LV QRW)'\$ DSSURYHG
EXW LW LV WKH RQO\ PHGLFDWLRQ HYDOXDWHG LQ D GR
LQ LQIDQF\ 60(, WUHDWPHQW VWXG\ >&KLURQ HW DO
GHPRQVWUDWHG HILFDF\ RI WKH GUXJ ZKHQ FRPSDUHG
PRGHUDWH VLGH HIIHFWV LQFOXGLQJ GURZVLQHV ORV
QHXWURSHQLD LQ LQIDQWV DQG \RXQJ FKLOGUHQ ZHUH
*\$%\$ UHFHSWRUV >4XLOLFKLQL HW DO @ EXW DOVR K
WKH VHUXP FRQFHQWUDWLRQ RI RWKHU FRPPRQ \$('V LG
DQG LWV PHWDEROLWH QRU FORED]DP >7KDQK HW DO
PD\ QRW WROHUDWH VWLULSHQWRO EHFDXVH RI GLJHVV
HW DO @
- %HQ]RGLD]HSLQH LGXDOV WDNLQJ VWLULSHQWRO PXVW
EHQ]RGLD]HSLQH >7KDQK HW DO @ \$ VLQJOH LQIXV
DSSHUV WR EH VDIH >7KDQK HW DO @
- 7RSLUDPD]SROD HW DO @
- 9DOSURLF DFLG NJ GD\ >7KDQK HW DO @
- 3KHQREDU\$DWDKXJK HIIHFWLYH SKHQREDUELWDO LV SP
HIIHFWV RQ FRJQLWLRQ :KHQ LW LV WDNHQ LQ FRPELQ
FRQFHQWUDWLRQ RI SKHQREDUELWDO LV LQFUHDVHG EH
DQG H[FUHWLRQ RI EDUELWXUDWHV

3UHYHQWLRQ RI 6HFRQGDU\ &RPSOLFDWLRQV

5RXWLQH VHL]XUH DQG SHUVRQDO VDIHW\ FRXQVHOLQJ LV LG
,QGLYLGXDOV H[SHULHQFLQJ DWRQLF VHL]XUH RU P\RFORQLF
ZHDU D SURWHFWLYH KHOPHW

6XUYHLOODQFH

6HULDO QHXURSV\FKRORJLFDQ HYDOXDWLRQ IRU QHXURORJL
LV DSSURSULDWH

((* PRQLWRULQJ LV DSSURSULDWH ZKHQ QHZ RU GLIIHUHQW

\$JHQWV &LUFXPVWDQFHV WR \$YRLG

&RQWUDLQGLFDWHG DQWLHSLOHSLF GUXJV \$('V

- &DUEPD]HSLQH ODPRWU\ZKLFK DQG LGXDOV RULHQFUHD
P\RFORQLF VHL]XUH >+RUQ HW DO *XHUULQL HW DO
@

- 3KHQ\DWLQW PD\ LQGXFH FKRUHDRDWKHWRVLV >6DLWR

\$FWLYLWLHV LQ ZKLFK D VXGGHQ ORVV RI FRQVFLRXVQHVV F
DYRLGHG VXFK DV EDWKLQJ VZLPPQLQJ GULYLQJ RU ZRUNL

7HVWLQJ RI 5HODWLYHV DW 5LVN

6HH *HQHWLF &RXQVHOLQJ IRU LVVXH UHODWHG WR WHVWL
SXUSRVH

7KHUDSLHV 8QGHU ,QYHVWLJDWLRQ

\$OWKRXXJK FORED]DP DQG VWLULSHQWRO VHH 7UHDWPHQW RI
IRU WUHDWPHQW RI V&H]XUH DWLQGVOR,VHLQLWKH 86 WKHVH WK
FRQVLGHUHG H[SHULPHQWDO DQG DUH QRW)'\$ DSSURYHG

6HDFUK &OLQLFDO7ULDOV JRY IRU DFFHVV WR LQIRUPDWLRQ
GLVHDVHV DQG FRQGLWLRQV

2WKHU

6OHHS GHSULYDWLRQ DQG \$HODWHG 6HL]XUH DWLQGVOR VHH JRRG
RXJKW WR EH HQFRXUDJHG

3HUVRQV ZLWK HSLOHSV\ VKRXOG EH PDGH DZDUH RI ORFDO
UHSRUWLQJ ODZV

6HL]XUH DUH QRW DOZD\ UHVSRQVLYH WR FRQYHQWLRQDO
WKH IROORZLQJ GUXJV WUHDWPHQW \$HODWHG 6HL]XUH
>'UDYHW HW DO @

- (WKRXX[LPLGH DQG KLJK GRVH SLUDFHWDP IRU P\RFORQ
- 7ULSOH EURPLGH
- &RUWLFVRVWHURLGV
- ,PPXQRJOREXOLQV
- 7KH NHWRJHQLF GLHW

*HQHWLF D&H]XUH RI LQIRUPDWLRQ IRU LQGLYLGXDOV
KLVWRU\ WUHDWPHQW PRGH RI LQKHULWDQFH DQG JHQHW
LQIRUPDWLRQ DERXW DYDLODEOH FRQVXPHU RULHQWHG UHV
'LUHFWRU\

6XSSRUW K&H]XUH HVWDEOLVKHG IRU LQGLYLGXDOV DQG
VXSSRUW DQG FRQWDFW ZLWK RWKHU DIIHFWHG LQGLYLGX
LQFOXGH GLVHDVH VSHFLILF DQG RU XPEUHOOD VXSSRUW RU

*HQHWLF &RXQVHOLQJ

*HQHWLF FRXQVHOLQJ LV WKH SURFHVV RI SURYLGLQJ LQGLY
WKH QDWXUH LQKHULWDQFH DQG LPSOLFDPDWLRQV RI JHQHW
PHGLFDO DQG SHUVRQDO GHFLVLRQV 7KH IROORZLQJ VHFWL
WKH XVH RI IDPLO\ KLVWRU\ DQG JHQHWLF WHVWLQJ WR FOD
VHFWLQJ LV QRW PHDQW WR DGGUHVV DOO SHUVRQDO FXOV
IDFH RU WR VXEVLWXWH IRU FRQVXOWDWLRQ ZLWK D JHQHW
GLDJQRVLV F&H]XUH &H]XUH 'LUHFWRU\

ORGH RI ,QKHULWDQFH

6&1 \$HODWHG VHL]XUH GLVRUGHUV DUH LQKHULWHG LQ DQ

1RWH 6&H]XUH \$HODWHG VHYHUH P\RFORQLF HSLOHSV\ LQ LQIDQ
FKLOGKRRG HSLOHSV\ ZLWK JHQHUDOLJHG WRQLF FORQLF VH
QRVHWHURJ\JRXV PXWDWLRQ

5LVN WR)DPLO\ 0HPEHUV

3DUHQWV RI D SUREDQG

- \$ SDUHQW RI WKH SUREDQG LV SUHVXPHG WR KDYH D GL DGGLWLRQDO IDPLO\ PHPEHUV ZKR KDYH VHL]XUHV
- \$ SUREDQG 6&1 \$ 5HODWHG VHL]XUH GLVRUGHU PD\ KDYH W RICH QRXW DWLRQ 7KH SURSRLQWLRQ RIXWIDFV FDXUHG E\ SKHQRW\SH 7KH SHUFHQW D JSHFD SURG DQG JXZHWKLR DQ DQG DQ DIIHFWHG SDUHQW GHFUHDVHV DV WKH VHYHULY LQFUHDVHV
 - 0RUH WKDQ RI LQGLYLGXDOV ZLWK *()6 KDYH D 6&1 \$ PXWDWLRQ
 - 2QO\ DSSUR[LPDWHO\ RI SUREDQGV ZLWK 60(, KD VDF&1 \$ PXWDWLRQ >:DOODFH HW DO &HXOHPDG)XNXPD HW DO @
 - 7HVWLQJ RI SDUHQWV RI FKLOGUHQ 6&1 ZKR KDG 60(, DO PXWDWLRQ VKRZHGH WKDW GH QRXW DWLRQ FKLOGUHQ 2I WKH IRXU FKLOGUHQ ZKR KDG D SDUHQW ZLWK W PXWDWLRQ DQG WZR KDG D WUXQFDWLRQ PXWDWLRQ DV\PSWRPDWLF RU KDG PLOG HSLOHSV\ >*HQQDUR @
 - %HUNRYLF HW 6&1 \$ PXWDWLRQV LQ FKLOGUHQ ZLWK SRVW YDFFLQH HQFHSKDORSEVORQLQH RI W
- ,I D GLVHDVH FDXVLQJ PXWDWLRQ IRXQG LQ WKH SURED H[WUDFWHG IURP WKH OHXNRF\WHV RI HLWKHU SDUHQW PXWDWLRQ LV ORZ EXW JUHDWHU WKDQ WKDW RI WKH J SRVVLELOLW\ RI JHUPOLQH PRVDLFLVP *HUPOLQH PRVD >*HQQDUR HW DO @
- 5HFRPPHQGDWLRQV IRU WKH HYDOXDWLRQ RI SDUHQWV QRXW PXWDWLRQ LQFOXGH PROHFXODU JHQHWLF WHVWLQJ PXWDWLRQ
- \$Q DSSDUHQWO\ QHJDWLYH IDPLO\ KLVWRU\ FDQQRW EH HYDOXDWLRQV KDYH EHHQ SHUIRUPHG 6&1 \$ DWKWHG RI *()6 KDYH DQ DIIHFWHG SDUHQW WKH IDPLO\ KLVWRU\ F RI IDLOXUH WR UHFRJQLJH WKH GLVRUGHU LQ IDPLO\ PHF WKH RQVHW RI V\PSWRPV ,I WKH SDUHQW LV WKH LQGLY RFFXUUHG V KH PD\ KDYH VRPDWLF PRVDLFLVP IRU WKH RU PLQLPDOO\ DIIHFWHG >*HQQDUR HW DO @

6LEV RI D SUREDQG

- 7KH ULVN WR WKH VLEV RI D SUREDQG GHSHQGV XSRQ W SDUHQWV
- ,I D SDUHQW RI WKH SUREDQG LV DIIHFWHG L H KDV W GRFXPHQWHG E\ UHVXOWV RI PROHFXODU JHQHWLF WHV FDXVLQJ PXWDWLRQ EDVHG RQ IDPLO\ KLVWRU\ WKH U PXWDWLRQ LV
- ,I D VLE KDV HSLOHSV\ KH VKH LV SUHVXPHG WR EH DII FDXVLQJ PXWDWLRQ

*HGH5HYLHZV 6&1 \$ 5HODWHG 6HL]XUH 'LVRUGHUV

- ,I D VLE GRHV QRW KDYH HSLOHSV\ WKH SULRU SUREDE
GLVHDVH UHODWHG PXWDWLRQ LV KRZHYHU WKH SU
V\PSWRPV GHSHQGV RQ WKH SHQHWUDQFH ZKLFK FDQ R
DQ HVWLDPDWHG SHQHWUDQFH RI IRU WKH *()6 SKHQ
DV\PSWRPDWLF VLE KDYLQJ LQKHULWHG WKH GLVHDVH F
- ,I D GLVHDVH FDXVLQJ PXWDWLRQ LV IRXQG LQ WKH SU
'1\$ RI HLWKHU SDUHQW WKH ULVN WR VLEV LV ORZ EXW
SRSXODWLRQ EHFDXVH RI WKH SRVVLELOLW\ RI JHUPOLC

2IIVSULQJ RI D SUREDQG

- (DFK FKLOG RI DQ 6&1\$HODWHG 6HL]XUH DQ GLVRUGHU KD
RI LQKHULWLQJ WKH PXWDWLRQ
- 3HQHWUDQFH LV LQFRPSOHWH VHH 3HQHWUDQFH DQG
- 7KH OLNHOLKRRG WKDW WKH 6&1\$HODWHG 6HL]XUH DQ
ZLOO GHYHORS WKH VDPH SKHQRW\SH LV WKH SUREDEL
WLPHV WKH SHQHWUDQFH IRU WKDW SDUWLFXODU SKHQ
- ,QGLYLGXDOV ZLWK *()6 PD\ KDYH RIIVSULQJ ZKR DUH PH
DUH)RU H[DPSON WKH\ PD\ KDYH D FKLOG ZLWK 'UDYH

2WKHU IDPLO\ PHPEHUV KRI D SUREDQV WKHU IDPLO\ PHPEHUV
VWDWXV RI WKH SUREDQG V SDUHQWV ,I D SDUHQW LV IRXQ
PXWDWLRQ WKH RWKHU IDPLO\ PHPEHUV DUH DW JUHDWHU U

5HODWHG *HQHWF &RXQVHOLQJ ,VVXH

,QWHUSUHWLQJ WHVW UHVXOWV LQ RDV UHOLQDQV D SPSPDPDQV
IDPLO\ PHPEHUV ZKR WHVW SRVLWLYH IRU WKH IDPLO\ VSHFL
EHFDXVH RI UHGXFHG SHQHWUDQFH DQG OLPLWHG DELOLW\ V
JHQHWF WHVWLQJ DORQH

&RQVLGHUWLRQV LQ IDPLO\ PXWDWLRQ DSSURWHQ
SUREDQG ZLWK DQ DXWRVRPDO GRPLQDQW FRQGLWLRQ KDV
HYLGHQFH RI WKH GLVRUGHU 6&1\$HODWHG 6HL]XUH SRV
QRQ PHGLFDO H[SODQDWRQV LQFOXGLQJ DOWHUQDWH SDWH
H[SORUH

)DPLO\ SODQDQSWLPDO WLPH IRU GHWHUPLQDWLRQ RI JHQ
DYDLODELOLW\ RI SUHQDWHO WHVWLQJ LV EHIRUH SUHJQDQ
GHWHUPLQH WKH JHQHWF VWDWXV RI DW ULVN DV\PSWRPDW
SUHJQDQF\

'1\$ EDQNLQ\$ EDQNLQJ LV WKH VWRUDJH RI '1\$ W\SLFDOO\ H
FHOV IRU SRVLEOH IXWXUH XVH %HFDXVH LW LV OLNHO\
XQGHUWDQGLQJ RI JHQHV PXWDWLRQV DQG GLVHDVHV ZLO
VKRXOG EH JLYHQ WR EDQNLQJ 'Testing' IRU VHOGLVGRYLGXDO
ODERUDWRULHV RIHULQJ '1\$ EDQNLQJ

3UHQDWHO 7HVWLQJ

3UHQDWHO GLDJQRVLV LQ SUHODWHG WHVWLQJ WHVWLQJ
SRVLEOH E\ DQDO\VLV RI '1\$ H[WUDFWHG IURP IHWDO FHO
SHUIRUPHG DW DSSUR[LPDWHO\ ZHHNV JHVWDWLRQ RU

DSSUR[LPDWHO\ WHQ WR ZHHNV JHVWDWLRQ 7KH GLVHDV
IDPLO\ EHIRUH SUHQDWDO WHVWLQJ FDQ EH SHUIRUPHG

1RWH *HVWDWLRQDO DJH LV H[SUHVVHG DV PHQVWUXDO ZHH
WKH ODVW QRUPDO PHQVWUXDO SHULRG RU E\ XOWUDVRXQG

3UHLPSODQWDWLRQ JHQHWLFH GLVWDORVLOH 3R'U IDPLOLHV LQ Z
FDXVLQJ PXWDWLRQV KDYH EHHQ LGHQ\ **Testing**)RU ODERUDV

0ROHFXODU *HQBWLFLV

,QIRUPDWLRQ LQ WKH 0ROHFXODU *HQBWLFLV WDEOHV LV FXU
XSGDWH ²

7DEOH \$ 0ROHFXODU *HQBWLFLV RI 6&1 \$ 5HODWHG 6HL]XUH 'LVRUGHU

*HQB 6\PERO RPRVRPDO /RFXV 3URWHLQ 1DPH		
6&1 \$	T	6RGLXP FKDQQHO SURWHLQ W\SH VXEXQLW DOSKD

'DWD DUH FRPSLOHG IURP WKH IROORZLQJ VWDQGDUG UHIHUHQFHV *HQB V\PERO IURP +8*2
FRPSOHPHQWDWLRQ JURXS IURP 20,0 SURWHLQ QDPH IURP 6ZLVV 3URW

7DEOH % 20,0 (QWULHV IRU 6&1 \$ 5HODWHG 6HL]XUH 'LVRUGHUV

62',80 &+\$11(/ 1(8521\$/ 7<3(, \$/3+\$ 68%81,7 6&1 \$
*(1(5\$/,(' (3,/(36< :,7+)(%5,/(6(,=85(6 3/86 *())6
)(%5,/(&2198/6,216)\$0,/,\$/)(%
6(9(5(0<2&/21,& (3,/(36< 2) ,1)\$1&< 60(,

7DEOH & *HQRPLF 'DWEDEVHV IRU 6&1 \$ 5HODWHG 6HL]XUH 'LVRUGHUV

*HQB 6\PERO(QWUH] *HQB*0'		
6&1 \$	0,0 1R	6&1 \$

)RU D GHVFULSWLRQ RI WKH JHQRPLF GDWEDEVHV OLVWHG FOLFN KHUH

1RWH*0' UHTXLUHV UHJLVWUDWLRQ

0ROHFXODU *HQBWLFL 3DWKRJHQBVLV

6&1 \$FRGHV IRU WKH DOSKD VXEXQLW WKH ODFXUHQZQ DROWDJH
VRGLXP FKDQQHO 5HODWHG HSLOHSV\ LV WKHUHIRUH EHVW FRQFH
ZLWK VHL]XUHV DQG WKHLU VHTXHODH DV LWV VROH PDQLI
QHXURQDO G\VIXQFWLRQ DQG XOWLDPDWHO\ K\SHUH[FLWDEL
VLQH TXD QRQ RI HSLOHSV\

6&1 \$LV SDUW RI D FOXVWHU RI VRGLXP FKDQQHO JHQBH HQFR
6&1 \$D&1 \$0XOOH\ HW DO @ 7KH DOSKD VXEXQLW RI VRO
PHPEUDQH SRUH (DFK DOSKD VXEXQLW SURWHLQ KDV IRXU C
VHJPHQWV FRQQHFWHG E\ ORRSV)LJXUH 3RUH OLQLQJ U
ORRS WKH ODWWHU FRQQHFWLQJ 6 ZLWK 6 7KH YROWDJH
UHVLGXHV DOORZ IRU WKH VHQVLQJ RI PHPEUDQH SRWHQWL
HSLOHSV\ DVVRFLDWHG PXWDWLRQWKH RFXQGP RQDOH \$DWH
WKH & WHUPLQXV WR VRPH H[WHQW LQ WKH 1 WHUPLQXV LQ
VHQVRU >&HXOHPDQV &ODHV HW DO 0XOOH\ HW DO @

*HQB5HYLHZV 6&1 \$ 5HODWHG 6HL]XUH 'LVRUGHUV

1RUPDO DOOHOLF YDULDQWV SDQV DSSUR[LPDWHO\ 0E RI JH
 KDV D WUDQVFULSW RI ES UHIHUHQFH VHTXHQFH 10B
 HQFRGH D SURWHLQ RI DPLQR DFLG UHVLGXHV UHIHUHQ
 YDULDELOLW\ KDV EHHQ UHSRUWHG >:DOODFH 6FKHIIHU HW

3DWKRORJLF DOOHOLF YDULDQWV

- *HQHUDOLJHG HSLOHSV\ ZLWK IHE*U)LOHFDHJXDMVRSQDW
 ZLW&1 \$PXWDWLRQV DUH PRVWO\ PLVVHQVH DQG IDPLOL
- 'UDYHW V\Q\$UPPHVW KDOI RI WKH PXWDWLRQV DVVRFLDY
 P\RFORQLF HSLOHSV\ LQ LQIDQF\ 60(, SKHQRW\SH DUH
 HW DO @ 7KH UHPDLQGHU LQFOXGH PLVVHQVH PXWD
 *()6 SKHQRW\SH EXW ZLWK D VLPLODU WRSRORHLF GLV
 VLWH PXWDWLRQV DQG GHOWLRQV >DGRSWHG
- ,QWUDFWDEOH FKLOGKRRG HSLOHSV\ ZLWK JHQHUDOLJH
 *7& 6HYHQ RXW RI WHQ LQGL&G\$FLOVHZQWK P&(W*DWLRQ
 >XOOH\ HW DO @ ,Q WKH WZR FDVHV ZLWK D IDPLOL
- ,QIDQWLOH SDUWLDO VHLJQUWKHZDWWRDULDEPSHURFLQFH
 RIWHQ KDYH PLVVHQVH PXWDWLRQV DIIHFWLQJ WKH SRU
 1Q
- ,QIDQWLOH 7&DPLWHUDWXUH FLWHV DQ LVRODWHG FDV
 6&1 \$PLVVHQVH PXWDWLRQ >:DOODFH HW DO @
- 9DFFLQH UHODWHG HQFHSKDORSDWKHDQGHVHPSRUHV RI
 FDXVLQJ WUXQFDWLRQ DQG VL[UHSRUWV RI PLVVHQVH P
 RI 1D >%HUNRYLF HW DO @

1RUPDO JHQHSHURORJLF XODU *HQHWLF 3DWKRJHQHVLV

\$EQRUPDO JHQHSHURORJLF XODU 6DWKRJHQHWHWRZHOO HOXFLC
 ,W LV DQ DFWLYH DUHD RI LQYHVWLJDWLRQ XVLQJ ERWK FHC
 FRPSHWLQJ K\SRWKHVVHV KDYH EHHQ DGYDQFHG >/RVVLQ HW
 DO 6SDPSDQDWR HW DO %DUHOD HW DO <X HW

5HVRXUFHV

*HGH5HYLHZV SURYLGHV LQIRUPDWLRQ DERXW VHOHFWHG QD
 WKH EHQHILW RI WKH UHJGHU *HGH5HYLHZV LV QRW UHVSRO
 RUJDQLJDWLRQV ,QIRUPDWLRQ WKDW DSSHDUV LQ WKH 5HVR
 DV RI LQLWLDO SRVLQJ RU PRVW UHFRUGLIRUHVWKV RI WKH
 GLVRUGHU **Resources** IRW WKH PRVW XS WR GDW(H 5HVRXUFHV
 \$PHULFDQ (SLOHSV\ 6RFLHW\
 1RUWK 0DLQ 6WUHHW
 :HVW +DUWIRUG &7
 3KRQH
)D[
 (PDLOQIR#DHVQHW RUJ
 ZZZ DHVQHW RUJ
 (SLOHSV\)RXQGDLRQ
 3URIHVVLRLQDO 3ODFH

*HGH5HYLHZV 6&1 \$ 5HODWHG 6HLJXUH 'LVRUGHUV

(DVW /DQGRYHU 0'
 3KRQH (\$) \$
)D[
 (PDLØHEPDVWHU#HID RUJ
 ZZZ HID RUJ

1DWLRQDO ,QVWLWXWH RI 1HXURORJLF 'LVRUGHUV DQG 6WU
)HEULOH 6HL]XUHV)DFW 6KHHW
 1,1'6 (SLOHSV\ ,QIRUPDWLRQ 3DJH

5HIHUUHQFHV

0HGLFDO *HQHWWLF 6HDUFKHV \$ VSHFLDOLJHG 3XE0HG VHDUF
 RQ WKH 3XE0HG &OL [PubMed](#) XHULHV SDJH

3XEOLVKHG 6WDWHPHQWV DQG 3ROLFLHV 5HJDUGLQJ *HQHWWLF 7HVW
 1R VSHFLILF JXLGHOLQHV UHJDUGLQJ JHQHWWLF WHVWLQJ IRU

/LWHUDWXUH &LWHG

\$U]LPDQRJORX \$ *XHUULQL 5 \$LFDUGL - \$LFDUGL V (SLOHSV\
 :LONLQV 3KLODGHOSKLD HGV
 \$XGHQDHUW ' &ODHV / &HXOHPDQV % /RIJUHQ \$ 9DQ %URHFNKRYH
 LV DVVRFLDWHG ZLWK IHEULOH VHL]XUHV DQG HDUO\ RQVHW DEVH
 >3XE0HG @
 %DUHOD \$- :DGG\ 63 /LFNIHWW -* +XQWHU - \$QLGR \$ +HOPHUV 6/
 PXWDWLRQ LQ WKH VRGLXP FKDQQHO 6&1 \$ WKDW GHFUHDVHV FKDQ
 >3XE0HG @
 %DXODF 6 *RXUILQNHQ \$Q , 3LFDUG) 5RVHQEHUJ %RXUJLQ 0 3UX
 /H*XHUQ (\$ VHFRQG ORFXV IRU IDPLOLDQ JHQUHODLJHG HSLOHSV
 FKURPRVRPH T T \$P - +XP *HQH @ ± >3XE0HG
 %DXODF 6 +XEHUIHOG * *RXUILQNHQ \$Q , 0LWURSRXORX * %HUDQ
 \$ %UX]]RQH 5 /H*XHUQ ()LUVW JHQHWWLF HYLGHQFH RI *\$%\$ \$ U
 PXWDWLRQ LQ WKH JDPPD VXEXQLW JHQH 1DQ *HQH ±
 %HUNRYLF 6) +DUNLQ / 0F0DKRQ -0 3HOHNDQRV -7 =XEHUL 60 :L
 -& 6FKHIIHU , ('H QRYR PXWDWLRQV RI WKH VRGLXP FKDQQHO JH
 HQFHSKDORSWK\ D UHWURVSHFWLYH VWXG\ /DQ FHW 1HXURO
 %RQDQQL 3 0DOFDUQH 0 0RUR) 9HJJLRWWL 3 %XWL ')HUUDUL \$
 +HURQ 6(%RUGR / 0DULQL & *XHUULQL 5 *HQUHODLJHG HSLOHS
 FOLQLFDO VSHFWUXP LQ VHYHQ ,WDOLDQ IDPLOLHV XQUHODWHG W
 (SLOHSVLD ± >3XE0HG
 &DWWHUDDO :\$)URP LRQLF FXUUHQWV WR PROHFXODU PHFKDQLVP
 VRGLXP FKDQQHOV 1HXURQ @ ± >3XE0HG
 &HXOHPDQV % %RHO 0 &ODHV / 'RP / :LOHNNHQV + 7KLU\ 3 /DJD
 LQIDQF\ WRZDUG DQ RSWLPDO WUHDWPHQW - &@LOG 1HXURO
 &HXOHPDQV %3 &ODHV /5 /DJDH /* &OLQLFDO FRUHHODWLRQV RI P
 VHL]XUHV WR VHYHUH P\RFORQLF HSLOHSV\ LQ LQIDQF\ 3HGLDWU
 @
 &KLURQ & 0DUFKDQG 0& 7UDQ \$ 5H\ (G \$WKLV 3 9LQFHQW - 'XO
 P\RFORQLF HSLOHSV\ LQ LQIDQF\ D UDQGRPLVHG SODFHER FRQW
 VWXG\ JURXS /DQ FHW @ >3XE0HG
 &ODHV / 'HO)DYHUR - &HXOHPDQV % /DJDH / 9DQ %URHFNKRYHQ
 WKH VRGLXP FKDQQHO JHQH 6&1 \$ FDXVH VHYHUH P\RFORQLF HSL
 ± >3XE0HG@

*HQH5HYLHZV 6&1 \$ 5HODWHG 6HL]XUH 'LVRUGHUV

&RSSROD * &DSRYLOOD * 0RQWDJQLQL \$ 5RPHR \$ 6SDQR 0 7RUW
 \$ 7RSLUDPDWH DV DGG RQ GUXJ LQ VHYHUH P\RFORQLF HSLOHSV
 WULDO (SLOHSV\ 5HV @± >3XE0HG
 &RVVHWWH 3 /RXNDV \$ /DIUHLHUH 5* 5RFKHURW ' +DUYH\ *LUD
 *\$)XQFWLRQDO FKDUDFWHULJDWLRQ RI WKH ' 9 PXWDWLRQ LQ
 FDXVLQJ JHQHUDOLJHG HSLOHSV\ ZLWK IHEULOH VHL]XUHV SOXV
 >3XE0HG @
 'LEEHRV /0)HQJ +- 5LFKDUGV 0& +DUNLQ /\$ +RGJVRQ %/ 6FRWW
 *5 6FKHIIHU ,(%HUNRYLF 6) 0DFGRQDOG 5/ 0XOOH\ -& *\$%5' H
 0RO *HQHW ± >3XE0HG
 'LFKJDQV 0)UHLQLQJHU 7 (FNVWHLQ * %DELQL (/RUHQJ 'HSLHUH
 YDQ GHQ 0DDJGHQEHUJ \$0 3XVFK 0 6WURP 70 0XWDWLRQ LQ WK
 FKDQQHO 6&1 \$ LQ IDPLOLDO KHPLSOHJLF PLJUDLQ /DQFHW
 'UDYHW & %XUHDX 0 2JXQL + HW DO 6HYHUH P\RFORQLF HSLOHSV
 & HW DO HGV (SLOHSLWF 6\QGURPHV LQ ,QIDQF\ &KLOGKRRG D
 (DVWOLJK SS
 (EDFK . -RRV + 'RRVH + 6WHSKDQL 8 .XUOHPDQQ *)LHGOHU % +D
 + 0XOOHU 8 1HXEDXHU %\$ 6&1 \$ PXWDWLRQ DQDO\VLV LQ P\RF
 LGLRSDWKLJ JHQHUDOLJHG HSLOHSV\ RI LQIDQF\ ZLWK JHQHUDOL
 ± >3XE0HG@
 (VFD\J \$ +HLOV \$ 0DF'RQDOG %7 +DXJ . 6DQGHU 7 0HLVOHU 0+ \$
 ZLWK JHQHUDOLJHG HSLOHSV\ ZLWK IHEULOH VHL]XUHV SOXV DQ
 HSLOHSV\ \$P - +XP *HQHW @± >3XE0HG
 (VFD\J \$ 0DF'RQDOG %7 0HLVOHU 0+ %DXODF 6 +XEHUIHOG * \$Q
 0RXODUG % &KDLJQH ' %XUHL & 0DODIRVVH \$ 0XWDWLRQV RI
 FKDQQHO LQ WZR IDPLOLHV ZLWK *()6 1DW *HQHW ±
)XMLZDUD 7 &OLQLFDO VSHFWUXP RI PXWDWLRQV LQ 6&1 \$ JHQH V
 UHODWHG HSLOHSLHV (SLOHSV\ 5HV@ 6 ± >3XE0HG
)XMLZDUD 7 6XJDZDUD 7 0DJDNL 0L\DJNL (7DNDKDVKL <)XNXVK
 0RULNDZD 7 <DJL . <DPDNDZD . ,QRXH < 0XWDWLRQV RI VRGLX
 6&1 \$ LQ LQWUDFWDEOH FKLOGKRRG HSLOHSLHV ZLWK IUHTXH
 ± >3XE0HG@
)XNXPD * 2JXQL + 6KLUDVDND < :DWDQDEH . 0L\DMLPD 7 <DVXPRV
 \$.LUD 5 0DWVXR 0 0XUDQDND + 6RIXH) =KDQJ % .DQHN 6 0L
 RI QHXURQDO YROWDJH JDWHG 1D FKDQQHO DOSKD VXEXQLW J
 HSLOHSV\ LQ LQIDQF\ 60(, DQG LQ ERUGHUOLQH 60(, 60(% (SL
 @
 *HQQDUR (6DQWRUHOOL)0 %HUWLQL (%XWL ' *DJJHUR 5 *REEL
 3DUPHJJLDQL \$ 6WULDQR 3 9HJJLRWWL 3 &DUGLQDOL 6 %ULFD
 JHUPOLQH PRVDLFLVPV LQ VHYHUH P\RFORQLF HSLOHSV\ RI LQIDQ
 ± >3XE0HG@
 *HQQDUR (9HJJLRWWL 3 0DODFDUQH 0 0DGLD) &HFFRQL 0 &DUG
 (%LDQFKL \$ *REEL * =DUD))DPLOLDO VHYHUH P\RFORQLF HSL
 DQG JHQHWLF KHWHURJHQHLW\ (SLOHSLWF 'LVRUG ± >3
 *URVVR 6 2UULFR \$ *DOOL / 'L %DUWROR 5 6RUHQWLQR 9 %DOH
 DW\SLFDO 3DQD\LRWRSRXORV V\QGURPH 1HXURORJ\ ±
 *XHUULQL 5 'UDYHW & *HQWRQ 3 %HOPRQWH \$.DPLQVND \$ 'XODF
 LQ VHYHUH P\RFORQLF HSLOHSV\ (SLOHSLD ± >3XE0H
 +DUNLQ /\$ 0F0DKRQ -0 ,RQD ; 'LEEHRV / 3HOHNDQRV -7 =XEHUL 6
 ')DUUHO . &RQQROO\ 0 6WDQOH\ 7 +DUERUG 0 \$QGHUPDQQ)
 :. *DUGQUH \$ 6XWKHUODQG * %HUNRYLF 6) 0XOOH\ -& 6FKHIIH
 UHODWHG LQIDQWLOH HSLOHSLWF HQFHSKDORS@WKLVH %UDLQ
 +RUQ &6 \$WHU 6% +XUVW '/' &DUEPDJHSLQH H[DFHUEDWHG HSLOH
 1HXURO ± >3XE0HG

*HQH5HYLHZV 6&1 \$ 5HODWHG 6HL]XUH 'LVRUGHUV

*HQH5HYLHZV

*HQH5HYLHZV

*HQH5HYLHZV

*HQH5HYL

.LPXUD . 6XJDZDUD 7 0DJDNL 0L\DJDNL (+RVKLQR . 1RPXUD < 7DW
 . 6HJDZD 0 \$ PLVVHQVH PXWDWLRQ LQ 6&1 \$ LQ EURWKHUV ZLWK
 60(, LQKHULWHG IURP D IDWKHU ZLWK IHEULOH VHLJXUHV %UDL
 @
 /RVVLQ & :DQJ ': 5KRGHV 7+ 9DQR\H &* *HRUJH \$/ -U 0ROHFXODU
 1HXURQ ± >3X00HG
 0DGLD) 6WULDQR 3 *HQQDUR (0DODFDUQH 0 3DUDYLGLQR 5 %LD
 5 3LHUOXLJL 0 0LQHWL & =DUD) &U\SWLF FKURPRVRPH GHOH
 P\RFORQLF HSLOHSV\ RI LQIDQF\ 1HXURORJ ± >3XE0H
 0DQWHJDJJD 0 *DPEDUGHOOD \$ 5XVFRQL 5 6FKLDYRQ (\$QQHVL)
 &KLIDUL 5 &DQHYLQL 03 &DQJHU 5)UDQFHVFKHWWL 6 \$QQHVL *
 RI DQ 1DY VRGLXP FKDQQHO 6&1 \$ ORVV RI IXQFWLRQ PXWDW
 IHEULOH VHLJXUHV 3URF 1DWO \$FDG 6FL 8 6 0 ± >3X
 0XOOH\ -& 1HOVRQ 3 *XHUHUR 6 'LEEHRV / ,RQD ; 0F0DKRQ -0 +D
 6) 6FKHIIHU ,(\$ QHZ PROHFXODU PHFKDQLVP IRU VHYHUH P\RFOR
 GHOHWLRQV LQ 6&1 \$ 1HXURORJ\ @ ± >3XE0HG
 0XOOH\ -& 6FKHIIHU ,(3HWURX 6 'LEEHRV /0 %HUNRYLF 6) +DUNL
 +XP 0XWDW ± >30E0HG
 1DEERXW 5 *HQQDUR ('DOOD %HUQDUGLQD % 'XODF 2 0DGLD) %
 &ULVWRIRUL * (OLD 0)RQWDQD (*DJJHUR 5 *UDQDWD 7 *XHU
 0DWULFDUGL \$ 5RPHR \$ 7JRODV 9 9DOVHULDWL ' 9HJJLRWWL 3
) %LDQFKL \$ =DUD) 6SHFWUXP RI 6&1 \$ PXWDWLRQV LQ VHYHUH
 1HXURORJ\ ± >30E0HG
 1DND\DPD - \$ULQDPL 7 0ROHFXODU JHQHWLHV RI IHEULOH VHLJXUHV
 @
 3HUHLUD 6 9LHLUD -3 %DUURFD) 5ROO 3 &DUYDOKDV 5 &DX 3 6H
 HSLOHSV\ UHWDUGDWLRQ DQG G\VRUSKLF IHDWXUHV ZLWK D T
 1HXURORJ\ ± >30E0HG
 4XLOLFKLQL 33 &KLURQ & %HQ \$UL < *RJODQ + 6WLULSHQWRO D
 GXUDWLRQ RI RSHQLQJ RI *\$ \$ UHFHSWRU FKDQQHOV (SLOHSV
 @
 5KRGHV 7+ /RVVLQ & 9DQR\H &* :DQJ ': *HRUJH \$/ -U 1RQLQDFWL
 FKDQQHOV LQ VHYHUH P\RFORQLF HSLOHSV\ RI LQIDQF\ 3URF 1D
 >3XE0HG @
 5RJHU - %XUHDX 0 'UDYHW & *HQWRQ 3 7DVVLQDUL &\$:ROI 3
 FKLOGKRRG DQG \$GROHVFHQFH HG -RKQ /LEEH\ (DVWOLJK HG
 6DLWR < 2JXQL + \$ZD\D < +D\DVKL . 2VDZD 0 3KHQ\WRLQ LQGXFH
 VHYHUH P\RFORQLF HSLOHSV\ LQ LQIDQF\ 1HXUR0HGLDWULFV
 6FKHIIHU ,(%HUNRYLF 6) *HQHUDOLJHG HSLOHSV\ ZLWK IHEULOH V
 KHWHURJHQHRXV FOLQLFDO SKHQRW\SHV %UDLQ 3W
 6LQJK 5 \$QGHUPDQQ (:KLWHKRXXVH :3 +DUYH\ \$6 .HHQH '/' 6HQL 0
) %HUNRYLF 6) 6FKHIIHU ,(6HYHUH P\RFORQLF HSLOHSV\ RI LQ
 (SLOHSVLD ± >30E0HG
 6SDPSDQDWR - .HDUQH\ -\$ GH +DDQ * 0F(ZHQ '3 (VFD\J \$ \$UDGL
 6ROWHVJ , %HQQD 3 0RQWDOHQWL (,VRP // *ROGLQ \$/ 0HLVOH
 WKH VRGLXP FKDQQHO 6&1 \$ LGHQWLILHV D F\WRSODVPLF GRPDLO
 ± >3XE0HG@
 6XJDZDUD 7 7VXUXEXFKL < \$JDUZDOD ./ ,WR 0)XNXPD * 0DJDNL 0
 ,PRWR . :DGD . 0LWVXGRPH \$.DQHN 6 0RQWDO 0 1DJDWD . +
 PLVVHQVH PXWDWLRQ RI WKH 1D FKDQQHO DOSKD , VXEXQLW JH
 DIHEULOH VHLJXUHV FDXVHV FKDQQHO G\IXQFWLRQ 3URF 1DWO
 @
 6XOV \$ &ODH\V . *RRVVHQV ' +DUGLQJ % 9DQ /XLMN 5 6FKHHUV
 7 %HHFNPQV 6 6PRXWV , &XOHPDQV % /DJDH / %X\H * %DU

*HQH5HYLHZV 6&1 \$ 5HODWHG 6HLJXUH 'LVRUGHUV

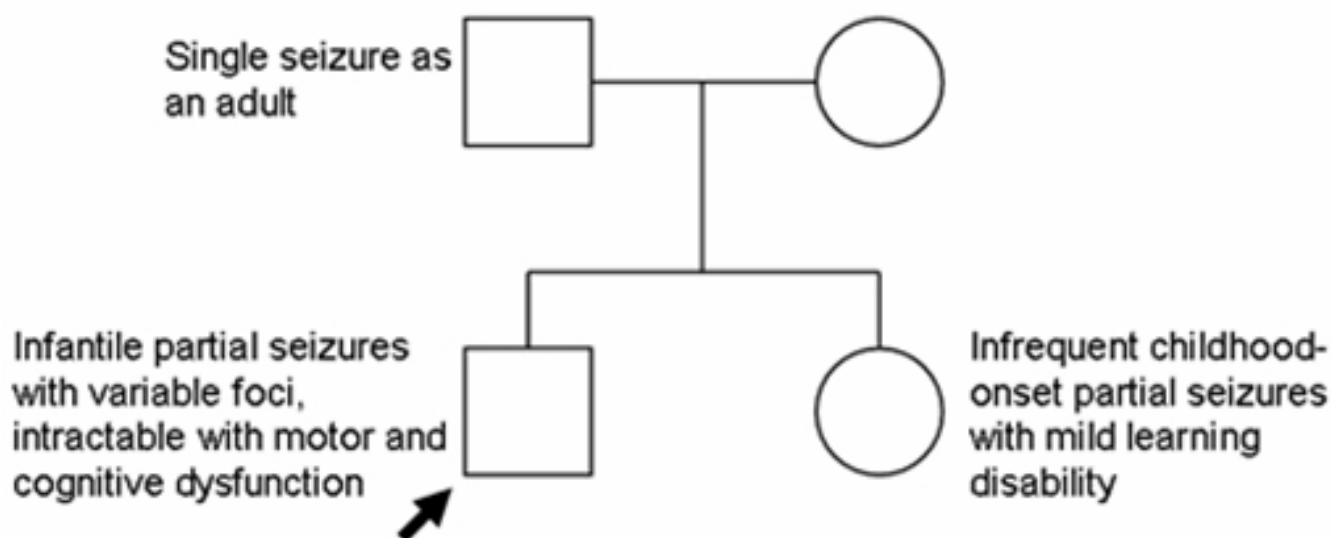
)DYHUR - 'H -RQJKH 3 &ODHV /5 0LFURGHOHWLRQV LQYROYLQJ V
 6&1 \$ PXWDWLRQ QHJDWLYH 60(, SDWLHQWV +XP @XWDW
 7KDQK 71 &KLURQ & 'HOODWRODV * 5H\ (3RQV * 9LQFHQW - 'XOD
 RI VWLULSHQWDRO LQ VHYHUH P\RFORQLF HSLOHSV\ RI LQIDQF\
 ± >3XE0HG@
 :DOODFH 5+ +RGJVRQ %/ *ULQWRQ %(*DUGLQHU 50 5RELQVRQ 5
 0RUJDQ - +DUNLQ /\$ 'LEEHQV /0 <DPDPRWR 7 \$QGHUPDQQ (0X
 ,(6RGLXP FKDQQHO DOSKD VXEXQLW PXWDWLRQV LQ VHYHUH P\
 VSDVPV 1HXURORJ\ ±@ >3XE0HG
 :DOODFH 5+ 0DULQL & 3HWURX 6 +DUNLQ /\$ %RZVHU '1 3DQFKDO
 0XOOH\ -& 6FKHIIHU ,(%HUNRYLF 6) 0XWDQW *%\$ \$ UHFHSWRU
 DEVHQFH HSLOHSV\ DQG IHEULOH VHLJXUHV 1@W *HQHW
 :DOODFH 5+ 6FKHIIHU ,(%DUQHWW 6 5LFKDUGV 0 'LEEHQV / 'HVDI
 \$ %UDQG 1 %HQ =HHY % *RLNKPQDQ , 6LQJK 5 .UHPPLGLRWLV *
 \$/ -U 0XOOH\ -& %HUNRYLF 6) 1HXURQDO VRGLXP FKDQQHO DOS
 HSLOHSV\ ZLWK IHEULOH VHLJXUHV SOXV \$P - +X@ *HQHW
 :DOODFH 5+ 6FKHIIHU ,(3DUDVLYDP * %DUQHWW 6 :DOODFH *% 6
 -& *HQHUDOLJHG HSLOHSV\ ZLWK IHEULOH VHLJXUHV SOXV PXWD
 1HXURORJ\ ± >3XE0HG
 :DOODFH 5+ :DQJ ': 6LQJK 5 6FKHIIHU ,(*HRUJH \$/ -U 3KLOOLSV +
 6XWKHUODQG *5 %HUNRYLF 6) 0XOOH\ -&)HEULOH VHLJXUHV DQ
 D PXWDWLRQ LQ WKH 1D FKDQQHO EHWD VXEXQLW JHQH 6&1 %
 @
 :HLVV /\$ (VFD\J \$.HQUH\ -\$ 7UXGHDX 0 0DF'RQDOG %7 0RUL 0 5
 0+ 6RGLXP FKDQQHOV 6&1 \$ 6&1 \$ DQG 6&1 \$ LQ IDPLOLDO DXWL
 >3XE0HG @
 <X)+ 0DQWHJDJJ 0 :HVWHQEURN 5(5REELQV &\$.DOXPH) %XUV
 6FKHXHU 7 &DWWHUODO :\$ 5HGXFHG VRGLXP FXUUHQW LQ *%\$H
 VHYHUH P\RFORQLF HSLOHSV\ LQ LQIDQF\ 1DW @HXURVFL

&KDSWHU 1RWHV

5HYLVLRQ +LVWRU\

- 1RYHPEHU PH 5HYLHZ SRVWHG WR OLYH :HE VLW
- 2FWREHU PVP 2ULJLQDO VXEPLVVLRQ

Pedigree with *SCN1A* missense mutation on D4S5 (pore region)



)LJXUHLQGLQJV LQ D IDPLO\ LOOXVWUDWLQJ YDULDEOH H[SU
VDPH PXWDWLRQ 7KH SUREDQG D ER\ DUURZ ZLWK IHEULO
KDG IUHTXHGW GLILFXOW WR FRQWURO SDUWLDO VHL]XUHV
LQIUHTXHGW SDUWLDO VHL]XUHV VWDUWLQJ DW HDUO\ VFKR
\RXQJ DGXOW \$OO WKUHH KDG WKH VDPH PXWDWLRQ LQ WKH
WKH SRUH UHLQDRI VWRWHLQ VHH OROHFXODU *HQHWLF 3
6RWHUR SHUVRQDO REVHUYDWLRQ@

= voltage sensor Segment 4

5 and 6 sequence

= Pore = Segments 5 and 6 and connecting AA sequence

Membrane

NH₂

COOH

)LJXU7RSRORJLF GLDJ WKP HIOISKD VXEXQLW RI WKH QHXURQD
FKDQQHO HQERGHGCHEN WKHV DPLQR DFLGV LQ VLJH DQG K
KRPRORJR XV GRPDLQV ' ' WKDW IROG DURXQG D FHQWUDO
ORRSV (DFK GRPDLQ KDV VLJ WUDQVPHPEUDQH VHJPHQWV 6
WKH WKLUG DQG IRXUWK GRPDLQ IRUPV WKH LQDFWLYDWRQ
YROWDJH VHQVRU 7KH SRUH LV IRUPHG E\ SDUWV RI 6 6 D
JDWHG VRGLXP FKDQQHOV KDYH RQH RU PRUH PRGXODWRU\ E
SLFWXUHG WKDW FRQVLVW RI D VLQJOH WUDQVPHPEUDQH VH
LQWUDFHOOXODU & WHUPLQXV \$QO YROWKDYH DWWHUGXFW & UDF
KRPRORJ\ > & DWWHUDDO @

*HQB5HYLHZV 6&1 \$ 5HODWHG 6HLJXUH 'LVRUGHUV